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Pathophysiological factors, benefits and recommendations in swimming for asthmatics

Fatores fisiopatológicos, benefícios e recomendações na natação para asmático

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ABSTRACT

Asthma is characterized by chronic inflammation of the airways that can be induced by contact with chemical products, cigarette smoke, dry and cold environments or intense exercise. Swimming is recommended for people with asthma because it is a sport that helps to improve lung function. The aim of this study was to analyze the benefits and recommendations for swimming in children diagnosed with asthma. The methodology adopted was a bibliographical review of articles published in PUBMED in the last five years. The results of the studies showed that at least 13 countries researched the relationship between asthma and swimming in this investigated period (Poland, Turkey, Japan, France, Belgium, Finland, Norway, USA, Sweden, Brazil, China, Nigeria and Italy). Research has shown that swimming is beneficial for asthmatics, among the advantages it can be mentioned the improvements for the practitioner: 1) conditions of the respiratory and cardiovascular system, 2) quality of life and psychosocial, 3) well-being, 4) physical resistance, 5) child growth and development, and 6) reduction in asthma symptoms and clinical picture. The recommendations for the practice of swimming for asthmatics were related to: 1) maintaining the adequate amount of water purification products (with chlorine), 2) avoiding places in the pool that have dry and cold environments, 3) managing the air quality in the pool area and waiting room, 4) adequately prescribe and monitor water exercise 5) avoid excessive submersion/diving. It can be concluded that swimming is a sport that provides the asthmatic with a decrease in symptoms and an improvement in the clinical picture, as there is a decrease in the intensity, duration and frequency of bronchospasm crises, improving respiratory capacity and strengthening the respiratory muscles, in addition to providing better motor, psychological and affective-social development. However, the possible contraindication of swimming for asthmatics may come from inadequate facilities, swimming pool, medication, prescription and class control. Thus, it is suggested that there is always periodic monitoring of students by physicians and teachers/professionals able to provide adequate prescriptions, in addition to monitoring external factors that may affect asthmatics.

Keywords: Swimming, Asthma, Chronic inflammation.

1 INTRODUCTION

Asthma is, according to the Aquatic Exercise Association, a lung disease that can be life threatening (AEA, 2008) characterized by chronic inflammation of the airways, which is associated with hyperresponsiveness of the airways, induced by the patient's contact with some allergens. (chemical products, cigarette smoke, dry and cold environments, gases and particles in the air, intense exercise, etc.).

The response to allergens triggers bronchoconstriction in the bronchioles, which compromises air passage through the airways/gas exchange in the alveoli because the smooth muscle, present in the bronchial wall, contracts; however, it can be reversible spontaneously or with treatment (STIRBULOV et al., 2006).

The diagnosis of the disease is carried out through the presence of the main symptoms: wheezing, dyspnea, chest tightness and cough, particularly at night or in the early morning, in addition to clinical tests (PIZZICHINI et al., 2020).

In children, the diagnosis is a little more complex, since at this stage of life they undergo a maturation of the immune system. According to Solé et al. (1998) in the presence of symptoms, it is important to carry out a detailed anamnesis with the family members, in addition to a careful evaluation of the respiratory function and laboratory evaluation for a better diagnosis.

For treatment, medications are used that vary according to the level of intensity of the inflammatory process in which the patient is, whether asthma is controlled or in a moment of crisis (STIRBULOV et al., 2006). But, in addition to the administration of medications, the practice of physical exercises is also indicated for the treatment of asthma.

According to Martins & Gonçalves (2016) the practice of physical activities with controlled intensity promotes a gain in physical conditioning and reduction of dyspnea, improving the quality of life and the psychosocial aspect of asthmatic individuals.

According to Jacques & Silva, 1997, the practice of physical exercise must be carried out in the intercrisis period, since the crisis prevention benefits occur exactly in this phase.

Swimming is a sport that must be practiced safely (VASCONCELLOS et al., 2022), often recommended for people with asthma because it is a sport that can contribute to improving lung function (KANIKOWSKA et al., 2018). The liquid medium provides the opening and conditioning of the airways, leading to an improvement in the respiratory system (PÄIVINEN et al., 2021), developing the strengthening of the locomotor system, the improvement of cardiovascular resistance and assists in the cognitive development of its practitioners.

According to research carried out in Belgium by Bernard (2010), the physical properties of water and the horizontal position of the body during swimming can also play an important role, as they change the respiratory route, generating less resistance of the airways to air when compared to other sports.

Thus, this work addresses the main benefits of swimming in children who have had some form of asthma in their lives. We sought to understand the best recommendations for properly prescribing the modality, such as duration and frequency of activity, temperature and chemical conditions of the water, the environment in which the pool is positioned (outdoor space or indoors).

In addition, the study addresses swimming as a "therapeutic" intervention in the treatment of asthma in children, taking into account not only the training prescription guidelines for this group of students, but also the physical and chemical conditions of the water so that the activity can be really beneficial to asthmatics, helping to reduce the use of medications to control crises.

The objectives of this study were: to analyze the recommendations for the practice of swimming in children diagnosed with asthma and the benefits provided by the practice of swimming; describe the pathophysiological factors that lead the individual to have asthma attacks; discuss asthma manifested during childhood and its main symptoms and diagnosis, its classifications according to the worsening of the patient's attacks and the forms of treatment.

2 RESEARCH METHODOLOGY

Bibliographic review of articles published in the last five years in the public access database of the United States National Library of Medicine (PUBMED) with the descriptors swimming and asthmatic written in English: swimming and asthmatic. 27 articles were found with full texts available, of which 20 were used that were directly related to the research. The countries where the surveys were carried out were (Poland, Turkey, Japan, France, Belgium, Finland, Norway, USA, Sweden, Brazil, China, Nigeria and Italy). In addition, health care books and articles that discussed asthma were examined to identify additional information.

3 ASTHMA PATHOLOGY

Asthma is a heterogeneous disease with a physiopathogenic characteristic (STIRBULOV et al. 2006), chronic bronchial inflammation of the airways (PIZZICHINI et al., 2020) resulting from a broad and complex spectrum of interactions between inflammatory cells, mediators and structural cells of the airways. airways (STIRBULOV et al., 2006). Another aspect that can be included in this definition, according to Silva (2008), are the anatomical and functional alterations

of the lower airway, collectively called bronchial remodeling, which are directly related to the prognosis of the disease.

