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The complicated relationship between asthma and swimming

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ABSTRACT:

Introduction: Apart from pharmacological treatment, non-pharmacological strategies including physical activity play a significant role in the management of asthma. The aim of this paper is to examine various topics related to swimming and asthma. They include the detailed effect of swimming on asthma control,the potential role of swimming in early childhood asthma development, exercise induced asthma in swimmers as well as the relationship between asthma and cold water swimming.

Review methods: This article is based on the literature found in the PubMed Database from the period of 1971-2024 with the use of keywords such as “asthma”, “swimming”, “cold water swimming”, “exercise induced asthma”, “childhood asthma”

Description of the state of knowledge: Swimming is a safe form of physical activity for asthma patients.Swimming training enhances aerobic capacity, reduces exercise-induced bronchoconstriction and improves lung function in both pediatric and adult patients. However, there is a concern regarding indoor swimming pools that chlorine can potentially induce airway inflammation. There is research suggesting that early life swimming pool exposure may contribute to the asthma development in atopic children. There is some premise to the thought that cold water swimming may help alleviate asthma symptoms, but it also carries many risks.Swimming is a major cause of exercise induced asthma in professional athletes.

Conclusions: Alongside appropriate pharmacological treatment, swimming is a valuable strategy in asthma management in both pediatric and adult asthma patients. The risks of chlorinating pools are still not known to outweigh the benefits of swimming for asthmatics. Further research should be carried out on safety of early swimming in atopic children. Cold water swimming should also be evaluated in terms of safety and potential benefits for asthma patients.

Keywords: Asthma, swimming, cold water swimming, exercise induced asthma, childhood asthma

Introduction

Asthma is a common, chronic respiratory condition characterized by chronic airway inflammation resulting in its hyperreactivity and obstruction. It is manifested by wheezing, cough shortness of breath, chest tightness and expiratory airflow limitation. Described symptoms are not constant, they vary over time and are usually triggered by respiratory infections, allergens or strenuous exercise. [1]

According to the World Health Organisation (WHO), approximately 339 million people around the world suffer from asthma and the number is constantly growing. [2] An important characteristic of asthma is the fact that it greatly affects both adults and children, which creates a significant challenge for healthcare systems. Asthma-related costs in European countries are estimated to be approximately €19.3 billion annually, with a significant portion attributed to lost productivity .[3] Apart from economic aspects, asthma significantly impacts a patient's quality of life. Asthma can cause frequent absences from work or school, impacting productivity and educational outcomes. Emotionally, dealing with chronic symptoms and the fear of attacks can cause anxiety and stress. Socially, limitations on activities can lead to a sense of isolation and frustration. [4] Therefore, it is crucial to manage symptoms of asthma effectively.

Nowadays, asthma can be well controlled with pharmacological management that involves various medications tailored to minimize symptoms and prevent exacerbations. Key drugs

include Inhaled Corticosteroids (ICS), Long-Acting Beta Agonists (LABAs) and Short-Acting Beta Agonists (SABAs). Most common are combination inhalers containing both ICS and LABAs used as Maintenance and Reliever Therapy (MART). Severe asthma can be managed with oral corticosteroids and biological therapy. Treatment guidelines both for children and adults are created and regularly updated by Global Initiative for Asthma (GINA).

Apart from pharmacological treatment, non-pharmacological strategies play a significant role in the management of asthma. They include cessation of smoking, avoidance of irritants and allergens as well as physical activity. Regular physical activity can improve lung function, slightly reduce symptoms, and enhance overall physical fitness.[5,6] One of the preferred forms of exercise in asthma patients is swimming with a great number of research papers evaluating its positive impact on disease activity in children and adults.[1] However swimming is generally known for its positive effects on asthma patients, the relationship of this sport with this disease is not that simple as there is a significant number of papers regarding possible connection with early exposure to swimming and later asthma development as well as increased prevalence of asthma and bronchial hyperresponsiveness in professional swimmers.

The purpose of this paper is to examine various topics related to swimming and asthma. They include the detailed effect of swimming on asthma control in both pediatric and adult patients,the potential role of swimming in early childhood on the future development of asthma, exercise induced asthma in swimmers as well as the relationship between asthma and recently extremely popular cold water swimming.

