0021-7557/08/84-06/543
Jornal de Pediatria

Respiratory disease and climatic seasonality in children under 15 years old in a town in the Brazilian Amazon

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Abstract

Objective: To analyze the climatic seasonality of primary care visits for respiratory disease (RD) in children less than 15 years old.

Methods: This was a descriptive, epidemiological study based on data from the municipal records of primary care events from basic healthcare centers for the period 2004-2005, for the municipality of Tangará da Serra (MT), Brazil. Population estimates were obtained from the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística, IGBE), and data on temperature and relative humidity of the air, from the National Meteorology Institute (Instituto Nacional de Meteorologia, INMET). Mean rates of primary care visits for RD were calculated according to sex, age group and anatomic location of complaint. The ratio of dry season to rainy season visits was calculated according to anatomic location of the RD. Data were analyzed using Epi-Info 3.2, testing differences between proportions using the chi-square test to a significance level of 5%.

Results: Male children had an almost 50% greater (37.3/25.0) rate of primary care visits for diseases of the lower respiratory tract than did females. The rates of primary care visits due to RD in children under 15 years of age varied as age increased, varying from 457.7‰ of children less than 1 year of age to 133.5‰ in the 10 to 14 years-of-age group. During the dry season there were an average of 21% (4,148/5,231) fewer visits for RD (p = 0.000). Peaks in numbers of visits were observed during the months of March and August, being more accentuated in March, which is the wet season in the region.

Conclusion: Primary care visits for RD, especially those due to upper airway diseases, are related to the rainy season in this municipality.

J Pediatr (Rio J). 2008;84(6):543-549: Respiratory diseases, climatic seasonality, upper airway diseases, lower respiratory tract diseases climate, season.

Introduction

Climatic changes have been generating growing concern with relation to their potential effects on human health, especially effects related to the respiratory system. Some studies have shown a relationship between seasonal variation and the proportion of primary care visits that are due to respiratory diseases (RD), and the same is true of hospital admissions.[1-5]

It is worth pointing out that a reduction in the relative humidity of the air to values below 30% is considered as putting the integrity of the airways at risk,[6] causing problems for internal homeostasis of the respiratory system. During wet

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Financial support: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) e Fundação de Amparo à Pesquisa do Estado de Mato Grosso (FAPEMAT).

No conflicts of interest declared concerning the publication of this article.

Suggested citation: Rosa AM, Ignotti E, Botelho C, de Castro HA, Hacon SS. Respiratory disease and climatic seasonality in children under 15 years old in a town in the Brazilian Amazon. J Pediatr (Rio J). 2008;84(6):543-549.

Manuscript received May 16 2008, accepted for publication Aug 17 2008.

doi:10.2223/JPED.1846

months, in contrast with the problem suffered during dry months, the elevated relative humidity of the air, combined with the fact that people spend more time indoors and domestic areas are aired less and receive less sunlight, encourages mold and fungi to grow, which contribute to the increase in RD, especially those with allergic causes.[6] Furthermore, certain viruses exhibit highly seasonal behavior, with greater frequency during colder periods in temperate zones and also during the rainy period in tropical zones, such as in the Legal Amazon. These viruses are frequently the causes of RD in children, particularly of upper airway diseases.[7,8] Nevertheless, there is a paucity of knowledge on the behavior of RD in areas within the Amazon biome and of the possible influences of the typical cycles of wet and dry seasons on human health.

In industrialized urban areas and/or in the areas where biomass is being burnt, the low humidity during rainless periods is compounded by higher levels of atmospheric pollution. Air pollutants trigger an inflammatory process in the respiratory system, changing the permeability of the airways, making it possible for pathogenic microorganisms to gain access and develop.[9] The particulate material that is part of the air pollution may interfere with sweeping and inactivation of bacteria that reach the pulmonary tissues and contribute to the appearance of infectious diseases.[10] In addition to this, children comprise a group that is more sensitive to the effects of atmospheric pollutants.