The allergic inflammatory response is initiated by the interaction of environmental allergens with some cells whose function is to present them to the immune system, more specifically the Th2 lymphocytes. These, in turn, produce cytokines responsible for the initiation and maintenance of the inflammatory process (STIRBULOV et al., 2006). Inflammatory mediators are released by mast cells, macrophages, lymphocytes, eosinophils, epithelial cells and neutrophils (Table 1):

Table 1: inflammatory mediators

Cell	Inflammatory mediators
Mast cells	Histamine, leukotrienes, tryptase and prostaglandins.
Macrophages	Tumor necrosis factor alpha (TNFα), interleukin-6 (IL-6), nitric oxide.
T lymphocytes	Interleukins (IL-2, IL-3, IL-4, IL-5), granulocyte colony growth factor.
Eosinophils	Major basic protein, eosinophil cationic protein (ECP), eosinophil peroxidase (EPO), lipid mediators and cytokines.
Epithelial cells	Endothelin-1, lipid mediators, nitric oxide.
Neutrophils	Elastase.

Prepared by the authors adapted from: STIRBULOV et al. (2006); SILVA (2008).

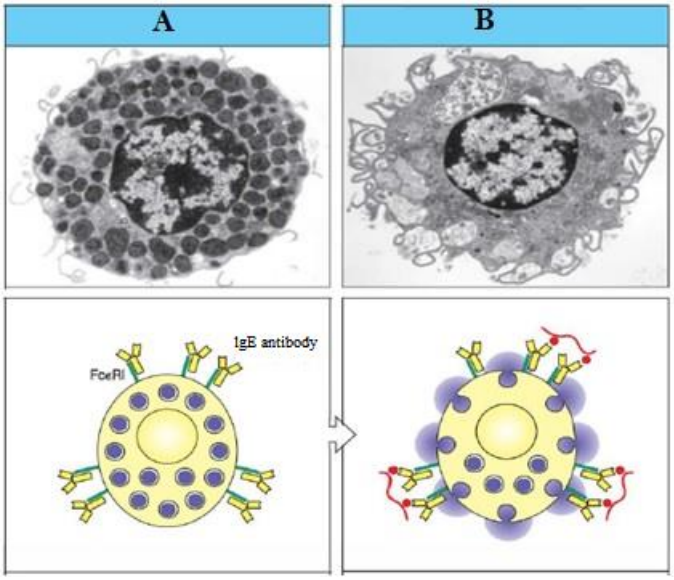
The activation of the inflammatory mediators, mentioned above, causes an injury and alteration in the epithelial integrity of the bronchioles, which causes an abnormality in the autonomic neural control and, consequently, an alteration in the air function, triggering a bronchoconstriction of the airways and an increase in the production of mucus in the pathway (STIRBULOV et al., 2006).

However, these inflammatory responses contribute to changes in vascular permeability, mucus hypersecretion, changes in mucociliary function and increased airway smooth muscle reactivity, making gas exchange and air passage difficult (KUMAR, 2001; STIRBULOV et al., 2006).

Mast cells are activated and in contact with IgE, they trigger autoimmune responses and activate the action of macrophages, eosinophils and helper T lymphocytes (Th2 type). T lymphocytes act through cytokines (IL-4, IL-5, IL-13, among others) involved in the coordination, amplification and perpetuation of the inflammatory response and by attracting additional inflammatory cells, such as dendritic cells. These inflammatory cells release multiple substances,

such as histamine, which act on the airway and promote bronchoconstriction, mucus secretion, plasma exudation and airway hyperresponsiveness (SOLÉ et al., 1998; SILVA, 2008).

Figure 1: Cross-linking of the IgE antibody on the mast cell surface leads to the rapid release of inflammatory mediators (resting mast cell A and activated mast cell B). Source: MURPHY, K., 2014, p-422.



As shown in figure 1: the mast cell at rest presents granules that contain histamine and other inflammatory mediators. In activated mast cells, multivalent antigens cross-link IgE antibodies, causing the granule contents to be released.

Figure 1 also shows how the allergic response occurs in atopic individuals, who have a genetically determined predisposition to produce large amounts of specific IgE antibodies for different allergenic factors that sensitize the immune system.

Therefore, cross-linking of IgE antibody molecules by the antigen triggers rapid degranulation, releasing inflammatory mediators into adjacent tissues. These mediators trigger localized inflammation, which recruits cells and proteins to the site of infection, which are necessary for host defense, thus characterizing an allergic reaction, when allergens bind to IgE on mast cells (Murphy, 2014).

Mast cells in the bronchial mucosa and submucosa lead to the activation and degranulation of these cells, which release preformed inflammatory mediators (already stored in their granules), such as histamine and platelet activator (PAF). The immediate effects of these substances are vasodilation and vascular extravasation, with consequent edema of the bronchial wall, hypersecretion of mucus and bronchoconstriction (SILVA, 2008). Another factor present in allergic diseases are the Th2 lymphocytes that produce a series of cytokines. Such substances

regulate the action of other cells. Table 2 highlights IL-4 and IL-13, which stimulate B lymphocytes to produce IgE against allergens, and IL-5, which contributes to eosinophilic inflammation (VAZ, 2011).

Table 2: T lymphocyte inflammatory mediators.

Inflammatory mediator	Função
Interleukin 13 (IL-13)	It acts analogously to IL-4, increasing the production of specific IgE by B lymphocytes differentiated into plasmocytes, both locally and at a distance.
Interleukin 4 (IL-4)	Increased production of specific IgE as well as expression of high- and low-affinity IgE receptors by many inflammatory cells, such as mast cells, basophils, and eosinophils.
Interleukin 5 (IL-5)	IL-5 is important in attracting, activating and increasing the survival of eosinophils, the main effector cell of tissue injury through the release of cationic proteins that attack the extracellular matrix and epithelial cells.

Source: SILVA (2008).

In addition to the changes in the pathway mentioned above, asthma can also present with an increase in submucosal glands, changes in the deposit and degradation of extracellular matrix components, functional changes in smooth muscle (hypertrophy and hyperplasia) and an increase in the number of goblet cells (STIRBULOV et al., 2006).

According to Silva (2008) some individual factors (genetic) are associated with the development of these inflammatory responses, which cause asthma attacks. According to Subbarao (2009) during childhood, some factors may contribute to the predisposition to asthmatic and allergic crises, such as: prenatal risk, including maternal smoking, diet, stress, use of antibiotics and type of delivery.