The effect of swimming on pediatric asthma patients

Asthma is the most common chronic illness in children therefore it is essential to develop effective strategies to minimize disease's detrimental effect on the quality of life of pediatric patients. As their symptoms can be triggered by exercise, they tend to be excluded from the activities that are normal for their peers. However, if their disease is effectively controlled with the medications, activities such as swimming are safe, can improve physical endurance and minimize symptoms in the pediatric population. [7]

The reasons why swimming may be beneficial form of activity for asthmatic children include the warmer and humidified air above the pool, low exposure to pollen, hydrostatic pressure on the chest wall reducing expiratory effort, relative hypoventilation due to controlled breathing that increases carbon dioxide levels. [7,8,9]

According to the review that included 8 randomized controlled trials, swimming training significantly increased exercise capacity compared to usual care, with participants showing improvements in maximal oxygen consumption (VO2 max). Swimming was well-tolerated and there was no evidence that swimming training adversely affected asthma control or increased the occurrence of asthma exacerbations. Unfortunately, the studies included in this paper did not show significant effects on the quality of life, overall asthma control, or the frequency of asthma exacerbations compared to other forms of physical activity or usual care. [7]

The meta-analysis focused on the effectiveness of swimming on lung function was also performed. It showed a statistically significant small effect on forced expiratory volume in one second (FEV 1) (L) and large effect on forced vital capacity(FVC) (%) , but not for forced expiratory volume in one second (FEV 1) % and peak expiratory flow (PEF). Moreover, this review also did not observe any adverse effects of swimming on asthmatic children suggesting that it is a safe form of physical activity for these patients. [10] Another study conducted on effects of swimming training on aerobic capacity and exercise induced bronchoconstriction in children with bronchial asthma showed a decrease in both the frequency and severity of exercise-induced bronchoconstriction after training. This indicates that regular swimming can aid in managing asthma symptoms triggered by physical activity. Overall, the study supports the idea that swimming is a beneficial exercise for children with asthma, enhancing their aerobic capacity and reducing exercise-induced bronchoconstriction. [11]

Despite all described benefits of swimming in the asthmatic children there are some concerns regarding swimming that have been raised. The main one relates to the potential pro-asthmatic effects of chlorine commonly used as a disinfectant in swimming pools. Chlorine may be problematic for individuals with asthma due to its irritant properties, potential to induce airway inflammation, increase mucus production, structural changes in the airway and overall sensitivity of asthmatic airways to such irritants. [12,13,14] However, there is not enough research suggesting that potential harmful chlorine properties outweigh overall swimming benefits.

Early life swimming and asthma onset in children

Alongside evaluating the effect of swimming on already sick patients, a noticeable amount of research was also carried regarding the connection between swimming at a young age and

asthma development. Swedish studies found a positive association between early life swimming pool exposure and the onset of asthma in children, especially in children with atopic history. [15,16] Children who were exposed to indoor swimming pools before the age of 2 had a higher risk of developing asthma compared to those who were not exposed. The article highlighted that exposure to indoor chlorinated swimming pools specifically, rather than outdoor pools or other water sources, was associated with the increased risk of asthma onset especially in sensitized (atopic) children. Potential mechanisms underlying this association were discussed such as exposure to disinfection byproducts (DBPs) like chloramines and other chemicals used in indoor pool maintenance. Moreover, a Portuguese cross-sectional study found that children with swimming pool exposure had increased airway reactivity to a beta-2 agonist. [17] This suggests heightened sensitivity of the airways, potentially indicating increased susceptibility to asthma-like symptoms or respiratory issues.

However, the meta-analysis with 5851 subjects did not find a notable discrepancy in asthma occurrence between children who attended swimming pools and those in the control groups. According to this meta-analysis, swimming during childhood does not raise the chances of being diagnosed with asthma by a doctor, as well as, the connection between the disease and attending indoor pools remains uncertain. [18]

Additionally, even one new Japanese prospective birth cohort study analyzed a group of 3-year-olds with wheeze and rhinitis and showed that swimming school attendance at a young age of 3 years may be associated with a reduced risk of wheeze at the age of 5 in this specific group of children, highlighting the potential benefits of early swimming lessons for respiratory health. [19]

Taking all of the above into consideration, further extensive research on this subject should be performed as the connection between early swimming exposure and asthma development in the future still remains unclear.

The effect of swimming on adult patients

Swimming is one of the most common forms of physical activity that does not require expensive and specialized equipment, while having a positive effect on, for example, physical strength or lipid metabolism [20]. Over the years, it has been recommended for people of all ages, including asthmatics, due to its potential benefits and low likelihood of triggering or exacerbating symptoms. While the mechanisms of the protective effect of swimming on

asthma are not fully understood, there is experimental evidence indicating a positive effect of high humidity at water level, which allows a reduction in the amount of heat lost through the airways, this probably also has an effect on the osmolarity of airway mucus. [21] According to the study that aimed to evaluate the effect of recreational swimming on lung function and bronchial hyperresponsiveness (BHR) in patients with asthma, participation in recreational swimming in non-chlorinated pools by patients with mild persistent asthma combined with regular medical treatment and education, leads to a better improvement in their lung function parameters and also to a greater reduction in their airway hyperresponsiveness compared to patients only with pharmacological treatment [22] Although the prevalence of respiratory symptoms such as wheezing, shortness of breath, coughing and mucous production in the airways is reported to be higher in competitive swimmers than in the general population[23,24], this form of physical activity causes fewer respiratory problems than other endurance sports such as running or cycling at the same intensity [25,26]. The occurrence of respiratory symptoms is also influenced by the regularity and frequency of exercise. One study on swimmers found that competitive swimmers reported significantly more respiratory symptoms during swimming than fitness and occasional swimmers, and the highest risk of reported symptoms was observed in competitive swimmers with a history of asthma and allergies.[27] However, the effect of aquatic exercise on pulmonary function and quality of life in asthma patients is still uncertain. [28]

