Revista ARACÊ
ISSN: 2358-2472

IMPACT OF ASTHMA AND RHINITIS CONTROL ON SLEEP QUALITY IN CHILDREN AND ADOLESCENTS

https://doi.org/10.56238/arev6n4-224

Submitted on: 11/13/2024 **Publication date:** 12/13/2024

Thalma Tibúrcio Venâncio Goulart[1], Drielli Noemia Castro Rezende[2], Letycia Wiwia Soares Queiroz[3], Cibelle Luiza Oliveira[4], Lusmaia Damaceno Camargo Costa[5], Natasha Yumi Matsunaga[6] and Raquel Vidica Fernandes[7].

ABSTRACT

Introduction: Studies indicate that the association between asthma and rhinitis is common and may be responsible for the presence of sleep disorders, with consequent impairment throughout the day, worsening of quality of life, decreased ability to concentrate, low school performance rates, and behavioral changes. Objective: To evaluate the impact of the level of asthma and rhinitis control on the sleep quality of children and adolescents. Methods: This was a cross-sectional, prospective, analytical, and quantitative study conducted with children and adolescents between 6 and 18 years of age diagnosed with asthma and allergic rhinitis who attended the Pediatric Pulmonology Outpatient Clinics of the Hospital das Clínicas of the Federal University of Goiás (UFG). The Asthma Control Test (ACT) and Childhood Asthma Control Test (c-ACT) questionnaires were applied to assess asthma

[1] Physician, pediatric pulmonologist from the Federal University of Goiás – UFG
E-mail: thalmav@gmail.com
ORCID: 0000-0001-7782-8066
Lattes: http://lattes.cnpq.br/9515694195323985
[2] Physician, pediatric pulmonologist from the Federal University of Goiás – UFG
Email: driellidecastro@yahoo.com.br
ORCID: 0000-0002-9771-8515
Lattes: http://lattes.cnpq.br/6907751936344954
[3] Student of the Physical Therapy Course at the Federal University of Goiás - UFG
Email: letycia_wiwia@discente.ufg.br
ORCID: 0009-0006-9586-7759
Lattes: https://lattes.cnpq.br/8023771626371375
[4] Student of the Physical Therapy Course at the Federal University of Goiás – UFG
Email: cibelleoliveira@discente.ufg.br
ORCID: 0009-0000-2842-0929
Lattes: https://lattes.cnpq.br/7438033326386211
[5] Physician, PhD in Health Sciences from the Federal University of Goiás – UFG. Adjunct Professor, Department of Pediatrics, Faculty of Medicine, UFG
Email: lusmaiapneumoped@gmail.com
ORCID: 0000-0002-9261-4514
Lattes: http://lattes.cnpq.br/7628268439291782
[6] Physiotherapist, PhD in Sciences from the State University of Campinas - UNICAMP. Adjunct Professor of the Physical Therapy Course at the Department of Functional Health at UFG
Email: natasha_matsunaga@ufg.br
ORCID: 0000-0002-5467-6482
Lattes: http://lattes.cnpq.br/7009489840566561
[7] Physician, PhD in Health Sciences from the Federal University of Goiás - UFG.
Preceptor of the pediatric pulmonology residency at HC-UFG
E-mail: raqvidica@yahoo.com.br
ORCID: 0000-0003-1309-2509
Lattes: http://lattes.cnpq.br/5245850137661140

Revista ARACÊ
ISSN: 2358-2472

control, the Rhinitis Control Assessment Test (RCAT) to verify rhinitis control, and the Sleep Disorders in Children Scale (EDSC). The data obtained were tabulated and processed using the SPSS for Windows version 16.0 program, in which the Mann-Whitney or Kruskal-Wall tests were applied to compare the distributions of quantitative variables of the groups (p=5%). Results: A total of 107 children and adolescents with asthma were included, 66 (61.7%) of whom were male, with a mean age of 10.93 ± 3.10 years. 47 (43.9%) patients were classified as having uncontrolled asthma, and they had higher EDSC values, which indicates the presence of greater sleep disorders. Regarding rhinitis, 68 (63.6%) had uncontrolled rhinitis, with significantly higher values in the total score ($p<0.001$) and in all disorders evaluated by the questionnaire ($p<0.05$) in this group. When associating the presence of asthma and rhinitis, the groups with controlled asthma and rhinitis showed differences in all the components mentioned above in relation to the group with uncontrolled asthma and rhinitis. Conclusion: We conclude that both asthma and AR are related to the presence of sleep disorders in children and adolescents and, when not controlled, may be more harmful to patients. Uncontrolled AR demonstrated a greater impact when compared with non-asthma control.

