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ASTHMA PREVALENCE AND THE IMPACT OF NUTRITIONAL STATUS ON
PRESCRIBED ASTHMA MEDICATIONS IN CHILDRENUČESTALOST ASTME I UTICAJ NIVOVA UHRANJENOSTI NA PREPISANE LEKOVE ZA
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Summary

Introduction. Asthma and obesity are the most common chronic health disorders in children. Although heredity plays a significant role in their development, environmental factors and early exposure have contributed to the increasing incidence of both disorders in recent decades. The aim of the study was to estimate asthma prevalence in schoolchildren in Indija, Srem District, Serbia, and to investigate differences in nutritional status of children with asthma as well as differences between their nutritional status and prescribed asthma medications. **Material and Methods.** A cross-sectional retrospective cohort study was conducted at the Primary Health Center in Indija. Of all the medical records of children aged 6 - 14 years, a cohort of children with asthma was formed. The retrospective study evaluated their nutritional status and the prescribed asthma medications. **Results.** The prevalence of asthma in children aged 6 - 14 was 6.9%. Children with asthma were significantly more overweight and obese (40.5%) than children without asthma. Boys accounted for 63.7% of children with asthma, with a statistically significant gender difference. Abnormal nutritional status was found in 44.3% of children with asthma and boys with asthma were significantly more obese (23%) compared to girls (7.8%). Overweight and obese children with asthma were not prescribed significantly more medications to relieve asthma symptoms than normal-weight children. **Conclusion.** The prevalence of asthma among schoolchildren in Indija was 6.9%. Children with asthma were more likely to be overweight and obese than children without asthma, whereas boys with asthma were significantly more obese than girls. No significant differences were found between their nutritional status and prescribed asthma medications.

Key words: Asthma; Nutritional Status; Therapeutics; Obesity; Overweight; Child; Primary Health Care; Prevalence

Sažetak

Uvod. Astma i gojaznost su najčešći hronični zdravstveni poremećaji kod dece. Iako nasleđe ima značajnu ulogu u njihovom razvoju, spoljni faktori i rana izloženost doprinose povećanju učestalosti oba poremećaja poslednjih decenija. Cilj rada bio je da se proceni prevalencija astme kod dece školskog uzrasta u Indiji, Srem, Srbija i da se istraži različitost nutritivnog statusa kod dece sa astmom kao i razlike između njihovog nutritivnog statusa i lekova propisanih za astmu. **Materijal i metode.** U Domu zdravlja Indija sprovedena je retrospektivna kohortna studija preseka. Od svih zdravstvenih kartona dece uzrasta 6–14 godina formirana je kohorta dece sa astmom u kojoj je retrospektivno praćen nutritivni status i propisani lekovi za astmu. **Rezultati.** Prevalencija astme kod dece uzrasta 6–14 godina bila je 6,9%. Dece sa astmom su bila više prekomerno uhranjena i gojazna (40,5%) od dece bez dijagnoze astme. Dečaci su činili 63,7% dece sa astmom, sa statistički značajnom razlikom po polu. Abnormalan nutritivni status bio je prisutan kod 44,3% dece sa astmom, a dečaci sa astmom su bili znatno gojazniji (23%) u poređenju sa devojkama (7,8%). Prekomerno uhranjenoj i gojaznoj deci nije propisano znatno više lekova za olakšanje simptoma astme ili lekova za kontrolu astme u odnosu na normalno uhranjenu decu. **Zaključak.** Prevalencija astme kod dece školskog uzrasta u Indiji iznosila je 6,9%. Dece sa astmom češće su imala prekomernu telesnu masu i gojaznost u odnosu na populaciju dece koja nisu obolela od astme, a dečaci sa astmom su bili značajno gojazniji nego devojčice. Nisu pronađene značajne razlike između njihovog nutritivnog statusa i propisanih lekova za astmu.

Glavne reči: astma; nutritivni status; terapija; gojaznost; prekomerna težina; dete; primarna zdravstvena zaštita; prevalenca

Introduction

Asthma and obesity are two of the most prevalent chronic disorders in children with a great impact on

public health. The prevalence of overweight and obesity among children has been rapidly increasing over the past 20 years and it is the same period in which the increase in asthma prevalence has occurred [1].