4 ASTHMA EPIDEMIOLOGY

In the 1990s, epidemiological data on asthma were limited, due to the lack of standardization of research, making it difficult to compare studies, thus creating the International Study of Asthma and Allergies in Childhood (ISAAC), where instruments were developed, techniques and protocols to assess the prevalence of asthma and other respiratory diseases in different parts of the world (BARRETO et al., 2014).

The ISAAC was designed to be carried out in three successive and dependent phases: a) first phase – compulsory central study designed to assess using standardized questionnaires; b) second phase – investigate possible etiological factors, particularly those suggested by the findings

of the first phase; and c) third phase – will be the repetition of the first after a period of three years (SOLÉ & NASPITZ ,1998).

Despite the creation of guidelines that try to seek the correct diagnosis of asthma and the advances in pathophysiology and its forms of treatment, the increase in the prevalence and mortality due to asthma in recent decades continues to be a cause for concern.

Many stressor components, such as environmental, nutritional, economic and psychological factors are investigated to understand the increase in the prevalence of asthma in recent decades. However, environmental factors are probably the main determinants of the recent growth in the prevalence of this disease (BARRETO et al., 2014).

The annual variation in the prevalence of asthma symptoms according to the ISAAC guidelines applied to different populations, showed an upward trend in the group of schoolchildren aged 6 to 7 years old in some regions of the world, which include India (+0, 06%), North America (+0.32%), Western Europe (+0.05%) and Eastern Mediterranean (+0.79%) (CHONG NETO et al., 2012).

Among 13- and 14-year-olds, the annual upward trend is evident in countries in Africa (+0.16%), Latin America (+0.32%), Northern Europe (+0.26%), Eastern Europe (+0.26%) and in India (+0.02%). On the other hand, there has been a trend towards stabilization or even a reduction in the prevalence of the disease in other regions, such as Oceania (-0.76%), especially in the group of adolescents (CHONG NETO et al., 2012). Among adolescents in Brazil, the prevalence of asthma symptoms was 20%, which is among the highest in the world (PIZZICHINI et al., 2020).

The study by Cardoso et al. (2017), which aimed to present official longitudinal data on the impact of asthma in Brazil between 2008 and 2013, analyzed the databases of the Department of Informatics of the Unified Health System (DATASUS). The results point to a reduction in the number of hospitalizations and costs in the analyzed years. Despite this reduction, hospitalization costs for asthmatic patients were still high, totaling US$21,490,888.95, mainly in the northeast and southeast regions of the country.

The main reasons or conditioning factors for these hospitalizations in asthma patients are unknown, but according to Amâncio & Nascimento (2012) the cause may be related to increased population growth and increased contamination through air pollution. In the Northeast region of Brazil, the increase in hospitalizations may be associated with the increase in temperature (climate) and lower latitude in the region (MEDEIROS et al., 2014).

When analyzing the prevalence between races in Brazil (Chart 1), it is noticed that the index is higher in brown individuals, with 185,071. Then, individuals without information

regarding race with 103,209 cases, white people with 93,073, black people with 10,169 cases, people considered yellow with 10,118 cases and the least affected race is indigenous people with 1,495 cases.

According to Marques et al. (2022), studies are lacking to describe the reason for prevalence in a given race in epidemiological studies.

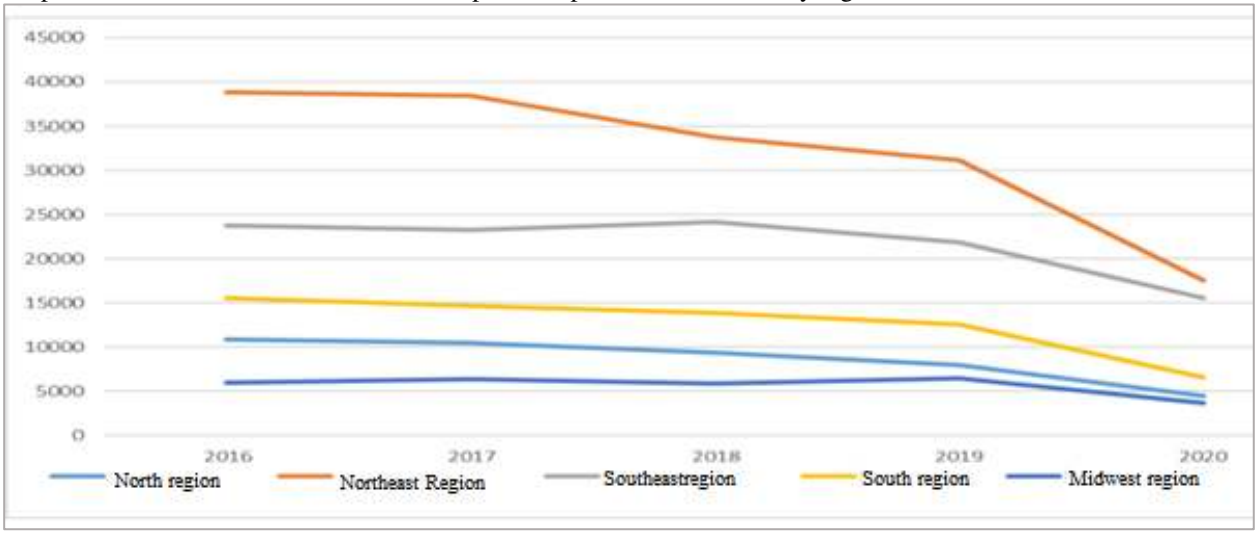
Table 1 - Distribution of hospitalizations for asthma in Brazil, according to gender, age group and race, from 2016 to 2020