Keywords: Asthma. Rhinitis. Sleep Disorders. Child.

Revista ARACÊ
ISSN: 2358-2472

INTRODUCTION

Asthma is a heterogeneous disease characterized by chronic inflammation of the airways, with the presence of recurrent episodes of wheezing, dyspnea, chest tightness, and cough, associated with expiratory flow variation, and which affects approximately 300 million people worldwide and causes about 1000 deaths per day (GINA, 2024)

It is considered one of the most common chronic childhood diseases, and affects 24.3% of Brazilian school-age children and 19% of adolescents (SOLÉ et al, 2006; GINA, 2024). In addition, uncontrolled asthma is one of the main causes of hospitalization in school-age children, which leads to higher morbidity and mortality, absenteeism from school, level of sedentary lifestyle, medication expenses, and poorer quality of life (RODRIGUES-BASTOS et al., 2013; MARQUES et al., 2022)

Another chronic disease with a high prevalence in the pediatric age group is allergic rhinitis (AR), which presents nasal manifestations such as anterior and posterior rhinorrhea, nasal obstruction, sneezing, hyposmia and nasal itching due to an inflammatory process after contact with allergens (CAMELO-NUNES et al., 2010; IV BRAZILIAN CONSENSUS ON RHINITIS, 2017; CALDEIRA et al., 2021).

Rhinitis has an overall prevalence of 10 to 40%, with variation according to the region, and is considered an underdiagnosed and undertreated disease (KATELARIS et al, 2012). In Brazil, the study with the *International Study of Asthma and Allergies in Childhood* (ISAAC) protocol identified the prevalence of allergic rhinitis in 12.8% in children aged 6-7 years and 18.0% among adolescents aged 13-14 years (SOLÉ et al., 2004).

The association between asthma and rhinitis is common, in which about 40% of patients with AR have asthma, while 80% of asthmatics have AR (AGUERO et al., 2023). This association can be explained by the physiological and pathological relationship between the upper and lower airways with the single airway theory, as well as by the chronic inflammatory component of both diseases (CAMELO-NUNES et al., 2010; DI-CARA et al., 2015; MORENO et al., 2019).

Studies have shown that children with asthma and/or rhinitis may have some type of sleep disorder, such as complaints of insomnia, poor sleep quality, difficulty falling asleep, sleep disturbances, daytime sleepiness, and night terrors (NALLU et al., 2019; BILGIN et al., 2022; REITER et al., 2022). General sleep complaints such as bedtime problems and nighttime awakenings, consistent with behavioral insomnia, are found in approximately 20-30% of school-age children (MINDELL et al., 2006).

Revista ARACÊ
ISSN: 2358-2472

Among the theories for the relationship between sleep disorders in patients with AR and asthma, the consequence of inflammatory processes with greater activation of inflammatory mediators, increased airway resistance, presence of wheezing, and coughing at night is mentioned (LOEKMANWIDJAJA et al., 2018; SANCHEZ et al., 2018). In addition, there is a complex bidirectional interaction between sleep-related breathing disorders and asthma, in which insufficient and poor quality sleep can aggravate asthma symptoms, and uncontrolled asthma can impair sleep (REITER et al., 2022).

From this perspective, it is noted that in recent years the quality of sleep has been a reason for questioning and concern, especially in the pediatric age group, given its influence on the child's development (MASKI et al., 2018). In addition, improving asthma and rhinitis control seems to be an important step to improve symptoms and prevent deterioration in sleep quality in children (D'ELIA et al., 2022). Therefore, the objective of this study was to evaluate the impact of the level of asthma and rhinitis control on the sleep quality of children and adolescents.