Abbreviations

ICD – International Classification of Diseases
BMI – body mass index

Asthma is a common, chronic respiratory disease affecting 1 – 18% of the population in different countries [2]. The majority of pediatric asthma presents before the age of 5 and has a strong familial aggregation [3]. Childhood asthma is more common in boys, while adult asthma is more common in women [4].

Changes in lifestyle such as diet, physical activity, and early life exposure are likely to be important factors contributing to the increase in the prevalence of both asthma and obesity [5, 6]. A physical or mechanical effect of obesity on the respiratory system seems likely to play a role in the obesity-asthma association [7]. Both conditions are characterized by chronic tissue inflammation, which includes numerous, although different inflammatory markers which may increase the bronchial responsiveness in patients with asthma [8]. Obesity is both a major risk factor and a disease modifier of asthma in children [5]. Although overweight/obesity and childhood asthma are associated, the causal pathway and temporal aspects of this relationship remain unanswered and deserve further epidemiological investigation [9]. Understanding the relationship between obesity and asthma may lead to new therapeutic strategies [10].

The aim of this study was to estimate asthma prevalence in children aged 6 – 14 in Indija, Srem District, Serbia, in 2019, and to investigate differences in nutritional status of children with asthma as well as differences between their nutritional status and prescribed asthma medications.

Material and Methods

A cross-sectional retrospective cohort study was conducted at the Primary Health Center “Dr. Milorad Mika Pavlović”, Indija. Indija is a town and a municipality located in the Srem District of the Autonomous Province of Vojvodina, Serbia. In 2011, the town had a total population of 26,025, while the municipality had 47,433 inhabitants [11]. The Pediatric Department of the Primary Health Center had approximately 6,850 medical records of children aged 0 – 18 years in the study period, out of which 3,263 children were born during 2005 – 2013.

All medical records, whether paper-based or electronic, of children born from 2005 to 2013, were reviewed during one month (February 1 to February 29, 2020) to identify children with the diagnosis of asthma using the International Classification of Diseases (ICD)-10 (J45) that were documented by evidence of pediatric pulmonologist's report. Out of these, the study included only children who visited the Pediatric Department at least once during the previous year (January 1 to December 31, 2019). Exclusion criteria were children whose height and/or weight were not recorded during the previous year. Out of the 3,263 children born from 2005 to 2013, 1,625 (49.8%) were boys and 1,638 (50.2%) were

girls. During the 2019, the children's height and weight were recorded in 2,802 medical records.

Medical records of children that met the inclusion criteria formed a cohort and were reviewed. Patient descriptive characteristics including the year of birth, sex, height, weight, age at which asthma was diagnosed, as well as prescribed asthma medications and data regarding referral to a hospital due to asthma exacerbations (J45-J46) during the previous year (January 1 to December 31, 2019) were extracted.

There were 226 children diagnosed with asthma, out of which 221 met the inclusion criteria. The children whose height and/or weight were not recorded during the previous year were excluded ($n=9$), leaving 212 children with asthma to be included in the study.

In 2019, the Pediatric Department had 15,760 curative care visits of children born from 2005 to 2013, out of which 867 (5.5%) were due to asthma diagnosis (J45-J45.9 and J46 according to ICD-10). Consequently, the average number of visits to a primary care pediatrician per child aged 6 – 14 with asthma diagnosis was 3.9.

The classification of nutritional status was based on body mass index (BMI). The BMI was calculated by dividing the child's weight in kilograms by the square of height in meters. The cut-offs used to define underweight, normal, overweight, and obesity in children and adolescents are different from those used in adults and vary by age and sex because of the natural growth in childhood and adolescence. Underweight is defined as a BMI below the 5th percentile, normal weight is defined as BMI at or above the 5th percentile and below the 85th percentile, overweight is defined as a BMI at or above the 85th percentile and below the 95th percentile, and obesity is defined as a BMI at or above the 95th percentile for children and teens of the same age and sex [12].

Prescribed asthma medications were identified and categorized as reliever medications (salbutamol, fenoterol/ipratropium bromide), controller medications (fluticasone propionate, budesonide, fluticasone/salmeterol, budesonide/formoterol, montelukast), or both. If no asthma medication was prescribed, it was categorized as “no therapy”.

