# Prevalence of asthma in schoolchildren in Alta Floresta – a municipality southeast of the Brazilian Amazon

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## ABSTRACT

**Objective:** To analyze the prevalence and the symptoms of asthma in students in the municipality of Alta Floresta-MT, Brazilian Amazon.

**Methods:** Cross-sectional study of the prevalence of asthma in children aged 6 and 7 years and adolescents aged 13 to 14 years, using the methodology of the Study of Asthma and Allergies in Childhood – ISAAC, phase I in 2007, considering asthmatics as those students that answered affirmatively to question 2 – "presence of wheezing in the last 12 months".

**Results:** Out of 2,071 students, 1,072 (51.7%) were children and 999 (48.3%) teenagers. The prevalence of asthma among the schoolchildren was 21.4%, while among the adolescents it was 12.4% ($\chi^2$ = 29.29; $\rho$ = 0.00). Children presented higher prevalence than adolescents of the following asthma symptoms: wheezing at some point in their life (49.9%), wheezing in the last 12 months (21.4%), 1 to 3 wheezing attacks in the last 12 months (16.4%) and dry coughing at night (38.2%). Regarding physician-diagnosed asthma, no difference was observed between the two age groups, with prevalence at around 6.0%. Male schoolchildren presented a higher prevalence of asthma, physician-diagnosed asthma and 4 or more wheezing attacks in the last 12 months ($\rho \leq$ 0.05). Teenage boys presented the highest prevalence of speech-restricting wheezing ($\rho \leq$ 0.05).

**Conclusion:** Alta Floresta presents one of the highest rates of prevalence of asthma in Latin America among schoolchildren aged 6 and 7 years old.

**Key-Words**: Respiratory Diseases; Asthma in Childhood; Asthma in Adolescents; ISAAC; Prevalence of Asthma.

## INTRODUCTION

Asthma is a chronic inflammatory disorder characterized by bronchial hyperresponsiveness and variable airflow obstruction. The clinical symptoms include coughing, dyspnea, recurrent wheezing and a tight chest [1]. It results in hindering the individual's interaction with the environment [2].

According to the World Health Organization [3], asthma is the most common chronic respiratory disorder among children. It is estimated that throughout the world roughly 300 million people of all ages are asthmatic [4] with significant variance in the prevalence between different countries and regions [1,4,5]; in 2005 alone asthma accounted for 255,000 deaths. In Brazil there are around 350,000 hospital admissions for asthma every year, representing the fourth most common cause for hospitalization by the Unified Health System (SUS) (2.3% of the total) and the third leading cause among children and young adults [1].

According to Chatkin et al. [6], asthmatic children suffer not only the symptoms of the disease, but also restrictions on their daily life, which may lead to their missing school or members of their family missing work and/or school. In a study into low income families, asthmatic children were twice as likely not to do their homework as children without asthma [7].

The Study of Asthma and Allergies in Childhood – ISAAC, phase I was proposed as a single instrument to standardize the identification of asthma in children. This method has been used with good levels of sensitivity and specificity in the identification of children with asthma in population studies [8]. The instrument has been validated in Brazil [9], allowing for comparisons against other studies which employed the same method.

The Multicentre International Study for Asthma and Allergies in Childhood – ISAAC [8] was conducted in 56 countries, presenting results showing a variable prevalence of asthma ranging from 1.6% to 36.8%. In developed countries asthma appears as one of the most frequent disorders during infancy, still with significant variation. In England, for instance, the prevalence of asthma is 10 to 15%, while in Australia it reaches 30%.

Brazil is 8th place among the countries where this method has been used, with an average prevalence of 20% [8]. In Brazil, the prevalence of active asthma among schoolchildren (SC) aged 6 and 7 years, indicated by an affirmative answer to the question about wheezing in the last 12 months varied from 16.5% in Aracaju to 31.2% in the western region of São Paulo. Among adolescents (AD), the prevalence of active asthma varied from 11.8% in Nova Iguaçu to 30.5% in Vitória da Conquista [10].

Possible explanations for this variability could be related to a westernized lifestyle, urbanization and increased population density [11], as well as variations in the nature and magnitude of existing environmental factors in each location [12], especially factors related to the climate variability and air pollution, above all in urban areas.