METHODOLOGY

This is a cross-sectional, prospective, analytical, and quantitative study, in which children and adolescents between 6 and 18 years of age, diagnosed with asthma and AR, who attended the Pediatric Pulmonology outpatient clinics of the Hospital das Clínicas of the Federal University of Goiás (UFG), from March to September 2019, were selected. Patients with neurological, cardiac and other pulmonary diseases, except asthma, were excluded.

The Asthma Control Test *(ACT) (ROXO et al., 2010)* and Childhood Asthma Control Test *(c-ACT) (OLIVEIRA et al., 2016),* Rhinitis Control Assessment Test *(RCAT) (FERNANDES et al., 2016) and Sleep Disorders Scale* in Children (EDSC) (FERREIRA, 2009) questionnaires were applied to parents or guardians of children and adolescents, all of which were validated for Portuguese.

The ACT consists of five questions about asthma symptoms, the effect of asthma on daily routine, and the use of reliever bronchodilators in the last four weeks for patients over 12 years of age. Each question includes five answer options, from 1 (worst) to 5 (best). The final score can range from 5 to 25, with a score less than or equal to 19 being considered uncontrolled asthma, and values ≥ 20 indicative of controlled asthma (ROXO et al., 2010).

Revista ARACÊ
ISSN: 2358-2472

The c-ACT is applied to children between 4 and 11 years of age, consisting of three items directed to parents, with scores ranging from 0 (worst) to 5 (best) and four items directed to children, with scores ranging from 0 (worst) to 3 (best), and at the end, a cutoff point of 19 was considered, in which a score ≥ 20 was indicative of good asthma control. (OLIVEIRA et al., 2016).

The RCAT is composed of six questions, whose answers are graded from one to five, according to the frequency of the events questioned, which at the end will be added to compose a total score. The questions refer to the frequency of rhinitis symptoms in the last week and its interference with daily activities and sleep. Patients with controlled rhinitis symptoms were considered to be those who obtained a score ≥ 22 points, and uncontrolled patients with < 22 points. (FERNANDES et al., 2016).

In order to evaluate the relationship between the level of asthma control and the level of rhinitis control, the patients were also classified into groups with controlled asthma and rhinitis, controlled asthma and uncontrolled rhinitis, uncontrolled asthma and controlled rhinitis, and uncontrolled asthma and rhinitis.

The EDSC has 26 items divided into six subscales: Sleep Onset and Maintenance Disorders (DIMS), Sleep-Disordered Breathing (SDB), Awakening Disorders (DD), Sleep-Wake Transition Disorders (VSD), Excessive Daytime Sleepiness (EDS), and Sleep Hyperhidrosis (HS), which results in a total score of 130 points, with the score being inversely proportional to sleep quality (FERREIRA, 2009).

The study was approved by the Research Ethics Committee of the Federal University of Goiás (UFG), opinion no.: 3,716,365. All parents or guardians signed the Informed Consent Form, as well as children and adolescents signed the Informed Consent Form.

The data obtained were tabulated and processed using the SPSS for Windows version 16.0 (Statistical Package for the Social Sciences; SPSS Inc., Chicago, IL; USA).

To verify the normality of the quantitative variables, the Kolmogorov-Smirnov test and the Shapiro-Wilk test were applied, and in both tests, variables with values of $p>0.05$ were considered to have a normal distribution.

The quantitative variables were presented as median, minimum and maximum. To compare the distributions of non-parametric quantitative variables between two groups, the Mann-Whitney test was used.

Revista ARACÊ
ISSN: 2358-2472

To compare the distributions of quantitative variables of four independent groups without normal distribution, the non-parametric Kruskal-Wallis test was used. When the latter presented statistically significant differences between the groups, the Non-Parametric Multiple Comparison Test (MCT) was applied.

In all cases, the significance level was set at 5%.

RESULTS

A total of 115 children and adolescents with asthma were evaluated, eight of whom were excluded because of the presence of cystic fibrosis or bronchiolitis obliterans or because they did not answer all the questions in the questionnaires. In the end, 107 asthma patients participated in the study, 66 (61.7%) of whom were male, with a mean age of 10.93 ± 3.10 years and a median of 11 (6-18) years.