Asthma prevalence in 2019 was calculated as the proportion of children diagnosed with asthma in the population of children born from 2005 to 2013 based on sex and age. Differences between groups were calculated by the chi-square test. The p-value of < 0.05 was considered significant. The data were analyzed using Statistical package for the social sciences for Windows, version 18.0 (SPSS Inc., Chicago, Ill., USA).

The study was approved by the Ethics Committee of the Primary Health Center “Dr. Milorad Mika Pavlović”, Indija.

Results

The demographic and clinical characteristics of the total number of children with and without asthma are summarized in **Table 1**. The children with asthma were significantly more overweight/obese (40.5%)

Table 1. Descriptive characteristics of the total population of children, with and without asthma**Tabela 1.** Deskriptivne karakteristike ukupne populacije dece, dece koja nisu i dece koja su obolela od astme

Variable/Varijabla	Total/Ukupno		Asthma No/Astmu nema		Asthma Yes/Astmu ima		p*
No/Br	2802		2590		212		
Mean years/Prosečna starost	9.9		9.8		10.0		
Sex/Pol	No/Br.	%	No/Br.	%	No/Br.	%	
Boys/Dečaci	1326	47.3	1191	46.0	135	63.7	0.000
Girls/Devojčice	1476		1399	54.0	77	36.3	
Nutritional status/Status uhranjenosti	52.7						
Underweight/Pothranjenost	75	2.7	67	2.6	8	3.8	0.002
Normal weight/Normalna uhranjenost	1850	66.0	1732	66.9	118	55.7	
Overweight/Prekomerna uhranjenost	453	16.2	404	15.6	49	23.1	
Obesity/Gojaznost	424	15.1	387	14.9	37	17.4	
Other/Ostalo							
Asthma Dg. < 5 age/Dg. astme pre 5. g.	122	4.35	0	0	122	57.5	
Referral to hospital (J45/J46) Upućivanje u bolnicu J45/J46	19	0.68	0	0	19	8.9	

*Statistically significant difference at $p < 0.05$ /*Statistički značajna razlika kada je $p < 0,05$

than children without asthma (30.5%), ($\chi^2 = 9.16$, $p < 0.05$). Boys developed asthma more frequently than

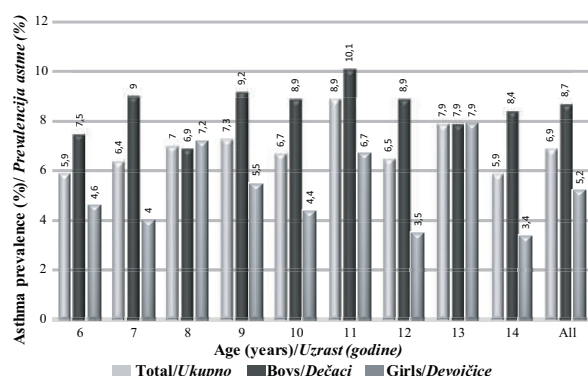
girls ($\chi^2 = 24.6$, $p < 0.001$) (**Table 1**). The nutritional status of children with asthma is shown in **Table 2**.

Table 2. Nutritional status and sex distribution of children with asthma referred to hospital**Tabela 2.** Nutritivni status i upućivanje na bolničko lečenje dece obolele od astme po polu

Variable/Varijabla	Total/Ukupno		Boys/Dečaci		Girls/Devojčice		p*
	No/Br.	%	No/Br.	%	No/Br.	%	
	212	100	135	63.7	77	36.3	0.000
Nutritional status/Status uhranjenosti							
Underweight/Pothranjenost	8	3.8	6	4.4	2	2.6	0.005
Normal weight/Normalna uhranjenost	118	55.7	69	51.1	49	63.6	
Overweight/Prekomerna uhranjenost	49	23.1	29	21.5	20	26.0	
Obesity/Gojaznost	37	17.4	31	23.0	6	7.8	
Referral to hospital J45/J46/Upućivanje u bolnicu J45/J46							
Total/Ukupno	19	8.9	12	8.9	7	9.0	
Underweight/Pothranjeni	0	0	0	0	0	0	
Normal weight/Normalno uhranjeni	10	52.6	5	41.7	5	71.4	
Overweight/Prekomerno uhranjeni	4	21.1	3	25.0	1	14.3	
Obesity/Gojazni	5	26.3	4	33.3	1	14.3	

