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Prevalence of exercise-induced bronchoconstriction in younger swimmers' asthmatics and non-asthmatics in a 200 meters front crawl swimming

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ABSTRACT
Background: Exercise-induced bronchospasm (EIB) present a very high prevalence among asthmatics and an increased prevalence in athletes, particularly swimmers. EIB prevalence is even higher in children. However, whether a swimming competition of 200 meters front crawl could lead to EIB in preadolescents and adolescent's asthmatic and non-asthmatic is unknown. **Objectives**: Test whether a swimming competition of 200 meters front crawl could lead or detect EIB in preadolescents and adolescent's asthmatic and non-asthmatic. **Methods**: Nineteen preadolescents and adolescents agreed to participate in the study, which occurred during the swimming championship of the state of Goiás. Lung function was evaluated by spirometry (FVC, FEV1, FEV1/FVC, FEF25-75%) using the Koko PFT spirometer, before and after the 200 meters front crawl. **Results**: The results demonstrated that for male and females, independent if there were asthmatics or not, did not present any signal of EIB or even any alteration in the lung function parameters, such as FVC, FEV1, FEV1/FVC, and FEF25-75%. **Conclusions**: The 200 meters front crawl, which is performed in around 2,3 minutes, did not result in exercise-induced bronchospasm in asthmatic and non-asthmatic preadolescents and adolescents.
Keywords: Exercise-induced bronchospasm; Lung function; Swimming; Airway obstruction.

BACKGROUND

Exercise-induced bronchoconstriction (EIB) is a common and highly specific characteristic of pediatric asthma and should be properly diagnosed using the exercise challenge test (ECT)(1). EIB negatively impacts several aspects of daily lives of asthmatic children's, such as physical(2) and psychosocial(3) aspects. Exercise, and specially exercise intensity and duration, are the most common triggers of EIB, while the level of physical preconditioning seems to have an impact on the prevalence and severity of EIB(4). On the other side, asthmatic children present increased school absenteeism, beyond to reduced participation in the classes of physical education due to EIB(5).

Regarding the classification of severity of EIB, a consensus state that a decrease in FEV1 smaller than 10% after sub-maximal or maximal exercise means a negative result for EIB, while reductions ≥10% but ≤25% represent a mild EIB, ≥25% but ≤50% moderate EIB and ≥50% severe EIB for steroid-naïve patients and ≥30% for steroid-treated patients(6). The duration of EIB symptoms endures, in general, among 5 – 20 minutes(1, 6). The main symptoms of EIB are shortness of breath, wheezing, decreased endurance, tightness in the chest, cough, upset stomach, and sore throat(1).

In addition, chlorine exposure when swimming, pollution during running or cycling, cold air exposure, dry air while ice skating exposure or playing hockey, air temperature during hot yoga, have been described as important triggers of EIB(7). Furthermore, age of children and adolescents also seems to influence EIB prevalence and intensity(8). Thus, an early diagnosis of EIB, a phenomena that might be asymptomatic especially for mild EIB severity, would help for an earlier and better treatment, which may help to avoid the exclusion of children and adolescents in practice sports.

Therefore, the present study aimed to investigate the prevalence of EIB after a maximal effort performed during a stage of the swimming championship of the state of Goiás, Brazil.

METHODS

All procedures were approved by the ethical committee of University Brazil, under registration number 3.066.009, and were performed according to the Declaration of Helsinki. All volunteers and their legal representant signed to the free consent term.

Volunteers Recruitment and Selection

All volunteers were recruited and selected during the 1st stage of the swimming championship (200 meters front crawl swimming) of the State of Goiás, Brazil, in the month of April of 2022. They had among 7 and 17 years old, from both genders and presented a minimum period of practice of swimming of 5 years.

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The characteristics of the volunteers are presented into the table 1. The volunteers were asked about the previous medical diagnostic of asthma and medication in use and then, the volunteers were distributed into asthmatic group and non-asthmatic group.