According to the ACT classification of the level of asthma control, 60 (56.1%) patients were classified as having controlled asthma and 47 (43.9%) as having uncontrolled asthma. Table 1 shows the comparison of the components of the Sleep Disorders in Children Scale (EDSC) and the level of asthma control, and significantly higher values were observed in the total score (p=0.002), in the sleep initiation and maintenance disorder (p=0.001), in the sleep-to-sleep breathing disorder (p=0.011), in the awakening disorder (p=0.033) and in the sleep-wake transition disorder (p=0.046) in the group with uncontrolled asthma, in which higher values indicate the presence of greater sleep disorders.

Table 1: Comparison of the Sleep Disorders in Children Scale (EDSC) score in relation to the level of asthma control in children and adolescents.

	ANC	AC	p
Total score	54 (30 – 102)	46 (30 – 83)	0,002
DIMS	15 (7 – 27)	12 (7 – 27)	0,001
DRS	6 (3 – 15)	5 (3 – 13)	0,011
DD	5 (3 – 9)	3 (3 – 11)	0,033
DTSV	12 (6 – 28)	11 (6 – 23)	0,046
SED	12 (5 – 24)	9 (4 – 22)	0,062
HS	4 (2 – 10)	4 (2 – 16)	0,102

ANC: Uncontrolled asthma; CA: Controlled asthma; DIMS: sleep onset and maintenance disorder, DRS: sleep-disordered breathing, DD: arousal disorder, DTSV: sleep-wake transition disorder, EDS: excessive daytime sleepiness, HS: sleep hyperhidrosis. Statistical test: Mann-Whitney test.

Regarding rhinitis, 39 (36.4%) children and adolescents were classified as having controlled rhinitis and 68 (63.6%) with uncontrolled rhinitis. Table 2 shows the comparison of the components of EDSC with rhinitis control, and significantly higher values were

Revista ARACÊ
ISSN: 2358-2472

observed in the total score (p<0.001) and in all disorders evaluated by the questionnaire (p<0.05) in the group with uncontrolled rhinitis.

Table 2: Comparison of the Sleep Disorders in Children Scale (EDSC) score in relation to the level of rhinitis control in children and adolescents with asthma.

	RNC	RC	p
Total score	54 (31 – 102)	43 (30 – 81)	<0,001
DIS	14 (7 – 27)	12 (7 – 27)	0,017
DRS	6 (3 – 15)	4 (3 – 8)	<0,001
DD	4 (3 – 11)	3 (3 – 8)	0,003
DTSV	13 (6 – 28)	9 (6 – 23)	<0,001
ED	11 (4 – 24)	8 (5 – 20)	0,004
HS	4 (2 – 16)	3 (2 – 10)	0,016

NCR: Uncontrolled rhinitis; CR: Controlled rhinitis; DIMS: sleep onset and maintenance disorder, DRS: sleep-disordered breathing, DD: arousal disorder, DTSV: sleep-wake transition disorder, EDS: excessive daytime sleepiness, HS: sleep hyperhidrosis. Statistical test: Mann-Whitney test.

When associating the presence of asthma and rhinitis, 33 (30.8%) patients with controlled asthma and rhinitis, 27 (25.2%) with controlled asthma and uncontrolled rhinitis, 6 (5.6%) with uncontrolled asthma and controlled rhinitis, and 41 (38.3%) with uncontrolled asthma and rhinitis were observed. When comparing the groups, a statistically significant difference was observed between the groups in the overall score (p<0.001) and in all components of the questionnaire, with the exception of sleep hyperhidrosis (p=0.101) (Table 3).

The groups with controlled asthma and rhinitis showed differences in all the components mentioned above in relation to the group with uncontrolled asthma and rhinitis. On the other hand, the group with asthma and controlled rhinitis showed differences with the group with controlled asthma and uncontrolled rhinitis in the items of total score, sleep-disordered breathing, and sleep-wake transition disorder.

