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Effect of the external nasal dilator on adolescent athletes with and without allergic rhinitis

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ABSTRACT

Objectives: The ability to effectively breathe through the nose is an important component of physical exercise. The goal of this study is to evaluate the effect of the external nasal dilator (END) on healthy adolescent athletes and those with allergic rhinitis.
Methods: Clinical trial, double-blind, crossover, in which we evaluated healthy adolescent athletes with allergic rhinitis, using experimental and placebo ENDs, submitted to a maximum cardio-respiratory test in randomized order. Predicted values for peak nasal inspiratory flow (PNIF%) and nasal resistance (NR) were obtained, and the rating of perceived exertion (RPE) was also assessed after the race test.
Results: 65 adolescents participated in the study, 30 of whom had allergic rhinitis. The use of experimental ENDs demonstrated a statistically significant improvement in peak nasal inspiratory flow values (predicted %), nasal resistance, maximal oxygen uptake value (VO_2Max.) and rating of perceived exertion, both in the healthy group and the one with allergic rhinitis.
Conclusion: Results suggested that END reduces nasal resistance, improves maximal oxygen uptake and rating of perceived exertion after a maximum cardio-respiratory test on healthy adolescents and those with allergic rhinitis.

1. Introduction

In recent decades, the prevalence of allergic diseases has increased worldwide, affecting approximately 30% of the population [1,2]. Allergic rhinitis is common in elite athletes and leaving it untreated can negatively impact recovery and performance [3–6]. Identifying allergic rhinitis in adolescent athletes is a challenge for coaches.

Of The World Anti-Doping Agency (WADA) [7], emphasizes two principles that must be taken into consideration when prescribing medicine for the treatment of allergic rhinitis in athletes: the prescribed medicine must not be prohibited in competition (on the doping list) and cannot have an adverse effect on sporting performance. Therefore, nasal dilators can be used as an alternative method of improving or maintaining sporting performance.

Horizontally fixed to the nasal cartilage, the external nasal dilator (END) consists of a narrow strip of adhesive tape with two parallel layers of plastic, going from one nasal wing to the other and acting as a spring. The purpose of these strips is to prevent the collapse of the nasal valve during breathing and reduce air passage resistance [8]. At present, evidence of improvement in the performance of adolescent athletes who used the END is limited [9,10]. A review [11] carried out recently found that many studies have shown the END increases the area of the nasal valve's transverse section, reduces nasal resistance and inspiratory transnasal pressure, and stabilizes the lateral nasal vestibule, preventing its collapse during final inspiration. On the other hand theres is a lack of studies that evaluated the effectiveness of the END in improving the sporting performance of adolescent athletes with allergic rhinitis. The studies carried out so far were on healthy adolescent athletes [9,10].

Some authors suggest that the END could lead to an improvement in peak inspiratory nasal flow rate [12], increased minute ventilation (MV), an increase in the partial pressure of oxygen in the alveoli, improved respiratory perception during exercise and a reduction in the perception of dyspnea (ventilatory exertion) [13,14]. These mechanisms create the conditions for an increase in the quantity of oxygen released to the respiratory muscles, enabling the athlete a better performance, due to the advantage in the production of energy during exercise. These effects may also facilitate

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breathing and are beneficial to patients with nasal congestion.

Several studies showed that the END was not effective during exercise for healthy adult populations [13–16]. It is possible that END would be useful for people with nasal congestion in the region of the nasal valve, a common characteristic among individuals with rhinitis.

The main objective of this study was to determine the effect of the external nasal dilator on nasal resistance and in the physical exercise of healthy athletes and those with allergic rhinitis.

2. Methods

2.1. Local design and period of study

A double-blind, crossover clinical trial, performed in the Santa Tereza Cachoeirinha Sports College, in Belo Horizonte-Brazil, in December of 2015 and April of 2016.

The convenience sample was composed of 35 healthy male adolescent athletes and 30 male athletes with persistent allergic rhinitis defined according to *Allergic Rhinitis and its Impact on Asthma* (ARIA) [2] initiative, consecutively chosen, aged between 12 and 15 years old, who practice football for 1 h and 30 min, three times per week.