Tangará da Serra (MT), the location of this study, is on the dispersion path of pollutants generated both in neighboring countries and in the area of the arc of deforestation.[11] It also has an increasing area under sugar cane cultivation, supplying three regional ethanol refineries. During the dry period the sugar cane fields are burnt, which results in increased concentrations of gases and particles of aerosol in the region's atmosphere. The municipality is within an area of the Amazon biome and has well-defined cycles of rainy and dry seasons, which have an effect on the dispersion of atmospheric pollutants.[12]

The choice of this municipality is based on its important socioenvironmental setting, on the prospects for growth of agricultural business in the region and the observation, between 2000 and 2004, of one of the worst sets of figures for morbidity and mortality from RD among children under 5 years of age in the state of Mato Grosso (Brazil).[13] This being the case, knowledge of the variations in primary care visits and their relationship with variations in humidity will contribute to understanding of the most common health problem in the area.

The objective of this study was to analyze the climatic seasonality of primary care visits for RD in children under 15 years of age.

Methods

This was a descriptive epidemiological study carried out in the municipality of Tangará da Serra, MT, Brazil, based on the Records of Primary Care Events (RPCE) reports produced by basic healthcare centers between 2004 and 2005.

Tangará da Serra is located 240 km from the state capital of Mato Grosso, Cuiabá. The estimated population in 2005 was 70,258 inhabitants, 90% of whom live in its urban area. The Human Development Index in 2000 was 0.780, which was one of the highest in the state.[14] The principal economic activities are livestock for slaughter and farming of soy, cotton, coffee, rice and sugar cane.

The municipality is set between the Chapada dos Parecis and the Serra Tapirapuã (elevated areas), and has a mean temperature of 25 ºC and relative humidity of the air of around 80%, which can drop to 25% or less during extremely dry periods, around July/August.[15]

During the period studied, this municipality had fully devolved control of its extended primary care network, managed in accordance with the official operational healthcare standard (*Gestão Plena da Atenção Básica Ampliada*, according to the *Norma Operacional da Assistência à Saúde*), and was only responsible for providing primary care services. The municipality set up its first three family healthcare teams in the year 2000, extending this coverage to 10 teams by the end of 2005. Currently, primary care visits on the public healthcare system are provided at eight conventional primary care centers, one polyclinic, 10 family health teams and one emergency service which deals with hospital admissions and low complexity surgery, being designated as a mixed unit.

This study analyzed all data provided by primary care centers. The care provided at the polyclinic was considered of medium complexity, since this is a local regional referral center for specialties, and for this reason these records were not included in this study. Records relating to procedures, such as dressings, vaccinations and others, were also excluded.

It was not possible to distinguish between primary care visits due to routine consultations from those due to emergencies provided at the mixed care service, since this type of distinction was absent from the RPCE.

Analysis of data

The visits were classified according to the chapters of the 2nd version of the International Classification of Primary Care (ICPC-2), rather than the International Classification of Diseases (ICD-10), since the latter is of limited value for classifying visits in a primary care setting.[16] Population estimates were obtained from the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística, IGBE),[14] and the data on relative humidity of the air were provided by the National Meteorology Institute (Instituto Nacional de Meteorologia, INMET), which has an automatic monitoring station in Tangará da Serra.[15]

In order to determine the number of visits for RD, among other chapters of the ICPC-2, it was necessary to construct a

database containing all primary and emergency care visits for the year 2005. However, for the specific analysis of the visits due to RD, the results from 2005 were combined with those from 2004. Constructing a two-year follow-up series reduces the variation in the records caused by specifics, both related to the weather and to the health service. Since these are primary care records, which very often include signs and symptoms with no definitive diagnosis, the diagnosis was not used as a study variable. The variables of interest were: sex, age, anatomic location of complaint, relative humidity of the air and temperature.

The decision to study data on those less than 15 years old was taken due to the fact that these people account for 30% of the municipality's population and because they have greater biological vulnerability, especially those less than 5 years of age.

Mean rates of primary care visits for RD by children under 15 were calculated according to age group and sex for the years 2004 and 2005. Age was categorized into: < 1 year, 1-4, 5-9 and 10-14 years. The ratio of dry season to rainy season visits was also calculated according to anatomic location of the RD. The seasons were defined as dry (May to October) and rainy (November to April). The classification according to anatomic location of complaint was according to the ICD-10,[17] taking the epiglottis as the dividing line between upper and lower airways. Those RD located above the epiglottis were considered as upper airway diseases (UAD), while those at the epiglottis and below were considered as diseases of the lower respiratory tract (DLRT). Symptoms related to the respiratory tract (such as coughing, for example), but with no diagnosis, were defined as non-specific RD.