*Statistically significant difference at $p < 0.05$ /*Statistički značajna razlika kada je $p < 0,05$ **Table 3.** Prescribed asthma medications in regard to the nutritional status of children with asthma in 2019**Tabela 3.** Propisani lekovi za astmu prema statusu uhranjenosti dece sa astmom u 2019. godini

The nutritional status Status uhranjenosti	Total Ukupno		Underweight Pothranjenost		Normal weight Normalna uhranjenost		Overweight Prekomerna uhranjenost		Obesity Gojaznost	
	No/Br.	%	No/Br.	%	No/Br.	%	No/Br.	%	No/Br.	%
	212	100	8	3.8	118	55.7	49	23.1	37	17.4
Asthma medications/Lekovi za astmu										
Reliever/Lekovi za olakšanje simptoma	54	25.5	2	25.0	29	24.6	14	28.6	9	24.3
Controller/Lekovi za kontrolu astme	41	19.3	3	37.5	22	18.7	7	14.3	9	24.3
Both/Oba	76	35.9	2	25.0	39	33.0	23	46.9	12	32.5
No therapy/Bez terapije	41	19.3	1	12.5	28	23.7	5	10.2	7	18.9



Graph 1. Prevalence of asthma by age and sex in 2019
Grafikon 1. Prevalencija astme prema uzrastu i polu u 2019. godini

Abnormal nutritional status was found in 94 (44.3%) children with asthma. Boys with asthma were more obese (31/135; 23%) than girls (6/77; 7.8%) and that was statistically significant ($\chi^2 = 7.83$, $p < 0.05$). No sex difference was found regarding referral to hospital due to asthma exacerbations (boys 12/135; 8.9% and girls 7/77; 9%). According to the nutritional status, 9 (47.4%) children with asthma who were referred to hospital were overweight and obese and 10 (52.6%) were normal-weight children. Overweight and obese boys (7/60; 13.2%) were more often referred to hospital than girls (2/26; 7.7%) (Table 2). The majority of children (122/212; 57.5%) were diagnosed with asthma before the age of 5 (Table 1). Asthma prevalence in 2019 was 6.9%, 8.7% in boys and 5.2% in girls, and the sex distribution is shown in Graph 1.

Some kind of asthma medication was prescribed to 81 (86.2%) children with abnormal nutritional status, and to 90 (76.3%) normal-weight children (Table 3). Asthma controller medication, alone or in combination with reliever, was prescribed to 51 (59.3%) overweight and obese children, as well as to 61 (51.7%) normal-weight children, and even to 5 (62.5%) underweight children. No significant differences were found between the nutritional status and prescribed asthma medications. However, only 14% of overweight and obese children with asthma were without any prescribed asthma therapy compared to 23.7% of normal-weight children.

Discussion

Asthma is the most common chronic disease in childhood. In the United States, 8.3% of children in 2016 and 1 in 12 children in 2017 had asthma [13, 14]. The study of Živković et al. showed that prevalence of childhood asthma ranged from 2.5% to 9.8% in Serbia and Montenegro [15]. The prevalence of asthma in children in the European Union was 9.4% in 2015 [16]. The prevalence of asthma in children born from 2008 to 2013 in our study was 6.9%, that is, 1 in 15 children had asthma in 2019.

Pre-pubertal boys have a higher asthma incidence, prevalence, and hospitalization rate than girls

of the same age, but this trend reverses during adolescence [4]. The reversal of this sex difference in asthma prevalence occurs around puberty, suggesting that sex hormones may play a role in the etiology of asthma [17]. Our study also showed that asthma is significantly more common in boys, given that 1 in 12 boys had asthma, compared to 1 in 21 girls in the study population.

Being underweight, overweight, or obese during childhood and adolescence is associated with adverse health consequences throughout the life-course [18]. Early interventions for children with asthma and/or wheezing may be warranted to prevent a vicious cycle of worsening obesity and asthma that could contribute to the development of other metabolic diseases, including prediabetes and type 2 diabetes later in life [19]. In girls, becoming overweight or obese between the ages of 6 and 11 has been found to increase the risk of developing asthma and to increase bronchial responsiveness during adolescence [20]. Some studies have shown that obese subjects are at an increased risk of asthma, and obese asthmatics have more symptoms, more frequent and severe exacerbations, reduced response to several asthma medications, and decreased quality of life [10]. In patients with obesity and asthma, asthma may occur first and then lead to a higher risk of obesity due to reduced exercise or to frequent corticosteroid therapy [3]. Diet-induced weight loss in children has also been shown to improve asthma control, but without significant changes in airway inflammation [21]. Our study showed that 17.4% of children with asthma were obese, and boys with asthma were significantly more obese.