Environmental pollution has been implied in relation to the outbreak of asthma cases and the exacerbation of symptoms [13,14,15,16]; although there are various methodological aspects to be considered when analyzing the effects of air pollution on human health [17]. Under five year-olds are among the groups considered most vulnerable biologically to asthma and its complications, diminishing their quality of life. These groups are described in the literature as those who suffer the greatest impact of exposure to atmospheric pollution [18].

The region of the Brazilian Amazon presents high levels of biomass burning, resulting in significant proportions of fine and coarse particulate matter in the atmosphere [19]. Although atmospheric pollution has been identified as an important causal factor of breathing disorders, very few studies have been developed in the Amazon.

The municipality of Alta Floresta was selected for this study due to its location in the extreme north of the state of Mato

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Grosso, southeast of the Amazon Forest and within the "Deforestation Arch" area. The process by which the municipality has been occupied is one of the main causes of the uncontrolled deforesting since the 1970s, which continues to this day [20,21].

The majority of investigations into the prevalence of asthma in Brazil have been conducted in larger, industrialized cities, unlike Alta Floresta, a rural region with considerable farming and livestock capacity. Understanding the distribution and behaviour of asthma in municipalities of the Amazon region is important insofar as enabling future analyses into the potential risk factors, the establishment of a baseline to identify trends, as well as the foundation of analytic studies into the effects of atmospheric pollutions on human health in the Brazilian Amazon.

Since 2006, the research project entitled "An evaluation of the effects of biomass burnings on human health in the Amazon deforestation arch region" has been developed in order to enhance our understanding of the effects of biomass burning on human health in the region. This is part of the research network Large Scale Experiment of the Amazon Biosphere-Atmosphere (LBA) and the *Instituto do Milênio* (Milênio) which studies the "Changes in Land Use in the Amazon: Implications on the Climate and the Carbon Cycling", funded by the CNPq, FAPEMAT and FIOCRUZ/PAPES IV.

The objective of this article is to analyze the prevalence and symptoms related to asthma among schoolchildren and adolescents who live in the municipality of Alta Floresta, Mato Grosso.

## METHODS

### Study design

A descriptive, population-based study into the prevalence of asthma among students in the municipality of Alta Floresta-MT. The Municipal Department and the Regional Coordination of State Education provided the list of schools and the school census by year group.
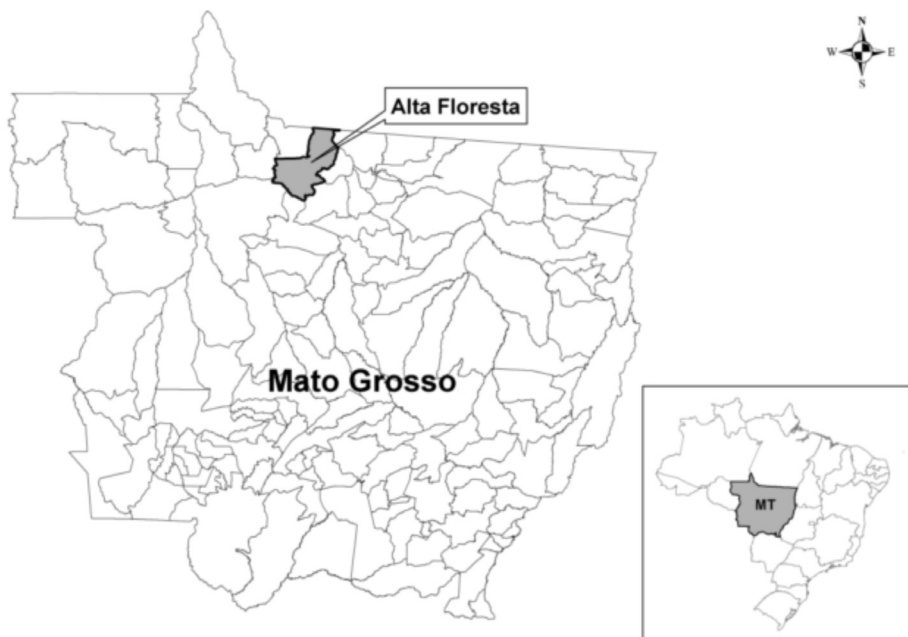
An internationally standardized, written questionnaire [8], validated in Brazil, was used to identify asthma among schoolchildren and adolescents, which characterizes phase I of the Study of Asthma and Allergies in Childhood – ISAAC(8).

