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Evaluation of the effectiveness of the external nasal dilator strip in adolescent athletes: A randomized trial

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ABSTRACT

Objectives: Evaluate the cardio-respiratory capacity (VO_2max.) and peak nasal inspiratory flow (PNIF) of healthy adolescent athletes with experimental and placebo external nasal dilator strips (ENDS).
Methods: 48 healthy adolescent athletes between the ages of 11 and 15 were evaluated and submitted to a cardio-respiratory 1000 m race in randomized order. The participants had peak nasal inspiratory flow (PNIF) values measured using the *In-check-inspiratory flow meter.* Dyspnea intensity was evaluated after a 1000 m test race using a labeled visual analog scale for dyspnea.
Results: In relation to VO_2max., when the participants used the experimental ENDS, significantly higher means were noted than when the placebo was used (53.0 ± 4.2 mL/kg min^{-1} and 51.2 ± 5.5 mL/kg min^{-1}, respectively) ($p < 0.05$). In relation to PNIF, there was a statistically significant difference between the experimental and placebo ENDS result, that being, 123 ± 38 L/min and 116 ± 38 L/min, respectively ($p < 0.05$). The dyspnea perceived by the participants was representatively lesser in the experimental ENDS condition compared to the placebo after the cardio-respiratory test ($p < 0.05$).
Conclusions: The results suggest that the ENDS improve maximal oxygen uptake, nasal patency and respiratory effort in healthy adolescent athletes after submaximal exercise.

1. Introduction

The interest and participation of children and adolescents in sporting activities has increased markedly in recent decades [1]. The need to enhance performance improvement strategies has become more important in the sporting environment.

One researched and under used resource in current times has attracted attention regarding its effectiveness. This resource is the external nasal dilator strip (ENDS), introduced approximately 15 years ago which has been used by athletes, patients with oral respiration, snoring caused by obstruction, among others. There is evidence that the device is effective in alleviating sleep and snoring disorders caused by a reduction in nasal resistance. Thus, it has potential benefits associated to the reduction of nasal respiratory work, increased nasal ventilation and delay in the onset of oral respiration during exercise [2–4].

Griffin et al. studied 30 healthy athletes aged between 18 and 33. The ENDS provided an important reduction in the subjective perception of exertion, heart rate (HR), ventilation and maximal oxygen uptake (VO_2max.), when compared with the placebo, during submaximal exercise [5].

In 1905, FRANCIS was probably the first researcher interested in developing an instrument to assess nasal obstruction in the area of the nasal valve [6,7]. This instrument was intranasal, differently from END, but with the same goal of dilating the nostrils.

More than 80 years later, in 1986, Lancer and Jones [7] used rhinomanometry to document the significant reduction in nasal resistance with the use of the device developed by Francis (The Francis alae nasi prop) in one patient.

There was only one study on adolescents where the researchers studied the effectiveness of the ENDS. In a randomized study, 30 Chinese adolescent athletes were analyzed [8]. Compared to the placebo, the ENDS provided a significant increase in aerobic performance. The authors concluded that the ENDS can representatively reduce respiratory effort and improve the peak of aerobic performance during field tests involving maximal racing. Contrary to our study, that study cited was restricted to boys and were not evaluated for nasal patency using peak nasal inspiratory flow (PNIF).

Raudenbush [9] studied 30 healthy individuals who complained of nasal obstruction during sleep. The goal was to compare the efficacy of two different nasal dilators, an internal one and an external one on nasal patency assessed by the peak nasal inspiratory flow (PNIF). The control values were significantly lower when compared to both.

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In a similar situation, in 1998, Lorino et al. [10] compared the effect of three treatments with the goal of reducing nasal resistance in 15 healthy individuals with ages between 18 and 45 years. The treatments were based on normal breathing, use of END (Respir+®; Kentia Diffusion; Boulogne, France), internal nasal dilator (Nozovent®; Prevancure; Ste Pouret, Paris, France) and 0.05% of nasal decongestant (tymazoline hydrochloride), (Pernazene; Synthelabo; le Plessis-Robinson, France). The nasal resistance was assessed by means of the posterior rhinometry. We did not find significant reduction in nasal resistance using the external nasal dilator (Respir+; Kentia Diffusion; Boulogne, France).