After obtaining authorization from the Municipal Health Department (Secretaria Municipal de Saúde) of Tangará da Serra, the RPCE reports were photocopied, and all data of interest were input. Differences between proportions were tested using the chi-square test to a significance level of 5%, using Epi-Info 3.2.

Ethical considerations

This study is the result of the research project entitled "Evaluation of the effects on human health of burning of biomass in the Legal Amazon," affiliated to the Instituto Milênio, and part of the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA). The research received financial support from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) and the Fundação de Amparo à Pesquisa do Estado de Mato Grosso (FAPEMAT). The study was approved by the Research Ethics Committee at the University Hospital Júlio Muller (HUJM), under protocol no. 290/CEP-HUJM/06, on 24th January of 2007.

Results

A total of 36,344 primary care visits to the Brazilian National Health Service (Sistema Único de Saúde, SUS) were recorded in Tangará da Serra in 2005, 6,895 of which were for children less than 15 years of age (19%). Diseases of the respiratory system accounted for the largest proportion of primary care visits in the municipality (15.8%), followed by consultations related to pregnancy, delivery and family planning (13.2%).

Whereas in the general population, visits for RD in 2005 accounted for less than 1/5 of the total number of medical consultations, among those under 15 years of age, RD were responsible for 1/3 of visits, with 32.7% of the total number of visits (2,256/6,895).

The combined data on RD for the years 2004 and 2005, analyzed for the under 15 age group, totaled 9,379 records. The highest proportion of visits due to RD was among children aged less than four years, at 52%, while children aged from 5 to 9 years accounted for 28%, and those from 10 to 14 years were responsible for around 20% of visits.

With relation to anatomic location, 71% of all of the RD cases were UAD (6,656), and 14.5%, were DLRT (1,347); while in 14.7% of cases, it was not possible to specify anatomic location (1,376).

Male children had a rate of primary care visits due to DLRT that was almost 50% higher than the female children's rate (ratio = 1.49). For UAD, the ratio was 1.03 (Table 1).

The rates of primary care visits due to RD among children under 15 varied from 457.5‰ among those less than 1 year old to 133.5‰ in the group of 10-to-14-year-olds (Figure 1).

When the dry season and rainy season were compared, the number of visits due to RD was an average of 21% lower during the dry period (ratio = 0.79), which was a statistically significant difference (chi-square = 122.2; p = 0.000). Although there were more than 10% of visits for RD with no location specified, the combined analysis, independent of anatomic location, demonstrates a higher proportion of visits during the period with more rain. There were more visits for UAD during the rainy season, but for DLRT there was no difference (Table 2).

The greatest frequency of visits occurred during March and April, which is the end of the rainy season, declining thereafter until another peak in August, with lower relative humidity of air. The lowest mean temperatures were recorded from May to July, when there was also a reduction in the frequency of visits due to RD (Figure 2).

Discussion

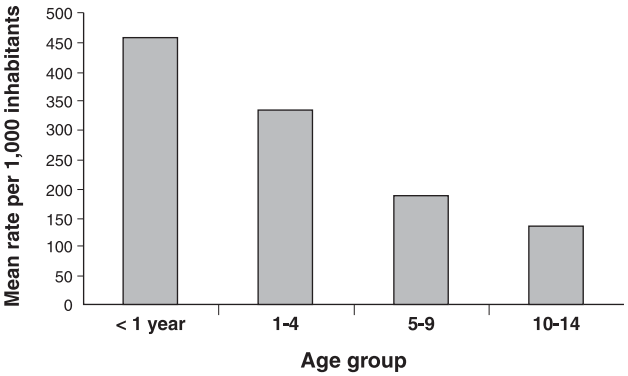
The most frequent cause of primary care visits in the municipality of Tangará da Serra during the study period was RD, particularly of the upper airways and with the greatest concentration among children under 5 years of age.

One study carried out in Brazil found that there was no differences between the sexes in terms of medical consultations for children.[18] Nevertheless, male sex has been

Table 1 - Ratios of mean rates of primary care visits by children under 15 years of age, by sex and anatomic location per 1,000 inhabitants (Tangará da Serra, Brazil, 2004-2005)*

Anatomic location†	Males		Females		Ratio of rates
	n	Rate	n	Rate	
UAD	3,302	157.38	3,151	152.02	1.03
DLRT	792	37.34	528	25.02	1.49
Total	4,094	225.97	3,679	207.61	1.08

Source: Records of Primary Care Events, Tangará da Serra Municipal Health Department, Brazil, 2006.
DLRT = disease of the lower respiratory tract; UAD = upper airway diseases.
* The mean for the male population during this period was 10,497 children and for females it was 10,380.
† Respiratory diseases with no specific anatomic location were excluded from this analysis.