### Study area and population

Alta Floresta covers an area of 9,310.27 km². It is located 830 km from the capital of the state of Mato Grosso – Cuiabá, 340 meters above sea level, with latitude of 09°52'33"S. The Human Development Index (HDI) in 2000 was 0.779, which is higher than the HDI of the state of Mato Grosso, 0.773; 25% of the Alta Floresta population presents low income [22]. In 2007, the number of inhabitants was 49,116, of which over 80% resided in the urban area. The main economic activities are beef cattle, agriculture and extraction and wood manufacture. The municipality has a humid, tropical climate, with the dry season during the months between May and October, in which there is intense heat and high levels of pollution due to the burnings; and wet summer between November and April, with high rainfall. The temperature varies between 24ºC and 34ºC. The relative humidity of the air can fall below 20% in the dry season and up to 100% in the rainy season. It is placed within the Amazon biome, with typical dry and rainy cycles which modify the levels of atmospheric pollution resulting from the burnings; it is also located in the region of the deforestation arch, where burnings may lead to adverse effects on human health.

Of the 40 schools in the local school network, 32 were elected for the study. Of those, 24 were in the urban area and 8 in the rural; 13 were public municipal schools, 12 public state schools and 7 private schools. The study did not include pupils enrolled in the Association of Parents and Friends of Special Needs Students (APAE) and in the Special School for the Deaf (CEEDA),

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Source: IBGE, 2008

**Figure 1 -** Geographic location of the municipality of Alta Floresta, State of Mato Grosso.

and also in the adult education school. All schoolchildren (SC) aged 6 and 7 years old and adolescents (AD) aged 13 and 14 years old were considered eligible. For the purposes of this study, schoolchildren and adolescents are considered as students.

The data were collected between March and April 2007, following meetings with local school teachers in which the purpose of the work was presented. The SC and AD were instructed about the objectives of the research and asked to take the questionnaires home for their parents or guardians to answer and then return them to the research team at the school. The deadline for returning the questionnaires was 10 days. For those who failed to return the questionnaire within the established timeframe, another opportunity was offered through a home visit made by the university students participating in the study, as a scientific initiation activity.

**Data Analysis**

The data obtained were analyzed using the software Epi-Info 3.2. The prevalence of asthma and its symptoms were calculated according to gender and age group. The Chi-squared test ($\chi^2$) was used to compare different proportional differences, to a 5% level of significance.

The ISAAC asthma module is composed of eight (8) questions about the symptoms of the disease. The schoolchildren and adolescents who answered affirmatively to question 2 – *"Presence of wheezing in the last 12 months."* were considered asthmatic. An affirmative answer to question 5 – *"Presence of strong wheezing restricting you from speaking more than two consecutive words"* implied a serious case of asthma [4,8,9,10].

**Ethical Considerations**

This study was approved by the Committee of Research Ethics of the Júlio Miller University Hospital, as per report number 388/CEP/HUJM/07. The study only considered questionnaires which contained the parents' or guardian's signature on the free and clarified consent agreement

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authorizing the child's participation in the survey.

## RESULTS

The return rate of the questionnaires, even with up to two home visits to all homes in the urban area, was 59.4% (2,071/3,489). The proportion of participants in the study per school category was 52.4% (1,086) at public state schools, 34.1% (706) at public municipal schools, 9.1% (188) at private schools and 0.001% (2) at the charity institution. Of all the questionnaires, 89 (4.3%) were not identified with any school, in other words, they were obtained by means of home visits and from children who were out of school. When comparing the group studied with the results of the population census conducted in 2007, no significant difference was found in the proportions among the SC and AD groups, even when stratified by gender. An overestimate of the school census by 336 students is also found when compared to the population census; 3,489 and 3,835, respectively.

The survey was answered by 2,071 students, of whom 1,023 (49.4%) were male and 1,048 (50.6%) female. Among the participants, 1,072 were SC (51.7%), of whom 533 (49.7%) were male and 539 (50.3%) female. Of the 999 SC (48.3%), 490 (49.0%) were male and 509 (51%) were female.