Variables		Absolute value	Percentage	Mean	Standard deviation
Sex	Masculino	200676	49,78%	40.135,2	±9.620,23
	Feminino	202459	50,22%	40.491,8	±9.605,73
Age range	Menor 1 ano	31615	7%	6.323	±2.578,99
	1-4 anos	126094	31,28%	25.218,8	±7.232,57
	5-9 anos	76455	18,96%	15.291,0	±2.904,13
	10-14 anos	26340	6,533%	5.268,0	±1.041,82
	15-19 anos	12770	3,17%	2.554,0	±590,57
	20-29 anos	20340	5,045%	4.068,0	±614,81
	30-39 anos	19747	4,90%	3.949,4	±651,636
	40-49 anos	19200	4,76%	3.840,0	±717,21
	50-59 anos	20039	4,97%	4.007,8	±883,52
	60-69 anos	19074	4,73%	3.814,8	±933,13
	70-79 anos	17730	4,40%	3.546,0	±977,73
	80 anos e mais	13731	3,41%	2.746,2	±718,73
Race	Branca	93073	23,08%	18.614,6	±4.562,64
	Preta	10169	2,52%	2.033,8	±295,88
	Parda	185071	45,91%	37.014,2	±7.408,76
	Amarela	10118	2,51%	2.023,6	±523,28
	Indígena	1495	0,37%	299	±57,4
	Sem informação	103.209	25,60%	20.641,8	±6.836,03

Source: SUS Hospital Information System MARQUES et al. (2022)

In 2021, the Unified Health System (SUS) recorded 1.3 million visits to patients with asthma in Primary Health Care (BRASIL, 2021). According to Marques et al. (2022) the Northeast and Southeast regions of Brazil have a higher prevalence of hospitalizations due to asthma attacks (Graph 1), but over the years there has been a small reduction in cases.

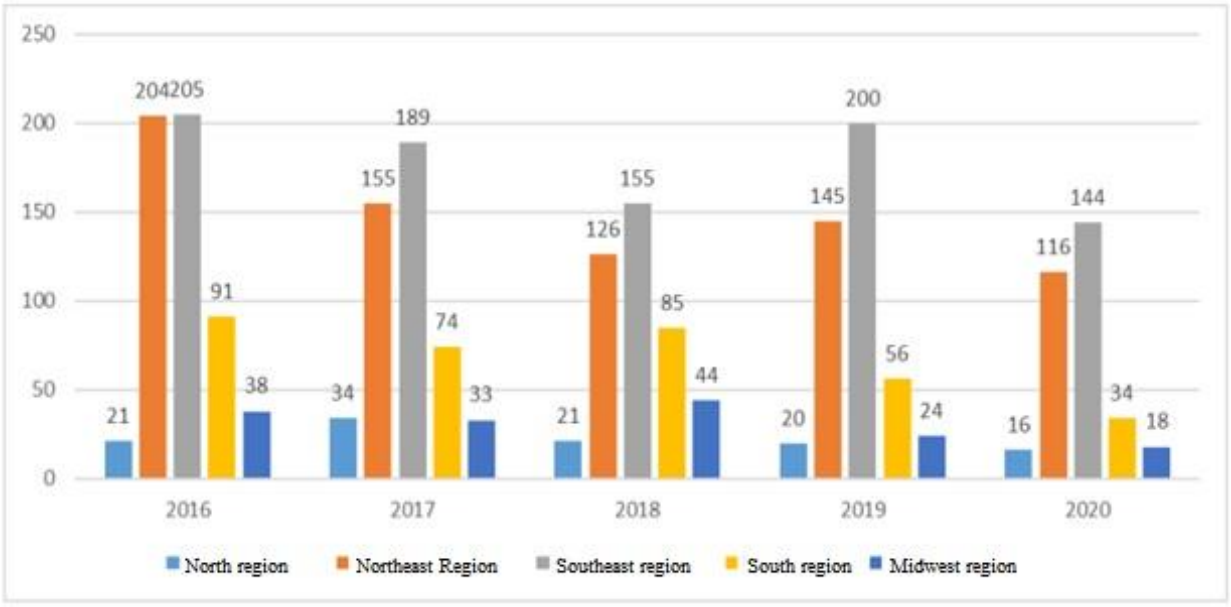
Graph 1 – Distribution of the number of hospitalized patients for asthma, by region, in Brazil, from 2016 to 2020.



*It is worth mentioning that the abrupt reduction in the graph, in 2020 in all regions, was due to the COVID-19 pandemic.
Source: SUS Hospital Information System MARQUES et al. (2022).

In Graph 2, it appears that the Southeast region, followed by the Northeast region, had the highest number of deaths:

Graph 2 - Deaths of people with asthma by region from 2016 to 2020.



Source: SUS Hospital Information System MARQUES et al. (2022).

Finally, it is worth mentioning the importance of public health policies to promote and improve the management of prevention, diagnosis, treatment and disease control measures, so that there is an effective reduction of these data in Brazil and worldwide.

5 ASTHMA DIAGNOSIS

Asthma is the most common chronic disease during childhood, which has several triggering factors that increase the severity of the disease, increasing the frequency of cases and hospitalizations in various parts of the world in recent years (SOLÉ et al., 1998).

The costs of treating the disease are high, the lesser the control and the greater the severity of the disease, the greater the expenses. The most severe cases of the disease consume almost a quarter of the family income of patients from the less favored class in our country (PIZZICHINI, et al. 2020).

In order for there to be a decrease in the number of hospitalizations due to asthma attacks, it is important to manage the correct medication after an early diagnosis, this requires a medical evaluation of the characteristic symptoms and the performance of tests such as spirometry, which is a method to determine the functioning lung and quantify airflow limitation in the lungs.

According to Pizzichini et al. (2020) early identification of possible factors that may contribute to the disease, such as exposure to allergens that aggravate the patient's condition, can help to alleviate the severity of the crisis. This identification is done with medical assistance that can be performed through anamnesis and/or skin tests.

The diagnosis of asthma is suggested by the presence of one or more symptoms, such as wheezing, shortness of breath (dyspnea), chest tightness/cough and variable limitation of expiratory airflow (PIZZICHINI et al., 2020).

Spirometry plays a central role in the diagnosis of many respiratory diseases, including asthma. It is used as a tool in the diagnostic evaluation of general respiratory symptoms or limitation to efforts, in the longitudinal evaluation of patients, in the classification of severity and evaluation of occupational capacity (TRINDADE et al., 2015).

According to the Brazilian Society of Pneumology and Phthisiology, some alterations are expressed by spirometry that determine the diagnosis of asthma:

a) airway obstruction characterized by a reduction in Forced Expiratory Volume in one second (FEV1) to below 80% of the predicted value and its relationship with forced vital capacity to below 75% in adults and 86% in children;

b) airflow obstruction, which disappears or significantly improves after the use of a bronchodilator (an increase in FEV1 of 7% in relation to the predicted value is 200 mL in absolute value, after inhalation of a short-acting beta2-agonist agent), emphasizing It is important to note that airflow limitation unresponsive to bronchodilators in an isolated test should not be interpreted as irreversible airway obstruction;

c) increases in FEV1 greater than 20% and exceeding 250 ml spontaneously over time or after intervention with controller medication (eg, prednisone 30 to 40 mg/day orally, for two weeks) (PIZZICHINI et al., 2020).