Revista ARACÊ
ISSN: 2358-2472

Table 3: Comparison of the score obtained on the Sleep Disorders in Children Scale (EDSC) in relation to the level of asthma and rhinitis control in children and adolescents.

	AC+RC	AC+RNC	ANC+RC	ANC+RNC	p
Total	43 (30 - 81)	50 (31 - 83)	49 (33 - 57)	59 (33 - 102)	<0,001
DIS	11 (7 - 17)	14 (7 - 22)	15 (11 - 25)	15 (7 - 27)	0,005
DRS	4 (3 - 8)	6 (3 - 13)	4 (3 - 8)	7 (3 - 15)	<0,001
DD	3 (3 - 8)	4 (3 - 11)	3 (3 - 7)	5 (3 - 9)	0,022
DTSV	9 (6 - 23)	14 (8 - 23)	11 (6 - 13)	13 (6 - 28)	<0,001
ED	8 (5 - 20)	11 (4 - 22)	6 (5 - 11)	12 (5 - 24)	0,008
HS	3 (2 - 10)	4 (2 - 16)	4 (2 - 4)	5 (2 - 10)	0,0101

ANC: uncontrolled asthma, CA: controlled asthma; NCR: Uncontrolled rhinitis; CR: Controlled rhinitis; DIMS: sleep onset and maintenance disorder, DRS: sleep-disordered breathing, DD: arousal disorder, DTSV: sleep-wake transition disorder, EDS: excessive daytime sleepiness, HS: sleep hyperhidrosis. Statistical test: Kruskal-Wallis test and Multiple Comparison Test (Total: AC+OHR#ANC+NCR and AC+WCR#AC+NCR; DIMS: AC+RC#ANC+RNC; DRS: AC+RC#ANC+RNC and AC+RC#AC+RNC; DD: AC+RC#ANC+RNC; DTSV: AC+RC#ANC+RNC and AC+RC#AC+RNC; SED: AC+RC#ANC+RNC).

DISCUSSION

In the present study, we identified a significant presence of sleep disorders in children and adolescents diagnosed with asthma and AR. The significant relationship found between uncontrolled asthma and sleep disorders, including respiratory disorders, is similar to data in the literature, which demonstrate that asthmatic patients have lower sleep quality, especially those with uncontrolled disease (BROCKMANN et al., 2014; LI et al., 2015; SANCHEZ et al., 2016).

According to previous studies, nocturnal exacerbations due to asthma affect about two-thirds of asthmatics in general (GREENBERG et al., 2012; REITER et al., 2022). It is believed that nocturnal asthma symptoms are related to changes in circadian variation as one of the factors for increased airway resistance during sleep (NUNES, 2002; GREENBERG et al., 2012).

Li et al., (2015) reinforced the relationship between asthma severity and the presence of nocturnal snoring, suggesting that asthmatic patients, in the search for disease control, should be screened for sleep-related respiratory disease. In the present study, higher EDSC values were found in those patients whose asthma was not controlled, establishing a negative association between asthma severity and sleep quality.

A systematic review conducted by Sanchez et al. (2016) evaluated the prevalence of asthma and sleep-disordered breathing in children and found that both studies with questionnaires and those that performed objective measures such as polysomnography (PSG) evidenced the relationship between asthma severity and sleep disorders. The same review proposes a bidirectional relationship between asthma and SDB, indicating that just as asthma patients have a higher prevalence of these disorders, those diagnosed with

Revista ARACÊ
ISSN: 2358-2472

obstructive sleep apnea (OSA) have a greater susceptibility to asthma exacerbations. (SANCHEZ et al., 2016).

In contrast, a meta-analysis conducted by Brockmann et al. (2014) proposes that there is no way to infer a risk relationship between asthma and OSA, since the few studies that have conducted PSG, considered the gold standard for the diagnosis of OSA, have not been able to demonstrate an association between these pathologies. In the present study, although no PSG was performed on the individuals evaluated, the application of questionnaires demonstrated a significant relationship between lack of asthma control and sleep disorders.

When we evaluated the population with uncontrolled allergic rhinitis compared with controlled AR, we found a significant difference in all sleep disorders evaluated by the EDSC, including the domains of excessive daytime sleepiness and sleep hyperhidrosis, which were not significant when asthma alone was evaluated.