Source: Records of Primary Care Events, Tangará da Serra Municipal Health Department, Brazil, 2006.

Figure 1 - Mean rates of primary care visits due to RD by age group (Tangará da Serra, Brazil, 2004-2005)

described as a risk factor for RD among children less than 12 months of age.[19] In Tangará da Serra, male children presented at a larger number of consultations due to RD, primarily due to DLRT, which are the more severe cases. This result corroborates the findings of a study Duarte & Botelho carried out in Cuiabá (which is the capital of the same state).[20]

Upper airway diseases were the most frequently observed cause of primary care visits in Tangará da Serra. Although the proportion of non-specific RD was above 10% and this finding may or may not modify the observed results, it should be considered that at the primary care level diagnostic coding is not always precise, since the health problems of primary care are undifferentiated and manifest in different stages.[16] It is possible that patients will seek medical care with a collection of signs and symptoms while still in initial phases, making differential diagnosis difficult. During the time needed for laboratory tests and return consultations, there may be remission of symptoms, with clinical improvement of the patient, who then may not return, making it impossible to identify the final diagnosis.

The seasonal variation observed in this study, with a higher proportion of primary care visits due to RD by children under 15 years during the rainy period, is different from the variation observed by Rosa et al.[5] in the municipality's hospital admissions for the same age group, the larger proportion of which were during the dry season.

The influence of climatic seasonality on visits due to RD, especially resulting from UAD during the rainy period, suggests that the more benign cases are responsible for the greater proportion of primary care visits, while during the dry period the increase in pollutants contributes to irritation of the airways, facilitating exacerbation of RD. A study based on emergency visits due to RD, in Cuiabá, found that these were more frequent during the rainy period and, similarly, a greater frequency of admissions during the dry season.[1]

Mato Grosso state is in a singular position, due to the cycles of dry and rainy seasons that characterize the environment. During the dry season, there is a significant increase in atmospheric pollution, primarily due to the burning of forests, pastures and the high plains nature reserves. In Tangará da Serra, these factors are added to the burning of sugar cane fields and dust from unpaved roads.

Both low and high relative humidity of the air can cause damage to the respiratory system, particularly in individuals who already have some prior involvement, even a simple cold.

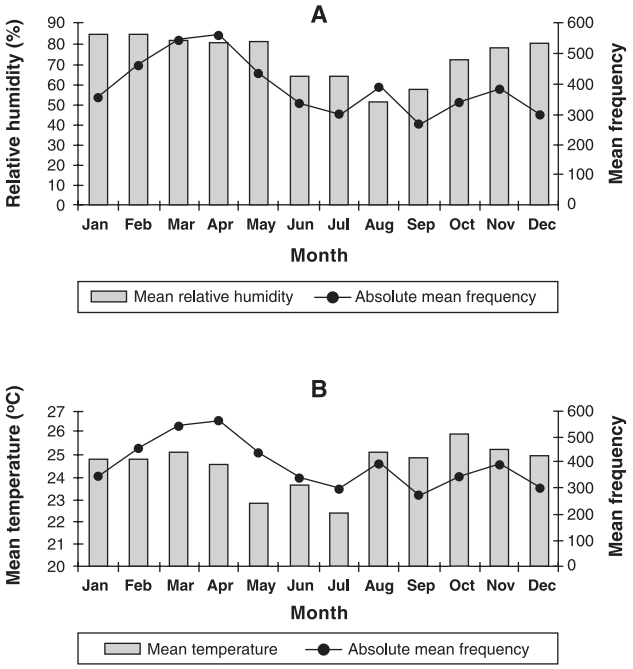
This paradox can be observed in the peak attendance in March, during the rainy season, and in August, which is dry. Nevertheless, although there is a peak in August, during March the number of visits is even higher. These months also have another factor in common, children returning to school after the holidays, which possibly has an influence on the observed volume of medical consultations as a result of children coming into greater contact with microorganisms transported from family spaces.[21] Although the temperature variation is only 5 to 6 ºC between the hottest and coldest months, the lower temperature, allied to the reduced relative humidity of the air, contributes to the reduced frequency of visits due to RD in the municipality during the study period.