Cold water swimming

While there is very little literature on the effects of open water swimming on asthma, there is growing evidence of other health benefits, including improved immune function, its anti-inflammatory effects and positive effects on mental health.[29] These include benefits in both the micro-environment of the body's cells and benefits in social functioning, which may improve the lives of asthmatics. Cold water swimming is becoming more popular every year. Such a claim is confirmed by the case of a 49-year-old female patient with asthma present since her teenage years, who suffered from the seasonal presence of coughing, wheezing, shortness of breath in the fall. [30] Her symptoms worsened after exercise and during cold weather. Her treatment included salbutamol and beclamethasone. She started regular open water swimming in the sea minimally once a week. During the next winter season she admitted her asthma was less problematic. This may be surprising, as cold air was usually seen as an asthma trigger. The patient's story was presented on youtube.com, where more

than 100 swimmers reported in the comments that this form of activity also resulted in an improvement in asthma symptom control, none of whom had started this activity for the aforementioned improvement. Unfortunately, cold water swimming can also be a risk for asthmatics. The most common is hypothermia [31,32] and exercise can predispose a person to greater heat loss and a greater drop in core body temperature when subsequently exposed to cold air.[33] Cold water immersion can also lead to cardiovascular disorders in the form of arrhythmias, due to disruption of the autonomic system. [34] Moreover, the literature shows that there is a connection between cold water temperature and the occurrence of pulmonary edema (SIPE) [35,36].

Furthermore, cold water immersion is a major stress for the body, which is associated with increased cortisol concentrations and the release of cytokines[37], higher concentrations of which are also recorded in asthma.[38] Taking into account all of the above, every asthma patient who would like to try cold water swimming should discuss it with their doctor. Moreover, further extensive research into the potential benefits of this physical activity for asthmatics should be carried out.

Exercise-induced asthma

The first reports of an increased prevalence of asthma and bronchial hyperresponsiveness (BHR) in elite athletes appeared more than 30 years ago, first in swimmers and then in cross-country skiers. [39] Symptoms can imitate those in asthma, including shortness of breath, coughing and wheezing airway narrowing, hyperresponsiveness, and inflammation. The exact causes of exercise-induced bronchospasm are uncertain, but are probably related to mechanical stress and airway desiccation, leading to increased osmolarity of the fluid lining the airways and release of mediators from immune cells (e.g. histamine, prostaglandins), which cause airway smooth muscle contraction and bronchoconstriction.[40] A higher incidence of this condition is observed in endurance sports, due to the higher respiratory load. Their occurrence is also influenced by external factors such as pollutants or allergens, as it has been observed that they occur more frequently in swimmers (who are exposed to the aforementioned chlorine compounds) than in boxers despite the same number of training hours[41]. When it comes to treatment, it is crucial for athletes not only to improve performance, but also to counter epithelial damage and fibrosis. In athletes with asthma, the incidence and severity of exercise-induced bronchoconstriction (EIB) are considered part of general asthma management and differ with non-asthmatics with EIB. Treatment generally

follows the same international guidelines published by the Global Initiative for Asthma (GINA), including inhaled corticosteroids and long-acting beta2-agonists in the first step. Nonpharmacologic strategies like pre-exercise warm up or using heat and moisture exchanger face masks are also highly recommended.[42]

Conclusion

The review synthesizes current research to provide a comprehensive understanding of how different swimming practices can influence asthma outcomes, emphasizing the need for individualized assessment and tailored recommendations for asthmatics engaging in swimming activities. Alongside appropriate pharmacological treatment, swimming is a valuable strategy in asthma management in both pediatric and adult asthma patients. The risks of chlorinating pools are still not known to outweigh the benefits of swimming for asthmatics. Further research should be carried out on safety of early swimming in atopic children. Cold water swimming should also be evaluated in terms of safety and potential benefits for asthma patients.

Author's contribution:

Conceptualization: KC and KB; methodology: AK; software: OS; check, EO, AMK, JJ and OŁ; formal analysis EW; investigation KC; resources OŁ, EO, AK; data curation KC, KS, AMK, KB, OŁ, JJ, EO, EW, OS, AK; writing - rough preparation, KS, EW, KC, KB; writing - review and editing KB, KC, EW, EO, OŁ, JJ, OS, KS, AMK, AK; visualization, EW and AMK; supervision, KB and KC; project administration, KB, KC, OS, JJ;
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