After associating AR and asthma, the group of patients with non-control of both diseases had significantly higher values in the global score of the EDSC and in the assessment of sleep-disordered breathing and sleep-wake transition disorder when compared to the group with controlled AR and asthma. These same items evaluated also had higher scores, which were statistically significant, in the group with AR that was uncontrolled, when compared with the group with controlled AR, both with controlled asthma.

However, when we compared groups with controlled AR, which differed only by whether or not asthma was controlled, there was no significant difference between the scores obtained, thus leading us to believe that uncontrolled AR has a greater impact on sleep quality than does asthma.

Authors propose that inflammatory mediators in patients with AR, such as cytokines and histamines, act on the central nervous system, modifying the circadian rhythm, thus promoting sleep disorders that negatively alter the quality of life of these patients (KIMPLE et al., 2013; PERIKLEOUS et al., 2018; LOEKMANWIDJAJA et al., 2018). Nasal obstruction is described as being the symptom with the greatest impact on quality of life, being seen as a nuisance during the performance of activities, when associated with mucosal edema it contributes to the increase of airway resistance, thus acting as a factor of worsening for sleep quality (CAMELO-NUNES et al., 2010; KIMPLE et al., 2013).

Revista ARACÊ
ISSN: 2358-2472

Studies have shown that after the treatment of AR with nasal corticosteroids, a significant improvement in the nasal symptoms of patients was identified and a consequent improvement in sleep quality, as well as a decrease in symptoms such as drowsiness and irritability during their daily activities (MANSFIELD et al., 2004; DAVIES et al., 2006). In our study, there was no evaluation of the impact of AR treatment on sleep quality, but it was found that disease control was the most relevant factor in the prevalence of sleep disorders, which leads us to believe that AR treatment could positively impact the quality of life of these children and adolescents.

In a review carried out by Owens, in children with SDB, impairment in executive functions and memory was identified, as well as behavioral problems, mood swings and attention deficits (OWENS, 2009). In addition, there are reports in the literature of lower school performance in these children (FANGUPO et al., 2021). Thus, since the disorders presented widely affect the quality of life of patients, parents and/or guardians should be alerted to signs of sleep and behavior changes, so that the diagnosis is as early as possible.

Finally, it is noteworthy that it was not possible to evaluate sleep disorders after optimizing the treatment of asthma and AR, since this is a cross-sectional study, indicating the need for further studies on this topic. Another limitation of the present study was the use of questionnaires only to assess sleep disorders, however, our results were similar to those found in the literature that used polysomnography (SÁNCHEZ et al, 2016). Thus, it is emphasized that services that do not have polysomnography, the application of simple and reproducible questionnaires such as the EDSC, can be a possible tool for screening the presence of sleep-disordered breathing in children and adolescents with asthma and/or rhinitis.

CONCLUSION

Both asthma and AR are related to the presence of sleep disorders in children and adolescents and, when not controlled, can be more harmful to patients. Uncontrolled AR demonstrated a greater impact when compared with non-asthma control.

Although there is an association between sleep disorders and AR/Asthma, further studies with objective methods are still needed to evaluate the impact of treatment on affected patients.

Revista ARACÊ
ISSN: 2358-2472

REFERENCES

1. Aguero, C., Sarraquigne, M., Parisi, C., Mariño, A., López, K., Porfírio, B. M., et al. (2023). Rinitis alérgica en pediatría: recomendaciones para su diagnóstico y tratamiento. Archives Argent Pediatric, 121(2), e202202894.

2. Bilgin, N., Ozdogan, S., Kaya, A., & Yıldırmak, Y. (2022). Sleep-related breathing disorders in children with asthma: Impact on asthma control. Journal College Physicians Surgery Pak, 32(4), 473-477.

3. Brockmann, P., Bertrand, P., & Castro-Rodriguez, J. (2014). Influence of asthma on sleep-disordered breathing in children: A systematic review. Sleep Medicine Reviews, 18(5), 393-397.