Table 1. Characterization of the volunteers

	Age	**Weight (Kg)**	**Height (m)**	**BMI (Kg/m^2)**	**Time of Swimming (years)**	**Asthmatic**	**Non-asthmatic**
Male (n=12)	13.91±2.36	59.41±13.27	1.68±0.12	20.63±2.78	8.16±3.91	7	5
Female (n=7)	15±1.85	51.57±7.97	1.62±0.05	19.43±2.44	8.71±2.96	5	2
Total (n = 19)	14.31±2.24	56.52±12.21	1.66±0.1	20.19±2.72	8.36±3.6	12	7

Lung Function Evaluation

The lung function was evaluated by spirometry, using the Koko™ pulmonary function test system according to the American Thoracic Society (ATS) and European Respiratory Society (ERS) joint standardization (9). The evaluated parameters were forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), tiffeneau index (FEV1/FVC), forced expiratory flow 25-75 (FEF25-75).

The reference values used were based on the study from Pereira et al[10]. The spirometry was performed before and after a maximum exercise effort, which was performed by a 200 meters free style swimming competition in a 25 meters pool. So, the average time for this test among the participants were 2 minutes and 27 seconds.

Statistical Analysis

The software GraphPad Prism 5.0 was used to perform the statistical analysis and to build the graphs. The distribution of the data was performed using the Pearson's' test. Paired T Test was used to compare the pre- and post-effects of a swimming competition into asthmatic and non-asthmatic groups. An additional analysis was also performed distributing the volunteers by gender, male and female. A p<0.05 was considered statistically significant.

RESULTS

Effects of Maximum Swimming Sprint on Forced Vital Capacity (FVC)

The results demonstrated in the Figure 1 shows that no differences were found comparing FVC among pre and post swimming sprint in asthmatic and non-asthmatic pre-adolescents and adolescents (p>0.05).

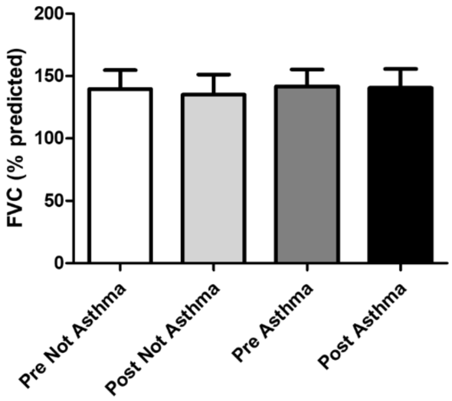

Figure 1. Describes the FVC in pre and post swimming sprint of asthmatic and non-asthmatic preadolescents and adolescents.

Effects of Maximum Swimming Sprint on Forced Expiratory Volume in First Second (FEV1)

The results demonstrated in the Figure 2 shows that no differences were found comparing FEV1 among pre and post swimming sprint in asthmatic and non-asthmatic pre-adolescents and adolescents (p>0.05).

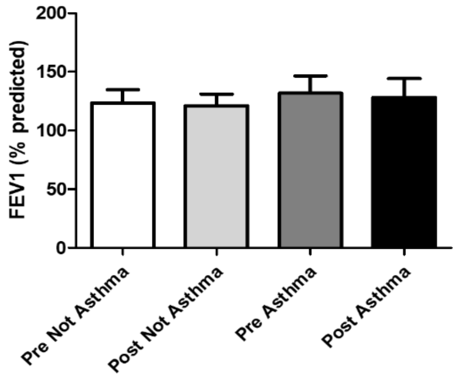

Figure 2. Describes the FEV1 in pre and post swimming sprint of asthmatic and non-asthmatic preadolescents and adolescents.

Effects of Maximum Swimming Sprint on the Relation of Forced Expiratory Volume in First Second (FEV1) / Forced Vital Capacity (FVC)

The results demonstrated in the Figure 3 shows that no differences were found comparing FEV1/FVC among pre and post swimming sprint in asthmatic and non-asthmatic pre-adolescents and adolescents (p>0.05).

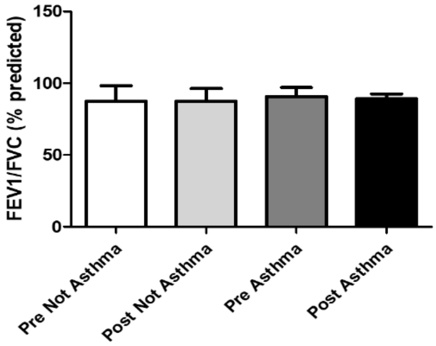

Figure 3. Describes the FEV1/FVC in pre and post swimming sprint of asthmatic and non-asthmatic preadolescents and adolescents.