Some patients have other diseases in addition to asthma, requiring a differential diagnosis, particularly in children under five years of age and the elderly. Thus, some diseases presented below can be found together with asthma, such as: rhinosinusitis, chronic pulmonary disease of prematurity and congenital malformations, cystic fibrosis, bronchiectasis, postinfectious bronchiolitis obliterans, aspiration syndromes (gastroesophageal reflux, swallowing disorders, tracheoesophageal fistula and foreign body aspiration), tuberculosis, heart disease, diastolic and systolic heart failure, pulmonary circulation disease (hypertension and embolism) (PIZZICHINI et al., 2020).

Table 3: Asthma control assessment instruments

Instrument	Characteristics	Data provided and application
Asthma Control Questionnaire (ACQ)	It contains seven questions in total, of which five involve signs and symptoms, one refers to the use of rescue medication, and the last one scores the pre-bronchodilator value of FEV1 expressed as a percentage of predicted. The questions are objective, self-administered and self-explanatory, with six answered by the patient and the last one completed by the physician. Items are equally weighted, and the ACQ score is the average of the seven items; therefore, scores range from zero (well controlled asthma) to 6 (extremely poorly controlled asthma).	Provides reproducible data when the clinical status is stable and can be discriminated between patients with different levels of asthma control) It is applicable to all adults with asthma (17 ± 70 years old).
Asthma Control Test™ (ACT)	There are five questions that assess signs, symptoms and use of rescue medication in the last four weeks. Each question presents a response scale whose score varies between 1 and 5, resulting in a total test score between 5 and 25 points. The goal is to reach 25 points, which means complete control or clinical remission of asthma symptoms. A score between 20 and 24 points indicates adequate control, and a score below 20 means uncontrolled asthma.	Method that can be used in the long term. It is useful for monitoring asthma control over time because it generates a score that can be compared with other data.

Asthma Control Scoring System (ACSS)	This instrument is subdivided into three domains: clinical, physiological and inflammatory. The clinical domain consists of questions about the past week, addressing daytime and nighttime symptoms, use of β2-agonists, and activity limitation. Scorers are measured in percentages, yielding a total score of 0-100%. A score of 100% indicates complete asthma control, 80-99% indicates adequate control, 60-79% indicates poor control, 40-59% indicates very poor control, and a score of less than 40% is considered no asthma control.	It can be completed by the interviewer (a healthcare professional) and include the airway inflammation management component.

Source: JUNIPER et al. (1999); LEBLANC et al. (2007); (PIZZICHINI et al., 2020).

6 CLASSIFICATION AND TREATMENT OF ASTHMA

Asthma is classified according to the analysis of the frequency and intensity of symptoms, so asthma management has as a priority to control and reduce asthma attacks, so that the disease does not affect your daily activities. Some protocols help health professionals to identify and establish the best form of treatment to control crises. Among them are three asthma monitoring instruments (Table 3):

The disease is now classified according to the symptoms, the need for relief medication, the limitation of physical activities and the intensity of the airflow limitation, present in the last four weeks. In summary, the disease can be classified into three distinct groups: controlled asthma, partially controlled asthma and uncontrolled asthma.

Through age, anamnesis (protocols mentioned above) and clinical examinations, the medical team will be able to define the best form of treatment, medication and indication of physical activity as a prophylactic form.

According to the Global Initiative for Asthma (2022), for effective management and control of the disease, there must be an evaluation (diagnosis confirmation, control of symptoms and risk factors); adjust (pharmacological strategies and medication adjustment); review (laboratory tests, symptoms and exacerbations). In addition to environmental control and exposure to inflammatory factors.

Some factors that influence good responses to asthma treatment are: incorrect diagnosis; lack of adherence; use of drugs that may decrease response to treatment; household exposure (eg, dust or smoke); occupational exposure; smoking; and other comorbidities (PIZZICHINI et al., 2020).

The awareness of asthmatic patients and their families, especially when they are children, is essential so that the action plans prescribed by the medical team are followed and the worsening of the crises is avoided (PIZZICHINI et al., 2020).

In an attempt to publicize and disseminate the first national and international guidelines for asthma control, the Programs and Centers for Asthmatic Care (PCAAs) were created in Brazil at the end of the 1990s. With the evolution of public health policies and PCAAs in Brazil, in 1998, the national drug policy was created, which led to the distribution of drugs to control asthma (STELMACH et al., 2015).

In 2021 in Brazil, Ordinance No. 2,898 (2021) started to assure asthmatic patients the free withdrawal of medications necessary for the treatment of arterial hypertension, diabetes mellitus and/or asthma. A measure taken by the Ministry of Health to control chronic diseases in the country (BRASIL, 2021).

7 ASTHMA AND EXERCISE

In patients where the disease is controlled, either by using medication or by controlling the stressor components that can cause a crisis, physical exercise is recommended to improve the conditions of the respiratory system (VASCONCELLOS, 2021), improving the quality of life and psychosocial of asthmatic individuals (MARTINS & GONÇALVES, 2016).

According to Martins & Gonçalves (2016) adequate guidance regarding the volume, intensity and method of exercise should be taken into account, if the recommendations are not complied with, the patient may develop the process of exercise-induced bronchospasm (EIB). This picture occurs in people who are unaware of the pathology or by individuals who are submitted to vigorous exercises, mainly in places with low temperatures (LAITANO & MEYER, 2007).

Among the physical activities most indicated for patients with respiratory diseases is swimming, especially during childhood (EKSI et al., 2021). Swimming is a modality well accepted by patients due to its benefits (BEIJA et al., 2023), which provide well-being to the practitioner.

Physical exercise can help in the treatment of asthma, as a form of therapy, as it improves and strengthens the airways. According to Kanikowska et al. (2018), regular physical activity in asthmatic patients improves their general condition, especially their physical resistance and lung capacity parameters.