The study which compared the nutritional status of healthy children and children with asthma showed that there were considerably less normally nourished children, and considerably more underweight and overweight children in the asthmatic group, showing that the two groups differ in the level of growth and development to a certain extent [22]. In our sample, abnormal nutritional status was found in 44.3% of children with asthma.

According to the current asthma guidelines, asthma with obesity is identified as an asthma phenotype where some obese patients with asthma have prominent respiratory symptoms and little eosinophilic airway inflammation. In the future, some phenotype-guided treatments are expected to be available but this requires further research, especially in children [2]. Some childhood asthma programs showed that overweight and obese children with asthma had a reduced response to inhaled corticosteroids leading to increased prednisone courses and moderate-to-severe exacerbations [23]. On the other hand, some studies showed no association between nutritional status and severity of asthma [24]. In our study, approximately 40% of children with asthma were overweight and obese, but did not get significantly more prescribed asthma medications nor were they referred to hospital more often when compared to normal-weight children. However, our results suggest that overweight and obese children

with asthma are less likely to be without any prescribed asthma medications. This may imply that these children are more symptomatic or have more severe asthma compared to normal-weight children. Asthma reliever medication, alone or in combination with a controller, was prescribed to 67.4% of overweight and obese children in comparison with 57.6% of normal-weight children in our study that may support the previous implication. On the other hand, no prescribed asthma medication could also be due either to good asthma control, or these children had a history of asthma. Regarding the choice of reliever medications, we found fenoterol-ipratropium bromide prescribed to a high number of children, despite the fact that fenoterol is not recommended in current guidelines and ipratropium bromide is not recommended for long-term use [2]. This, however, demands further investigation that is out of the scope of this study.

Age-standardized admission rates for asthma (all ages) in Serbia, 2011 – 2015 were approximately 130 per 100,000, and the mortality rate (ages 5 – 34) for the same period was under 2% [25]. In the United States, asthma is the third-ranking cause of hospitalization among children younger than 15 years [26]. In our research, 9% of children with asthma were referred to secondary or tertiary health care for asthma exacerbation in 2019, 1 in 9 overweight and obese children, and 1 in 12 normal-weight children.

There are several limitations that should be considered in interpreting these results. Medical records in-

cluded limited data, which enabled further stratification (for example, no data on measures of pulmonary function). The relatively small study sample limited our ability to find proper associations between asthma and overweight and obesity. Conducting cross-sectional study enabled assessing changes in asthma severity and BMI which could be interconnected. Adherence to therapy and additional therapy, were not considered.

Despite the limitations, our study has several strengths. To the best of authors' knowledge, this is the first study examining the possible association between nutritional status and prescribed asthma medications in children in Serbia. Additional strengths of this study include the availability of asthma diagnosis made by a pediatric pulmonologist, rather than reliance on self-reports as well as the availability of asthma-specific prescriptions. This study can serve as a basis for future studies with larger study samples in Serbia.

Conclusion

The prevalence of asthma among children aged 6 – 14 in Indija, Srem District, Serbia, was 6.9% in 2019. Children with asthma were more overweight and obese than children without asthma. It was more common in boys, and boys with asthma were significantly more obese than girls. In our study, no significant differences were found between nutritional status of children with asthma and prescribed asthma medications.