The prevalence of asthma among SC was 21.4%, and among AD it was 12.4% ($\chi^2 = 29.29$; $\rho = 0.00$). All symptoms were more prevalent in the SC group, except for wheezing after physical exercise, which was more frequent in the AD group ($\rho < 0.00$). In relation to physician-diagnosed asthma, no difference was found between the groups.

Table 1 shows that the prevalence of asthma was 23.8% among male SC and 18.9% among female SC ($\chi^2 = 3.84$; $\rho = 0.05$). Asthma symptoms were similar between genders, with the exception of frequency of wheezing attacks $\geq 4$ ($\chi^2 = 10.71$; $\rho < 0.00$) and physician-diagnosed asthma ($\chi^2 = 5.76$; $\rho < 0.01$), which were more common among boys.

For the AD group, the prevalence of asthma was 13.0% among boys and 12.0% among girls [$\chi^2 = 4.11$; $\rho = 0.04$]. With the exception of the prevalence of serious asthma, which was 3.7% among males, and

**Table 1** – Prevalence (%) of symptoms of asthma according to gender in 6-7 year-old schoolchildren. Alta Floresta-MT, 2007.

| Question | Gender | | | CI (95%) |
| | M | F | Total | |
|---|---|---|---|---|
| Presence of wheezing at some point in your life | 51.6 | 48.2 | 49.9 | 46.9 – 52.9 |
| Presence of wheezing in the last 12 months | 23.8* | 18.9 | 21.4 | 19.0 – 24.0 |
| Frequency of wheezing attacks | | | | |
| 1 – 3 | 17.4 | 15.4 | 16.4 | 14.3 – 18.8 |
| ≥ 4 | 6.4* | 2.4 | 4.4 | 3.3 – 5.8 |
| Frequency of wheezing preventing sleep | | | | |
| < 1 time a week | 10.1 | 8.3 | 9.2 | 7.6 – 11.2 |
| ≥ 1 time a week | 9.6 | 6.7 | 8.1 | 6.6 – 10.0 |
| Strong wheezing restricting speech | 7.1 | 5.0 | 6.0 | 4.7 – 7.7 |
| Asthma at some point in your life | 7.5* | 4.1 | 5.8 | 4.5 – 7.4 |
| Wheezing after physical exercise | 7.7 | 5.9 | 6.8 | 5.4 – 8.5 |
| Dry cough at night | 38.4 | 38.0 | 38.2 | 35.3 – 41.2 |

Note: * $\rho \leq 0.05$

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**Table 2 -** Prevalence (%) of symptoms of asthma according to gender in 13-14 year-old adolescents. Alta Floresta-MT, 2007.

| Question | Gender | | Total | CI (95%) |
|---|---|---|---|---|
| | M | F | | |
| Presence of wheezing at some point in your life? | 39,0 | 39,3 | 39,1 | 36,1 – 42,3 |
| Presence of wheezing in the last 12 months | 12,9 | 12,0 | 12,4 | 10,5 – 14,7 |
| Frequency of wheezing attacks | | | | |
| 1 – 3 | 10,2 | 10,0 | 10,1 | 8,3 – 12,2 |
| ≥ 4 | 3,7 | 2,6 | 3,1 | 2,2 – 4,4 |
| Frequency of wheezing preventing sleep | | | | |
| < 1 time a week | 5,5 | 6,9 | 6,2 | 4,8 – 7,9 |
| ≥ 1 time a week | 4,7 | 3,3 | 4,0 | 2,9 – 5,5 |
| Strong wheezing restricting speech | 3,7* | 1,6 | 2,6 | 1,7 – 3,8 |
| Asthma at some point in your life | 6,1 | 6,1 | 6,1 | 4,7 – 7,8 |
| Wheezing after physical exercise | 11,0 | 9,0 | 10,0 | 8,3 – 12,1 |
| Dry cough at night | 24,1 | 25,9 | 25,0 | 22,4 – 27,9 |

Note: * $\rho \leq 0.05$

1.5% among females ($\chi^2 = 4.35$ $\rho = 0.03$), there were no differences observed between genders in relation to the other symptoms.