Health guidelines suggest practicing sports for anyone with a chronic disease, when it is controlled and by medical clearance. Regular practice helps people with these diseases to maintain a better quality of life (VERTADIER et al., 2022).

Asthmatics can do any type of physical exercise, as long as it is monitored by a qualified professional for the appropriate prescription. According to Chinese researchers Wu et al. (2020), continuous full-body aerobic exercises, such as swimming or treadmill training done at moderate intensity, at least 20 minutes and twice a week, are effective for promoting better results in the measurement of lung function and related quality of life to asthma.

However, the fear of possible symptoms after practicing any kind of physical activity makes children and adolescents not adhere to physical activity programs that would improve their physical conditioning and soon help to control symptoms (CORREIA et al., 2019).

In fact, when physical exercise is not monitored, it can lead the individual to have an Exercise-Induced Asthma (EIA) crisis. EIA is characterized by transient obstruction in the airways shortly after vigorous exercise, and its main symptoms are shortness of breath, dry cough, wheezing and low effort tolerance that can be observed in children and adolescents of different levels of physical conditioning. (LAITANO & MEYER, 2007).

8 ASTHMA AND SWIMMING

Swimming is a sports activity linked to aerobic effort, recommended for people of all age groups and indicated to start as soon as possible (VASCONCELLOS & MASSAUD, 2021). Turkish researchers claim that swimming training can be considered a reliable sport for children diagnosed with asthma (EKSI et al., 2021).

Polish researchers report that the positive effects of swimming come mainly from the involvement of all the muscles in the body, reducing the load on the joints, as well as from the functional improvement of both the heart and the lungs (KANIKOWSKA et al., 2018).

This improvement of the airways through swimming was also identified in an investigation carried out in Belgium, which helps to reinforce the idea of benefit (BERNARD, 2010).

Namely, during the practice of swimming training, water influences the pressure of the chest walls, helping expiration, as well as the retention of CO2 attributed to secondary hypoventilation, helping bronchial relaxation (BOUGALT & BOULET, 2013).

According to Päivinen et al. (2021), in a study carried out in Finland, swimming induces less respiratory symptoms of asthma than other modes of resistance exercise, such as running or cycling at the same exercise intensity. The possible explanation given by Polish researchers is that the humid and warm air breathed by people using the pool causes less occurrence of asthma exacerbation or exertional-related bronchial spasm (KANIKOWSKA et al., 2018).

In a study carried out in Japan with children aged 3 to 5 years, swimming benefited growth and development in the first years of life, however, it did not work as a therapeutic form or as a prophylactic measure against asthma (IRAHARA et al, 2020).

French researchers warn that, specifically in swimming athletes, there may be a greater risk of having asthma than those who practice other sports due to the hyperventilation necessary for long periods of time and/or the high environmental exposure to chlorine during the practice of the sport (VERTADIER et al., 2022).

Studies of the prevalence of asthma in Swedish swimmers have shown how self-reported asthma among competitive endurance athletes appears to be higher when compared to the general Swedish population. A large proportion of recreational athletes with asthma use ICS + LABA, seizure control drugs. Thus, training volume should be thoroughly researched in athletes with exercise-induced shortness of breath (NÄSMAN et al., 2018).

With a group of Italian swimmers, which aimed to determine the prevalence of respiratory symptoms (cough, chest tightness, breathing difficulties) and correlating the training prescription, it was observed in their results the prevalence of respiratory symptoms during or immediately after the training and that the worsening of cases occurred much more in winter, when compared to summer (ZACCARIN et al., 2022).

Researchers from Norway mention that some cases of asthma are related to swimming waiting room facilities and reinforce that stricter requirements should be implemented for pool management, as well as for air and water quality, as quality variation of water also leads to variation in air quality (NITTER & SYENDSEN, 2020).

Excess chlorine and its by-products may be responsible for the development of bronchial hyperreactivity, promote the development of allergies, and induce mucous membrane inflammation of the nose and eyes.

Perhaps for this reason, researchers from the USA and Nigeria mention that strict control of water quality is important, acting on the appropriate dosages of disinfectants, number of bathers, temperature and pH of the water to avoid inducing asthma attacks (MUSTAPHA et al., 2021) .

In a Swedish study on childhood asthma and trichloramine exposure, exposure to indoor, chlorinated swimming pools was found to increase the risk of preschool asthma, especially among younger children and those with an atopic predisposition (Andersson et al., 2018) .

Namely, swimming can negatively influence asthmatics if, in the classroom, the swimming pool has added chemical substrates to the water in an uncontrolled manner. According to Martins

& Gonçalves (2016) products such as chlorine or other by-products irritate the airways of swimmers and can contribute to asthma attacks after exercise.

In fact, anthropogenic substances introduced by swimmers such as sweat, saliva, lotions and urine when interacting with chlorine and other disinfectants can cause asthma (MUSTAPHA et al., 2021). Furthermore, there is still no product to treat pool water that is free of toxic by-products (KANIKOWSKA et al., 2018).

US researchers checked swimmers' level of blood concentrations of Trihalomethanes (THMs), a compound found in chlorinated pools, and observed that blood concentrations of THM decrease within minutes to hours after exposure. But it is believed that they are relatively stable due to the high frequency of activity, in addition to punctuating the aggravation of this substance when associated with exposure to tobacco smoke, making asthma attacks more frequent (SUN et al., 2022).

9 RECOMMENDATIONS FOR SWIMMING WITH ASTHMATICS

Swimming classes for asthmatic students bring physical, motor and physiological benefits to their practitioners. But, as the modality needs a physical structure, in question the swimming pool, it is recommended that there is a strict control of the quality of the water acting on the adequate dosage of disinfectants, number of bathers, temperature and pH of the water to avoid inducing asthma attacks (MUSTAPHA et al., 2021).

For swimming lessons in chlorinated pools, air circulation is crucial because it dissipates airborne toxic compounds. The use of the smallest effective amounts of disinfectant chlorine, careful washing of the body by people using the pool before swimming, and the use of swimming caps to limit the dissipation of organic compounds in the pool, are also important (KANIKOWSKA et al., 2018).

For the chemical substrates used for water purification, regular swimmers, whether asthmatic or not, can be recommended to avoid poorly managed pools, with excessive levels of chlorine in the water and in the environment (BERNARD, 2010). In addition, special attention should be given to children with asthma, as they seem to be more susceptible to bronchoconstrictor stimuli, such as exertion and cold, dry air (BUWALDA et al., 2020).