4. Caldeira, L. E., Silva, M. I., Martins-dos-Santos, G., & Pereira, A. M. (2021). Rinite alérgica – Classificação, fisiopatologia, diagnóstico e tratamento. Revista Portuguesa de Imunoalergologia, 29(2), 95-106.

5. Camelo-Nunes, I. C., & Solé, D. (2010). Rinite alérgica: Indicadores de qualidade de vida. Jornal Brasileiro de Pneumologia, 36(1), 124-133.

6. Davies, M., Fisher, L., Chegini, S., & Craig, T. (2006). A practical approach to allergic rhinitis and sleep disturbance management. Allergy and Asthma Proceedings, 27(3), 224-230.

7. D'Elia, C., Gozal, D., Bruni, O., Goudouris, E., & Cruz, M. M. (2022). Allergic rhinitis and sleep disorders in children - coexistence and reciprocal interactions. Jornal de Pediatria (Rio J), 98(5), 444-454.

8. Di Cara, G., Carelli, A., Latini, A., Panfili, E., Bizzarri, I., Ciprandi, G., et al. (2015). Severity of allergic rhinitis and asthma development in children. World Allergy Organization Journal, 8(13), 1-3.

9. Fangupo, L., Haszard, J., Reynolds, A., Lucas, A., McIntosh, D., & Richards, R. (2021). Do sleep interventions change sleep duration in children aged 0-5 years? A systematic review and meta-analysis of randomized controlled trials. Sleep Medicine Review, 59, 1-10.

10. Fernandes, P. H., Matsumoto, F., Solé, D., & Wandalsen, G. F. (2016). Translation into Portuguese and validation of the Rhinitis Control Assessment Test (RCAT) questionnaire. Brazilian Journal of Otorhinolaryngology, 82(6), 674-679.

11. Ferreira, V. R. (2009). Escala de Distúrbios do Sono em Crianças: Tradução, adaptação cultural e validação. (Master's thesis). Universidade Federal de São Paulo, São Paulo, Brazil.

12. Global Initiative for Asthma (GINA). (2024). Global strategy for asthma management and prevention 2024. Available from www.ginasthma.org. Accessed November 2024.

Revista ARACÊ
ISSN: 2358-2472

13. Greenberg, H., & Cohen, R. (2012). Nocturnal asthma. Current Opinion Pulmonology Medicine, 18(1), 57-62.

14. Katelaris, C. H., Lee, B. W., Potter, P. C., Maspero, J. F., Cingi, C., Lopatin, A., et al. (2012). Prevalence and diversity of allergic rhinitis in regions of the world beyond Europe and North America. Clinical Experimental Allergy, 24(2), 186-207.

15. Kimple, A., & Ishman, S. (2013). Allergy and sleep-disordered breathing. Current Opinion of Otolaryngology Head Neck Surgery, 21(3), 277-281.

16. Li, L., Xu, Z., Jin, X., Yan, C., Jiang, F., Tong, S., et al. (2015). Sleep-disordered breathing and asthma: Evidence from a large multicentric epidemiological study in China. Respiratory Research, 16(1), 1-8.

17. Loekmanwidjaja, J., Carneiro, A. C., Nishinaka, M. L., Munhoes, D., Benezoli, G., Wandalsen, G., et al. (2018). Sleep disorders in children with moderate to severe persistent allergic rhinitis. Brazilian Journal of Otorhinolaryngology, 84(2), 178-184.

18. Mansfield, L., Díaz, G., Posey, C., & Flores-Neder, J. (2004). Sleep-disordered breathing and daytime quality of life in children with allergic rhinitis during treatment with intranasal budesonide. Annals of Allergy, Asthma and Immunology, 92(2), 240-244.

19. Marques, C. P. C., Bloise, R. F., Lopes, L. B. M., Godói, L. F., Souza, P. R. P., Rosa, I. M. S., et al. (2022). Epidemiologia da Asma no Brasil, no período de 2016 a 2020. Research, Society and Development, 11(8), e5211828825.

20. Maski, K., & Owens, J. (2018). Pediatric sleep disorders. Continuum (Minneap Minn), 24(1), 210-227.

21. Mindell, J., Kuhn, B., Lewin, D., Meltzer, L., & Sadeh, A. (2006). Behavioral treatment of bedtime problems and night wakings in infants and young children. Sleep, 29(10), 1263-1276.