2.2. Definition and classification of persistent allergic rhinitis

Persistent allergic rhinitis was classified through the presence of nasal pruritus, itchiness of the oropharynx, eye itch, serous or seromucous rhinorrhea, sneezing and nasal congestion, in isolation or association, for more than four days in the week and more than four consecutive weeks [2]. To evaluate rhinitis severity, we used a clinical score adapted from other researchers [17], which ranged from zero to 18 points. Each of these signs/symptoms received zero to three points, according to the intensity. Therefore, zero signified the absence of the symptom; 1 point indicated a slight symptom, which was tolerable and did not interfere with sleep or daily activities; 2 points indicated a more significant impact, which was bothersome and interfered with activities that demanded heightened concentration, while not upsetting the patient's routine; finally, 3 points signified a high intensity, which greatly interfered with the patient and his family, and was difficult to tolerate, compromising sleep and daily activities. Adding up the scores allowed us to classify the intensity of the allergic rhinitis as light, moderate and severe where the result was 0–6, 7 to 12 and 13 to 18 points, respectively.

2.3. Inclusion and exclusion criteria

Healthy adolescents with negative response in the *International Study on Asthma and Allergies in Childhood* (ISAAC) [18] questionnaire, in relation to questions on asthma and allergic rhinitis, were included. Those with positive response in the ISAAC questionnaire for sneezing, coryza (runny nose) or nasal obstruction symptoms in the last 12 months were included in the allergic rhinitis group. An inability to carry out the correct maneuver to obtain peak nasal inspiratory flow (PNIF), using rhinomanometry; not being able to fit the END; not presenting the informed consent agreement signed by the parents or guardian, non-completion of the Léger race test [19] or aerobic race test to a 20 m point and back, and failure to attend the second part of the test were the criteria for exclusion. Adolescents with any of the following were also excluded: moderate to severe adenoid hypertrophy; with bacterial sinusitis clinically diagnosed by the presence of purulent nasal discharge, postnasal drip, facial pain on percussion associated, or not, to headache and fever; nasal septum deviation, nasal polyps, any respiratory tract infection in activity on admission; and underlying illnesses of any nature.

3. Material, equipment and data collection procedures

3.1. Anthropometry

To collect anthropometric data, the variables of body weight (kg) and height (m) were used. Weight was measured on a Plenna® (São Paulo, SP, Brazil) digital weighing scale, with precision of 100 g and capacity of 150 kg. Height was measured using a measuring tape against a straight wall, with a precision scale of 0.1 cm. The body mass index (BMI) was calculated based on the equation: body weight (kg)/height^2 (m).

3.2. Cardio-respiratory test

To evaluate cardio-respiratory capacity, we used the Léger race test [19] or aerobic race test to a 20 m point and back, in an appropriate court or space. The test assessed the maximum aerobic capacity of the participants, and was performed in an open area where 20 m was measured out between two parallel lines. On the evaluator's mark, participants began running together (maximum of 10 people), at a pace determined by a CD specially recorded for this test. In the first stage, the speed was 8.5 km/h, which corresponds to a brisk walk, and was progressively speeded up by 0.5 km/h in each of the following stages. Each stage lasted approximately 1 min. Each stage had a duration of approximately 1 min. The CD made “beeps” at specific intervals in each stage. At each beep, the participant had to be crossing one of the two parallel lines with his foot, that is, starting out from one of the lines in the direction of the other, crossing it with at least one foot on hearing the beep and returning in the opposite direction.

The distance of 2 m before the parallel lines is the exclusion area (cutoff limit) of the test, that is, any participant who was yet to reach this section when the beep sounded was warned to accelerate his pace. But if the participant could no longer keep up the pace, he was excluded from the test, since the test finishes when the participant can no longer keep up with the pace set by the CD. The duration of the test depended on the cardio-respiratory performance of each participant. The goal of the test was to measure the $V0_2Max$, which is less intense at the start, becoming more intense at the end, in a total of up to 21 min. The maximal oxygen uptake value was calculated using the following formula:

$$Y = 31.025 + (3.238 \times A) - (3.248 \times B) + (0.1536 \times AB)$$

Whereas:

Y = $V0_2$ in mL/kg/min;
A = speed in km/h (in the stage achieved);
B = age in years.

3.3. Obtaining PNIF

Before verification of PNIF, the participant performed habitual nasal hygiene, lightly blowing the nostrils. In a standing position, the participant was carefully fitted with the facial mask. He was then instructed to carry out vigorous nasal inhalation, from the residual volume, with a closed mouth until total lung capacity was reached. The equipment used was the *In-check-inspiratory flow meter* (Clement Clarke, Harlow, England), illustrated in Fig. 1.

Three measurements were taken and the highest result was chosen. Based on the absolute values, the predicted values were obtained according to the reference curves proposed by Ibiapina et al. [20].