Pereira et al (2020), also state that it is necessary for the physical education teacher to know the disease at least, and through their study found that none of the evaluated teachers had the necessary knowledge to correctly include students in sports. Therefore, most were unaware of the triggering factors, symptoms and procedures to act in an asthma attack.

The prescription of the activity will also be a determining fator (VASCONCELLOS & VEIGA, 2022), so that the practice brings improvements and not the worsening of the clinical condition of asthmatics, as causing excessive diving should be avoided during swimming lessons (BUWALDA et al., 2020). On the other hand, there must be a pedagogical progression for the asthmatic to adapt to the liquid environment so that the practice of sports is beneficial (AEA, 2008).

10 CONCLUSION

Practicing swimming for asthmatics is beneficial, especially when the student has a controlled clinical condition and follows the medical recommendations and the physical education professional, however, it is necessary to take into account not only the motivational factors and the prescription of physical training (intensity and duration), the chemical conditions of the water and the environment, in which the child will be introduced to the practice, but above all the category of asthma that he/she is (controlled, partially controlled and not controlled).

The findings point to swimming as a sport that provides the asthmatic with a decrease in symptoms and an improvement in the clinical condition due to the decrease in the intensity, duration and frequency of bronchospasm crises, improving respiratory capacity and strengthening the respiratory muscles. In addition to providing better motor, psychological and affective-social development. However, water purification products (with chlorine), the location of the pool (dry and cold environments) and inadequate exercise prescription increase the likelihood of exercise-induced bronchoconstriction.

It is believed that more detailed studies that compare the benefits of swimming between different types of pools and water treatment may provide new answers about asthma and swimming.

REFERENCES

AEA. Aquatic Exercice Association. Manual do Fitness aquático. 5ª ed. Rio de Janeiro: Shape, 2008.

AMÂNCIO CT, NASCIMENTO LFC. Asma e poluentes ambientais: um estudo de séries temporais. Revista da Associação Médica Brasileira. 2012;58(1):302-307.

ANDERSSON M, BACKMAN H, NORDBERG G, HAGENBJORK A, HEDMAN L, ERIKSSON K, FORSBERG B, RONMARK E. Early life swimming pool exposure and asthma onset in children - a case-control study. Environ Health. 2018;11;17(1):34.

BARRETO ML, SILVA RCR, MALTA DC, CAMPOS MO, ANDREAZZI MA, Cruz AA. Prevalência de sintomas de asma entre escolares do Brasil: Pesquisa Nacional em Saúde do Escolar (PeNSE 2012). 2014;17(1):106-115.

BEIJA RS, NASSIF JV, CARVALHO NF, VASCONCELLOS MB. The effect of post-activation potentiation in the sprint in freestyle. International Seven Multidisciplinary Journal. 2023;2(2):38-49.

BERNARD A. Asthma and swimming: weighing the benefits and the risks. Jornal de pediatria. 2010;86(5):350-351.

BOUGALT V, BOULET LP. Airways Disorders and the swimming pool. Immunol Allergy Clin N Am. 2013; 33:395–408.

BRASIL. Ministério da Saúde. https://www.gov.br/saude/pt-br/assuntos/noticias/2022/maio/em-2021-sus-registrou-1-3-milhao-de-atendimentos-a-pacientes-com-asma-na-atencao-primaria-a-saude-1

BRASIL. Ministério da Saúde. Portaria GM/MS Nº 2.898, de 03 de novembro de 2021. <https://bvsms.saude.gov.br/bvs/saudelegis/gm/2021/prt2898_04_11_2021.html>.

BUWALDA M, QUERIDO AL, VAN HULST RA. Children and diving, a guideline. Diving Hyperb Med. 2020;50(4):399-404.

CARDOSO TA, RONCADA C, SILVA ER, PINTO LA, JONES MH, STEIN RT, PITREZ PM. The impact of asthma in Brazil: a longitudinal analysis of data from a Brazilian national database system. Jornal Brasileiro de Pneumologia. 2017;43(3):163-168.

CARVALHO RM, AARESTRUP FM. Processo inflamatório na asma e rinite alérgica. Revista Interdisciplinar de Estudos Experimentais-Animais e Humanos Interdisciplinary Journal of Experimental Studies. 2013;(5):22-27.

CHONG NETO HJ, ROSÁRIO NA, SOLÉ D. Asthma and rhinitis in South America: how different they are from other parts of the world. Allergy, asthma & immunology research. 2012;4;(2):62-67.

CORREIA MAV, LAIENNE ECC, BARROS CB, SOARES AA, SARINHO ESC, RIZZO JA, SARINHO SW. Nível de atividade física em adolescentes asmáticos: estudo transversal comparativo de base populacional. Revista paulista de pediatria, 2019;37(2):188-193.

EKSI N, CALIS ZAB, SEYHUN N, OZKARAFAKILI A, COSKUN BU. Evaluation of exercise-induced bronchoconstriction and rhinitis in adolescent elite swimmers. North Clin Istanb. 2021;8(5):493-499.

IRAHARA M, YAMAMOTO-HANADA K, YANG L, SAITO-ABE M, SATO M, INUZUKA Y, TOYOKUNI K, NISHIMURA K, ISHIKAWA F, MIYAJI Y, FUKUIE T, NARITA M, OHYA Y. Impact of swimming school attendance in 3-year-old children with wheeze and rhinitis at age 5 years: A prospective birth cohort study in Tokyo. PLoS One. 2020;15(6):e0234161.

JACQUES GP, SILVA, OJ. Influência da natação como coadjuvante terapêutico no tratamento de crianças asmáticas. Revista Brasileira de Medicina do Esporte. 1997;3(1):15-21.

KANIKOWSKA A, NAPIÓRKOWSKA-BARAN K, GRACZYK M, KUCHARSKI MA. Influence of chlorinated water on the development of allergic diseases - An overview. Ann Agric Environ Med. 2018; 20;25(4):651-655.

KUMAR RK. Understanding airway wall remodeling in asthma: a basis for improvements in therapy? Pharmacology & Therapeutics. 2001;91(2):93-104.

LAITANO O, MEYER F. Asma induzida pelo exercício: aspectos atuais e recomendações. Revista brasileira de medicina do esporte. 2007;13(1):1-4.