Another phenomenon can also be observed, one which could be described as operational seasonality, with reduced

Table 2 - Mean proportions of primary care visits according to dry or rainy season (Tangará da Serra, Brazil, 2004-2005)

	Dry		Rainy		Ratio		
Anatomic location	**n**	**%**	**n**	**%**	**n**	**Chi-square**	**p**
UAD	2,820	42.43	3,836	57.57	0.73	148.57	0.000
DLRT	704	52.26	643	47.74	1.09	2.76	0.09
Nonspecific	624	45.34	752	54.65	0.83	11.80	0.000
Total	4,148	44.22	5,231	55.78	0.79	122.24	0.000

Source: Records of Primary Care Events, Tangará da Serra Municipal Health Department, Brazil, 2006.
DLRT = disease of the lower respiratory tract; UAD = upper airway diseases.



Source: Records of Primary Care Events, Tangará da Serra Municipal Health Department, Brazil, 2006. National Meteorology Institute (Instituto Nacional de Meterologia), 2006.

Figure 2 - Monthly mean numbers of primary care visits due to RD by children under the age of 15 years, by month of visit. A) Monthly mean relative humidity of the air (%);B) mean temperature (Tangará da Serra, Brazil, 2004-2005)

frequency of visits to the primary care network during the months of December and January, and also February and July although with less significance than in December and January, and which is probably the result of these being the periods during which health professionals, especially doctors, take their holidays.

The RPCE which were used as the data source for this study may suffer from the limitation of the quality of records, lack of standardization and diagnostic validation. Furthermore, in the primary care context one or more return visits may result from the same health problem. This phenomenon, very much more operational than epidemiological, cannot be controlled. The RPCE are not a trustworthy record continuity of treatment nor is the number on the medical record a trustworthy form of identification.

Although this study relates to secondary data, where diagnoses were not validated, the fact that diagnosis is in no way related to financial gain at the primary health care level emphasizes the importance of the results observed. Furthermore, even were there to be some type of discrepancy with relation to diagnosis, it seems very unlikely that that would be related to which anatomic system was involved.

This study population is just one section of the municipality's residence, not only because it only includes those who use the SUS, but also because the cases are those who had access to medical consultations and sought care. Seeking health care is influenced by several factors, with some theories existing to explain the phenomenon, such as the behavioral theory proposed by Andersen & Newman,[22] in which individual determinants are related to characteristics of access to services, promoting or limiting their use.

Nevertheless, data from primary care relate to a wider section of the population and offer greater possibilities for identifying diseases that may be related to risk factors, such as atmospheric pollution, for example, at very early phases of the disease. Furthermore results of the National Household Sample Survey show that, on average, 24.5% of the population of Brazil have some type of private healthcare plan.[23] It is possible that both primary care consultations and hospitalizations on the SUS account for the majority of care episodes in the country, as observed by Silva et al.,[24] although there are regional variations in dependency on the public health system.

It is considered necessary to increase understanding of the behavior of RD in the Brazilian Amazon region, and to establish strategies for validation of these diagnoses and for identification of risk factors, which may or may not be different from those reported in the literature. Although beyond the scope of this study, all of these questions merit future investigations and are part of our research team's agenda.

Faced with the environmental scenario describes and the conditions of child health observed in the municipality, it is apt to consider it as an area of atmospheric environmental interest to health and to establish an integrated local environmental health care network.

The RPCE could be used as a data source for the construction of a system of indicators of risk factors providing the basis both for environmental health surveillance actions and for the decision-making process. These indicators should be defined based on discussions with social actors, in order to select those most sensitive for identifying cases and changes in the tendencies of distributions. In order to reduce the vulnerability of social and environmental systems it is necessary to increase the organizational capacity of services and improve the use of available resources,[25] in addition to attaining a dynamic understanding of the relationships between production and consumption in the community, with a multidisciplinary focus.[26]

It is also suggested that measures be taken for health promotion, surveillance of risk factors, early identification of cases and standard management and adequate follow-up based on strategies adopted nationally and internationally, such as, for example, Integrated Care for Diseases Prevalent in Childhood.

It is concluded that primary care visits due to RD, especially those for UAD, which are generally of lesser severity, are related to the rainy period in this municipality.

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