22. Moreno, J. M. L., Salvador, A. O. M., & Bernal, M. G. O. (2019). Patología alérgica de vías respiratorias superiores. Protocolos Diagnósticos y Terapéuticos em Pediatria, 2, 133-148.

23. Nallu, S., Guerrero, G., Lewis-Croswell, J., & Wittine, L. (2019). Review of narcolepsy and other common sleep disorders in children. Advances in Pediatrics, 66, 147-159.

24. Nunes, M. L. (2002). Distúrbios do sono. Jornal de Pediatria (Rio J), 78(1), 1-10.

25. Oliveira, S., Sarria, E., Roncada, C., Stein, R., Pitrez, P., & Mattiello, R. (2016). Validation of the Brazilian version of the childhood asthma control test (c-ACT). Pediatric Pulmonology, 51(4), 358-363.

26. Owens, J. (2009). Neurocognitive and behavioral impact of sleep-disordered breathing in children. Pediatric Pulmonology, 44(5), 417-422.

Revista ARACÊ
ISSN: 2358-2472

27. Perikleous, E., Steiropoulos, P., Nena, E., Iordanidou, M., Tzouvelekis, A., Chatzimichael, A. (2018). Association of asthma and allergic rhinitis with sleep-disordered breathing in childhood. Frontiers in Pediatrics, 11(6), 1-7.

28. Reiter, J., Ramagopal, M., Gileles-Hillel, A., & Forno, E. (2022). Sleep disorders in children with asthma. Pediatric Pulmonology, 57(8), 1851-1859.

29. Rodrigues-Bastos, R. M., Campos, E. M. S., Ribeiro, L. C., Firmino, R. U. R., & Bustamante-Teixeira, M. T. (2013). Internações por condições sensíveis à atenção primária em município do sudeste do Brasil. Revista da Associação Médica Brasileira, 59(2), 20-27.

30. Roxo, J. P. F., Ponte, E. V., Ramos, D. C. B., Pimentel, L., Júnior, A. D. O., & Cruz, Á. C. (2010). Validação do Teste de Controle da Asma em português para uso no Brasil. Jornal Brasileiro de Pneumologia, 36(2), 159-166.

31. Sakano, E., Solé, D., Cruz, Á., Pastorino, A. C., Tamashiro, E., Sarinho, E., et al. (2017). IV Consenso Brasileiro sobre Rinites. Documento conjunto da Associação Brasileira de Alergia e Imunologia, Associação Brasileira de Otorrinolaringologia e Cirurgia Cérvico-Facial e Sociedade Brasileira de Pediatria. Available from https://www.sbp.com.br/fileadmin/user_upload/Consenso_Rinite_9_-27-11-2017_Final.pdf

32. Sánchez, T., Castro-Rodrigues, J., & Brockmann, P. (2016). Sleep-disordered breathing in children with asthma: A systematic review on the impact of treatment. Journal of Asthma & Allergy, 18(9), 83-91.

33. Sánchez, T., Rojas, C., Casals, M., Bennett, J. T., Gálvez, C., Betancur, C., et al. (2018). Trastornos respiratorios del sueño en niños escolares chilenos: Prevalencia y factores de riesgo. Revista Chilena de Pediatría, 89(6), 1-7.

34. Solé, D., Camelo-Nunes, I. C., Vana At, Y., Yamada, E., Werneck, F., Freitas, L. S., et al. (2004). Prevalence of rhinitis and related-symptoms in schoolchildren from different cities in Brazil. Allergologia Immunopathologia (Madr), 32, 7-12.

35. Solé, D., Wandalsen, G., Camelo-Nunes, I. C., Naspitz, C., & Isaac – Brazilian Group. (2006). Prevalence of symptoms of asthma, rhinitis, and atopic eczema among Brazilian children and adolescents identified by the International Study of Asthma and Allergies in Childhood (ISAAC) – Phase 3. Jornal de Pediatria (Rio J), 82(5), 341-346.