References

- Gilliland FD, Berhane K, Islam T, McConnell R, Gauderman WJ, Gilliland SS, et al. Obesity and the risk of newly diagnosed asthma in school-age children. *Am J Epidemiol*. 2003;158(5):406-15.
- Global initiative for asthma. Global strategy for asthma management and prevention [Internet]. 2020 [cited 2020 May 16]. Available from: www.ginaasthma.org.
- Lang JE. Obesity, nutrition, and asthma in children. *Pediatr Allergy Immunol Pulmonol*. 2012;25(2):64-75.
- Fuhlbrigge AL, Jackson B, Wright RJ. Gender and asthma. *Immunol Allergy Clin North Am*. 2002;22(4):753-89.
- Peters U, Dixon AE, Forno E. Obesity and asthma. *J Allergy Clin Immunol*. 2018;141(4):1169-79.
- Ljustina-Pribic R, Petrovic S, Tomic J. Childhood asthma and risk factors. *Med Pregl*. 2010;63(7-8):516-21.
- Rasmussen F, Hancox RJ. Mechanisms of obesity in asthma. *Curr Opin Allergy Clin Immunol*. 2014;14(1):35-43.
- Shore SA, Fredberg JJ. Obesity, smooth muscle, and airway hyperresponsiveness. *J Allergy Clin Immunol*. 2005;115(5):925-7.
- Mebraska TF, Feltbower RG, Greenwood DC, Parslow RC. Childhood body mass index and wheezing disorders: a systematic review and meta-analysis. *Pediatr Allergy Immunol*. 2015;26(1):62-72.
- Shore SA. Obesity and asthma: implications for treatment. *Curr Opin Pulm Med*. 2007;13(1):56-62.
- Statistical Office of the Republic of Serbia. 2011 Census of population, households and dwellings in the Republic of Serbia. Comparative overview of the number of households in 1948-2011 and dwellings in 1971-2011. Vol. 21. Belgrade: Statistical Office of the Republic of Serbia; 2014.
- Barlow SE; Expert Committee. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics*. 2007;120 Suppl 4:S164-92.
- Zahrn HS, Bailey CM, Damon SA, Garbe PL, Breyse PN. Vital signs: asthma in children - United States, 2001-2016. *MMWR Morb Mortal Wkly Rep*. 2018;67(5):149-55.
- Centers for Disease Control and Prevention. Most recent asthma data [Internet]. 2018 [cited 2020 May 16]. Available from: www.cdc.gov/asthma/most_recent_data.htm.
- Zivković Z, Vukašinović Z, Cerović S, Radulović S, Zivanović S, Panić E, et al. Prevalence of childhood asthma and allergies in Serbia and Montenegro. *World J Pediatr*. 2010;6(4):331-6.
- Selroos O, Kućczyk M, Kuna P, Łacwik P, Bousquet J, Brennan D, et al. National and regional asthma programmes in Europe. *Eur Respir Rev*. 2015;24(137):474-83.
- Dharmage SC, Perret JL, Custovic A. Epidemiology of asthma in children and adults. *Front Pediatr*. 2019;7:246.
- NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128.9 million children, adolescents, and adults. *Lancet*. 2017;390(10113):2627-42.
- Chen Z, Salam MT, Alderete TL, Habre R, Bastain TM, Berhane K, et al. Effects of childhood asthma on the development of obesity among school-aged children. *Am J Respir Crit Care Med*. 2017;195(9):1181-8.
- Castro-Rodríguez JA, Holberg CJ, Morgan WJ, Wright AL, Martinez FD. Increased incidence of asthmalike symptoms

in girls who become overweight or obese during the school years. *Am J Respir Crit Care Med*. 2001;163(6):1344-9.

21. Jensen ME, Gibson PG, Collins CE, Hilton JM, Wood LG. Diet-induced weight loss in obese children with asthma: a randomized controlled trial. *Clin Exp Allergy*. 2013;43(7):775-84.

22. Scepanovic A, Perovic A, Bozic-Krstic V. Nutritional status (BMI) in children suffering from asthma. *Archives of Biological Sciences*. 2013;65(3):1157-62.

23. Covar RA, Fuhlbrigge AL, Williams P, Kelly HW; the Childhood Asthma Management Program Research Group. The Childhood Asthma Management Program (CAMP): contributions to the understanding of therapy and the natural history of childhood asthma. *Curr Respir Care Rep*. 2012;1(4):243-50.

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24. Morishita RYM, Strufaldi MWL, Puccini RF. Evolução clínica e estado nutricional de crianças e adolescentes asmáticos acompanhados em Unidade Básica de Saúde [Clinical evolution and nutritional status in asthmatic children and adolescents enrolled in Primary Health Care]. *Rev Paul Pediatr*. 2015;33(4):387-93.

25. The Global Asthma Report 2018. Auckland: Global Asthma Network; 2018.

26. American Lung Association. Asthma and children: fact sheet [Internet]. 2017 [cited 2020. May 18]. Available from: <https://www.lung.org/lung-health-diseases/lung-disease-lookup/asthma/learn-about-asthma/asthma-children-facts-sheet>.