Considering both the groups examined, the proportion of students with asthma at private schools was 6.5% greater than at public schools; however, this difference is not statistically significant ($\chi^2 = 0.14$; $\rho = 0.71$). Neither was any significant difference found between the prevalence of asthma among residents of urban and rural regions ($\chi^2 = 0.33$; $\rho = 0.94$).

## DISCUSSION

This study demonstrated a greater prevalence of asthma among SC, with a difference of 42% more asthmatics in the younger age group. The higher prevalence of the disorder among this age group could be a result of patterns of early exposure to allergens and the prior existence of viral diseases that can cause wheezing [23]. These factors allied to genetic predisposition contribute to the outbreak and exacerbation of asthma cases [4].

The prevalence of asthma observed in the municipality of Alta Floresta was found to be similar to the Brazilian average, however among the highest in Latin America. The scarce studies conducted in areas of the Amazon biome show a prevalence of asthma of 24.4% among SC in Manaus [10] and 25.2% in Tangará da Serra [24]; while among the AD group it was 23.1% in Belém, 18.1% in Manaus [10] and 15.9% in Tangará da Serra [24].

Compared to the other municipalities mentioned above, Alta Floresta is located in an area with a higher concentration of outbreaks of biomass burnings and consequently greater emission of atmospheric pollution derived from the burnings. In the period of May to November in 2004 and 2005, the estimated concentration levels of fine particulate matter in the region reached 326 μg/m³, and averaged 40.6 μg/m³ (CPTEC/INPE). Considering the intense air pollution in Alta Floresta during the dry season [21] and the biological vulnerability of the younger groups, the differences in the results of the SC and AD groups would seem coherent. As regards the comparison with the results from the municipalities of

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Manaus, Belém and Tangará da Serra, one should take into account that the former two are industrialized capital cities and have a much more vehicles on the roads than the two municipalities in Mato Grosso. Tangará da Serra, on the other hand, as well as being affected by the smoke from the deforestation arch, is situated in the region of sugarcane plantations, where the vegetation is burned systematically between May and October [24].

As well as the factors identified as producing atmospheric pollution, the Amazon is a geographically vast region, the population of which presents significant biological and cultural diversity due to the varied origin of the constant migratory flow [25].

In Cuiabá, the first study conducted in Mato Grosso employing the ISAAC questionnaire showed a prevalence of asthma symptoms of 28.2% among schoolchildren and 26.4% among teenagers [26]. However, despite using the ISAAC questionnaire, the authors used different criteria for defining cases of asthma to that recorded by the ISAAC study group, thus making comparisons unfeasible.

As regards the gender, it was observed that in Alta Floresta the prevalence of asthma among SC is greater in boys, while in the AD group no difference between the genders was found. The difference in the prevalence of asthma between genders is at issue in the literature; with it often being higher for boys among SC and for girls among AD [26,27,28]. This may be related to the physiological characteristics of boys' airways and hormonal conditions during adolescence [29].

In relation to physician-diagnosed asthma and serious asthma, these cases were prevalent among boys both for SC and AD, lending weight to the hypothesis that in Alta Floresta the disorder really is more prevalent among boys. When comparing the SC and AD groups in terms of serious asthma, this was more frequent in SC; in relation to gender, no difference was found in the schoolchildren, however it was more prevalent among the males in the AD group. It is possible that this is influenced both by the response capacity of the bronchial tonus and the exposure patterns of AD males, for example, to environmental risk factors [30].

All the homes were visited, on up to two occasions at different times, in order to find the student and a member of the family responsible for the student. The return rate of the questionnaires was similar to those observed in other studies [8]. Furthermore, the instrument presented the advantages of a lack of influence of the time of application on the results, operational ease as it was self-applicable, good sensitivity and specificity in identifying cases of asthma, as well as being validated both in Brazil and worldwide.

It can be concluded that Alta Floresta is among the Brazilian municipalities with the highest prevalence of asthma in Latin America for school children ages 6 and 7 years old.

Based on the results found, it is suggested that an integrated health surveillance and air quality monitoring network be implemented in the municipality, with the establishment of indicators that contribute to the analysis, planning and intervention in the local conditions that influence human health.

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