MARQUES CPC, BLOISE RF, LOPES LBM, GODÓI LF. Epidemiologia da Asma no Brasil, no período de 2016 a 2020. Research, Society and Development.2022;11(8):e5211828825-e5211828825.

MARTINS ICS, GONÇALVES A. Asma e exercício: ambiente seco versus aquático–uma breve revisão. Revista Brasileira de Pesquisa em Ciências da Saúde. 2016;3(2):10-14.

MEDEIROS ML. Solé D, Costa ADPV, Andrade ANVF, Nascimento EAO. Prevalência de asma e rinite entre adolescentes de 13-14 anos em uma capital do Nordeste, de acordo com o questionário do International Study of Asthma and Allergies in Childhood (ISAAC). Arquivos de Asma, Alergia e Imunologia. 2014;2(3):112-118.

MURPHY K. Imunobiologia de Janeway. Kenneth Murphy; tradução: Denise C. Machado, Gaby Renard, Lucien Peroni Gualdi; revisão técnica: Denise C. Machado. 8ª ed. Dados eletrônicos. Porto Alegre: Artmed, 2014.

MUSTAPHA S, Jimoh T, Ndamitso M; Abdulkareem AS, Taye SD, Mohammed AK, Amigun AT. The Occurrence of N-nitrosodimethylamine (NDMA) in Swimming Pools: Na Overview. Review. Environ Health Insights. 2021;1(15):11786302211036520.

NÄSMAN A, IREWALL T, HALLMAKER U, LINDBERG A, STENFORS N. Asthma and Asthma Medication Are Common among Recreational Athletes Participating in Endurance Sport Competitions. Can Respir J. 2018;21:3238546.

NITTER TB, SVENDSEN HKV. Covariation amongst pool management, trichloramine exposure and asthma for swimmers in Norway. Sci Total Environ. 2020;25;723:138070.

PÄIVINEN M, KESKINEN K, PUTUS T, KUJALA UM, KALLIOKOSKI P, TIKKANEN HO. Asthma, allergies and respiratory symptoms in different activity groups of swimmers exercising in swimming halls. BMC Sports Sci Med Rehabil. 2021;13(1):119-130.

PEREIRA A, SOUZA AC, CÔRREA P. Treinamento muscular respiratório no tratamento da asma brônquica. Revista Multidisciplinar do Nordeste Mineiro. 2021;3(1):67-81.

PITCHON RR, ALVIN CG, ANDRADE CR, LASMAR LMLBF, CRUZ AA, REIS AP. Mortalidade por asma em crianças e adolescentes no Brasil ao longo de 20 anos. Jornal de Pediatria. 2020;96(4):432-438.

PIZZICHINI MMM, PINTO RMC, CANÇADO JED, RUBIN AS et al. Recomendações para o manejo da asma da Sociedade Brasileira de Pneumologia e Tisiologia-2020. Jornal brasileiro de pneumologia. 2020;46(1):e20190307.

SILVA EC. Asma brônquica. Revista Hospital Universitário Pedro Ernesto. 2008;7(2):33-58.
SOLÉ D, NASPITZ CK. Epidemiologia da asma: estudo ISAAC (International Study of Asthma and Allergies in Childhood). Rev Bras Alergia Imunopatol.1998;21(2):38-45.

SOLÉ D, NUNESB IC, RIZZOC MC, NASPITZD CK. Asma na criança: classificação e tratamento. J Pediatra (Rio J). 1998; 74(1):48-58.

STELMACH R, NETO AC, FONSECA ACCF, PONTE EV, ALVES G, COSTA INA. Programas e centros de atenção à asmáticos no Brasil; uma oficina de trabalho: revisitando e explicitando conceitos. Jornal Brasileiro de Pneumologia. 2015;41(1):3-15.

STIRBULOV R, BERND LAG, SOLE D. IV Diretrizes brasileiras para o manejo da asma. Rev. bras. alerg. imunopatol. 2006;29(5):222-245.

SUBBARAO P, MANDHANE PJ, SEARS MR. Asthma: epidemiology, etiology and risk factors. Canadian Medical Association Journal. 2009;81(9):181-190.

SUN Y, XIA PF, XIE J, MUSTIELES V, ZHANG Y, WANG YX, MESSERLIAN C. Association of blood trihalomethane concentrations with asthma in US adolescents: nationally representative cross-sectional study. Eur Respir J. 2022;26;59(5):2101440.

TRINDADE AM; SOUSA TLF; ALBURQUEQUE ALP. A interpretação da espirometria na prática pneumológica: até onde podemos avançar com o uso dos seus parâmetros? Pulmão RJ. 2015; 24(1):3-7.

VASCONCELLOS MB & MASSAUD MG. What is the adequate number of students per class for safety in swimming lessons? Reflection by teachers from Rio de Janeiro, Brazil. Brazilian Journal of Development. 2022;8;(2):8417-31.

VASCONCELLOS MB, MACEDO FC, SILVA CCC, BLANT GO, SOBRAL IMS, VIANA LCA. Segurança aquática: teste de conhecimento preventivo de afogamento usado nas aulas de natação para prevenir o afogamento. Brazilian Journal of Health Review. 2022: 5(6):24304-24.

VASCONCELLOS MB, VEIGA GV. Prática de atividade física de escolares adolescentes e o apoio de pais amigos e professores de educação física. Brazilian Journal of Development, 2022;8(1):36647-60.

VASCONCELLOS MB. Swimming and hydroginastic classes during covid-19: use of a mask and/or face Shield protector. Revista Brazilian Journal of Development. 2021;7(1):103396-405.

VAZ M. Asma. Acta Farmacêutica Portuguesa. 2011;1(1):77-85.

VERTADIER N, TRZPIZUR W, FAURE S. Overuse of Short-Acting Beta-2 Agonists (SABAs) in Elite Athletes: Hypotheses to Explain It. Sports (Basel). 2022;10(3):36-45.

WU X, GAO S, LIAN Y. Effects of continuous aerobic exercise on lung function and quality of life with asthma: a systematic review and meta-analysis. J Thorac Dis. 2020;12(9):4781-4795.

ZACCARIN M, ZANNI S, GALLÉ F, ROTANO C, VALERIANI F, LIGUORI G, ROMANO SV, VITALI M. Studying Respiratory Symptoms Related to Swimming Pools Attendance in Young Athletes: The SPHeRA Study. Toxics. 2022;6;10(12):759.