More recently, in a randomized and crossover design study, nine healthy men underwent submaximal aerobic exercise sessions using the ENDS, the placebo and without the device [11]. There was an expressive increase in nasal volume compared to the placebo. There was no difference in HR, VO_2max., ventilation and the effort perception rate between the three conditions analyzed.

Nevertheless, some works are consistent in affirming that few positive results were found in relation to improved athletic performance [12–14]. Apart from this, the majority of studies are composed of small samples.

The purpose of this study was to evaluate and compare the cardio-respiratory capacity of healthy adolescent athletes, with experimental and placebo ENDS.

2. Methods

2.1. Local design and period of study

A double-blind, crossover clinical trial performed in one of the headquarters of the "*De peito aberto*" project in Belo Horizonte, Brazil, in the period between January and June 2012. The sample was composed of consecutively selected healthy adolescents between the ages of 11 and 15 that regularly practice basketball, an aerobic activity.

2.2. Inclusion and exclusion criteria

Healthy adolescents with negative response in the *International Study on Asthma and Allergies in Childhood* (ISAAC) [15] questionnaire, in relation to questions on asthma and allergic rhinitis, were included. Those with positive response in the ISAAC [15] questionnaire regarding asthma, sneezing, (runny nose) or nasal obstruction in the last 12 months were excluded, as well as individuals with any chronic disease, with moderate to severe hypertrophy of the adenoids, posture of mouth breather, ogival palate, crossbite and anterior rhinoscopy, bacterial sinusitis clinically diagnosed by the presence of purulent nasal discharge, postnasal drip, facial pain on percussion associated, or not, to cephalgia and fever, nasal septum deviation, nasal polyps and infection of the upper airways in activity detected by clinical evaluation. The inability to carry out the correct maneuver to obtain peak nasal inspiratory flow (PNIF), not being able to fit the ENDS (e.g.: the ENDS do not fix on the participant skin or the nose shape that do not allow adequacy fixation), not presenting the informed consent agreement signed by the parents or guardian, non-completion of the 1000 m cardio-respiratory test (or walking during itself) and failure to attend the second part of the test were the criteria for exclusion.

2.3. Material, equipment and data collection procedures

2.3.1. Anthropometry and physiological variables

To collect anthropometric data, the variables of 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: weight (kg)/height^2 (m). For the collection of skinfolds, the Body Caliper® (Littleton, CO, USA) skinfold calipers was used. The formula standardized by Slaughter et al. [16] was used in estimating the fat percentage of participants. In the collection of heart rate and oxygen saturation (SpO_2) data, the Nonin wristOx® 3100 (Plymouth, Minnesota – MN, USA) pulse oximeter was used.

2.3.2. Cardio-respiratory test

A 1000 m track race test, proposed by Matsudo [17], was used to evaluate cardio-respiratory capacity. On the evaluator's mark, the participants ran the distance in the minimum time possible, with walking during the race not being permitted.

The maximal oxygen uptake value (VO_2max.) was calculated through the following formula [17]:

$$X = \frac{652.17 - Y}{6.762}$$

whereas:

X = maximal oxygen uptake in mL/kg min^{-1}.

Y = race time, in seconds, in the 1000 m and 652.17 and 6.762 are constants.

2.3.3. Obtaining peak nasal inspiratory flow (PNIF)

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

2.3.4. Labeled visual analog scale for dyspnea

The intensity of dyspnea was evaluated after the 1000 m race test, using the labeled visual analog scale (VAS) for dyspnea [18] with score ranging from zero, one, two and three points: four drawings in a logical sequence whereby the drawing of a boy doing exercise, at one end of the scale, signified "no symptoms" (zero points) and of the same boy sitting, on the opposite end of the scale, meant "serious dyspnea" (three points).

2.3.5. Experimental external nasal dilator strip (ENDS)

The ENDS used in the study is the one sold in Brazil (*ClearPassage*®, RJ, Brazil), available in three sizes: small, medium and large, and may be used by children, adolescents and adults. The

Fig. 1. Peak nasal inspiratory flow meter (PNIF).