Effects of Maximum Swimming Sprint on the Relation of Forced Expiratory Flow 25-75% (FEF25-75%)

The results demonstrated in the Figure 4 shows that no differences were found comparing FEV1/FVC among pre and post swimming sprint in asthmatic and non-asthmatic pre-adolescents and adolescents (p>0.05).

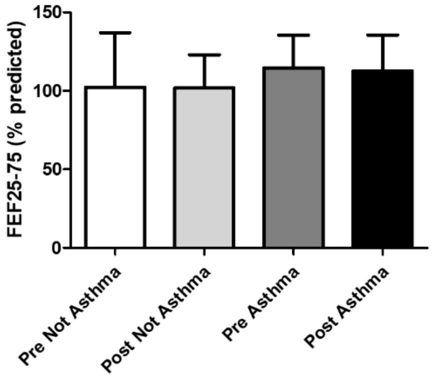

Figure 4. Describes the FEF25-75% in pre and post swimming sprint of asthmatic and non-asthmatic preadolescents and adolescents.

DISCUSSION

The present study demonstrated that experienced (minimum of 5 years) swimmer's preadolescents and adolescents with and without asthma, did not present exercise-induced bronchospasm (EIB).

The rate of asthma symptoms, such as wheezing, breathlessness and bronchospasm, especially during efforts, are largely common among sportsmen, particularly among swimmers, rating between 4% to 15%(11). In particular, in athletes, EIB have been reported more than 50 years ago(12).

Considering the classification and symptoms of EIB, is currently observed that individuals possessing between 10%-25% of reduction in FEV1, classified as mild EIB, in an EIB test, normally did not present EIB symptoms. So, especially for sportsmen aiming to improve their performance, an EIB test should be mandatory, due to its asymptomatic manifestation in a high rate of individuals, which can seriously compromise the performance development.

Furthermore, EIB manifestations, especially in asthmatic population is still high, compared to non-asthmatics and should be evaluated with special care(13). In the present study, however, no one of the 19 preadolescents and adolescents, asthmatic and non-asthmatic evaluated presented EIB during an official swimming competition. This is worthy of note, because according to the literature, the rate of EIB prevalence among swimmers are normally higher in comparison to other sports modalities(14).

Another aggravating factor for EIB development and severity is the presence of asthma, especially in children(1). Thus, asthmatic children presented reduced exercise tolerance, which is related to the degree of resting airflow obstruction, ventilatory capacity, perceived dyspnea, and with exercise-induced bronchoconstriction (EIB)(2). Herein, the present study did not find the presence of any degree of EIB comparing asthmatic children with non-asthmatic children.

This is contrary to the current literature and perhaps could be explained, at least partially, by a big adaptation of the respiratory system, inhibiting the development of EIB. Of note, the VFC, FEV1 and FEF25-75% of the volunteers revealed a high value, corresponding to more than >50% of the predicted value, which can be explained for a long period of aerobic training. In addition, whether such increased lung function could attenuate the manifestations of EIB still needs to be clearly determined. On the other hand, there is no enough evidence demonstrating whether regular physical training could inhibits the frequency and the severity of EIB in preadolescents and adolescents asthmatics(15).

Another important discussion for the obtained results, are the fact that all swimmers were tested before and after a 200 meters front crawl swimming, a test that endured in average for this specific population in 2 minutes and 27 seconds. So, this was a different situation, in comparison to the gold standard protocols for evaluation of the EIB, which preconizes a duration between 6 to maximum 8 minutes.

Therefore, at least, we can affirm that this "short" swimming test, are not a predictor or a trigger for EIB in asthmatic and non-asthmatic swimmers' children. Thus, further studies are needed to determine whether this population negative for EIB using a short-term swimming test may be positive for EIB when submitted to a gold standard EIB test.

CONCLUSIONS

The present study did not observe any significant incidence of exercise-induced bronchospasm in well trained swimmer's pre-adolescent and adolescent, independently if they were asthmatics or not, as evidenced by no reduction in FEV1 or in FEF25-75% in a spirometry lung function test.

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Authors' contribution: AGS and RPV contributed to the elaboration of the design of the study; AGS, GLS, APSBO, AKRT, RABLM, IOS, RPV development of the study and data acquisition. AGS, GLS, APSBO, AKRT, RABLM, IOS, RPV contributed to article design and data tabulation. AGS, GLS, APSBO, AKRT, RABLM, IOS, RPV contributed to the critical review, correction and approval of the final version.

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Conflict of interest: the authors declare that they have no conflict of interest

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