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Effect of the Airmax® Internal Nasal Dilator on Peak Nasal Inspiratory Flow, Aerobic Capacity, and Rating of Perceived Exertion in Healthy Rugby Players

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ABSTRACT

Dinardi RR, Andrade CR, Ibiapina C. Effect of the Airmax® Internal Nasal Dilator on Peak Nasal Inspiratory Flow, Aerobic Capacity, and Rating of Perceived Exertion in Healthy Rugby Players. **JEPonline** 2017;20(1):92-101. Nasal dilators have been widely used by athletes to improve performance. This study aimed to evaluate the effect of the Airmax® internal nasal dilator (IND) on the aerobic capacity (VO_2 max), peak nasal inspiratory flow (PNIF), and rating of perceived exertion (RPE) of rugby players. We used a double-blind, crossover study in which 15 adult athletes were assessed while using and not using the IND during a maximum cardio-respiratory test, with experimental treatment presented in randomized order. PNIF was obtained and RPE was assessed. In relation to PNIF, the subjects using the IND showed significantly higher means than those not using the IND (180.7 ± 55.1 $L \cdot min^{-1}$ vs. 160.7 ± 54.7 $L \cdot min^{-1}$, respectively) ($P<0.001$). There was no significant difference in the VO_2 max values or in RPE with or without the IND ($P=0.106$ and $P=0.105$, respectively). Thus, the findings indicate that the Airmax® IND improves nasal patency, as measured by PNIF, in healthy rugby athletes, but does not increase VO_2 max or RPE. New studies should be conducted to evaluate the effect of IND in adult athletes with nasal obstruction, perhaps also through the use of other cardio-respiratory assessment methods.

Key Words: Internal Nasal Dilator, Nasal Patency, PNIF, Airmax®, Rugby, Aerobic Power

INTRODUCTION

Nasal dilators have been widely used by athletes to improve performance (18). In the 1990s, professional athletes from the North American Football League (NFL) believed that if there was a dilation of the lateral nasal walls, performance could improve by the increase in the supply of nasal air, leading to an increase in body oxygenation. The flow of nasal air and oxygenation are essential components for the utilization of aerobic power (24).

The dilation of the nasal lateral walls, specifically in the region of the nasal valve can happen through medication or the use of devices, such as the internal or external nasal dilators (7). The purpose of these nasal dilators is to prevent the collapse of the nasal valve in inspiration and lessen air flow resistance (14,22). Dinardi et al. (8) put forward several studies confirming these findings in a recent review.

The internal Airmax® nasal dilator consists of a device that once inserted into the nostrils, acts as if it is a lever, simultaneously pushing the two lateral nasal walls outwards, dilating the nasal valve. It has been recommended for the relief of nasal congestion and/or nasal obstruction that is associated with allergic rhinitis, snoring, sleep disorders, and during physical activity (26).

Studies such as those by Trocchio et al. (24) and Overend et al. (21) evaluated external nasal dilators (ENDs) in high level athletes and noted no performance improvement. There are no studies in the literature on the Airmax® internal nasal dilator for adult athletes. Recently, Dinardi et al. (7) evaluated the use of Airmax® in a pediatric population with mean age of 12.8 ± 1.2 yrs and found no improvement in aerobic output when compared with the placebo. On the other hand, there was a significant improvement in the nasal patency evaluated by peak nasal inspiratory flow (PNIF).

Since mouth guards, mandatory or recommended for protection in many sports, create an oral obstruction to breathing, the idea that they can negatively impact performance has justified the use of nasal dilators by athletes (21). This study aimed to assess the effect that the Airmax® internal nasal dilator has on aerobic capacity, peak nasal inspiratory flow, and rating of perceived exertion in rugby players who normally use mouth guards.

METHODS

Subjects

This study consisted of 15 healthy amateur male rugby players with a mean age of 26.5 ± 4.7 yrs. The players selected played rugby three times per week with two hours of training. The study included athletes who had been playing rugby for at least 12 months and could prove their registration in the Brazilian Rugby Confederation (CBRu). We included healthy, non-smoking, adult athletes, free of respiratory and allergic diseases, without any history of sinonasal conditions, deformities, obstructions, and surgeries. Exclusion criteria included an inability to carry out the correct maneuver to obtain peak nasal inspiratory flow (PNIF), not being able to fit the IND, not presenting the written informed consent agreement, non-completion of the intermittent recovery test, and failure to attend retesting. Athletes who had any type of musculoskeletal injury or demonstrated any restriction in the tests performed

were also excluded. The protocol and informed consent agreement were approved by the Research Ethics Committee of the Federal University of Minas Gerais (UFMG).

Procedures

An experimental double-blind crossover study was performed in the Uni-BH university center in Belo Horizonte/MG in the month of March 2016. Each of the 15 volunteers participated randomly in two experimental situations, one using and one not using the IND. Each subject made two visits to the university center with an interval of at least one week. In the first session, with or without the IND, the subjects underwent anthropometric evaluation, assessment of nasal patency through PNIF, evaluation of aerobic capacity, and RPE, immediately after. In the second session, they were submitted to evaluations of nasal patency, aerobic capacity, and RPE immediately after. Subjects who used the IND in the first session did not use it in the second session and vice-versa. The anthropometric evaluation and PNIF were performed in a room fitted with the proper equipment. The aerobic capacity test was carried out in a playing field. All data collection procedures were carried out by appropriately trained Physical Education teachers.

Anthropometric Evaluation

The anthropometric evaluation involved the measurement of body mass (kg) and height (m) that complied with recommendations by the International Society for the Advancement of Kinanthropometry (17). Body mass was measured using a digital scale manufactured by Plenna® (São Paulo, SP, Brazil) with a precision of within 100 g and a capacity for 150 kg. Height was measured using a measuring tape against a straight wall, with a precision of within 0.1 cm. Body mass index (BMI) was calculated based on the equation: body weight (kg)/height^2 (m).

Peak Nasal Inspiratory Flow (PNIF)

Before verification of PNIF, the subject performed habitual nasal hygiene practices, lightly blowing the nostrils. The subject 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 facia mask. The equipment used was the In-check-inspiratory flow meter (Clement Clarke, Harlow, England), illustrated in Figure 1. Three measurements were taken and the highest value was chosen.

Figure 1. Peak Nasal Inspiratory Flow (PNIF).

Yo-Yo Intermittent Recovery Test (Level 1)

Test dynamics followed guidelines by Bangsbo et al. (2). The Yo-Yo Intermittent Recovery Test (Level 1) consisted of repeated races to a 20 m point and back until exhaustion. The races were controlled by a sound signal. Between each series, the subjects had a period of 10-sec active rest in a 5 m marked area at the starting point. For the subject who did not cross the line at the two points within the forecast time, the distance covered was recorded and represented the end of the test. The test was held in a training field and markings were made using cones separated by 2 m and with a length of 20 m. Another cone was placed behind the finishing line to mark out the 5 m active rest area. The total duration of the test was from 6 to 20 min. All subjects were familiarized with the test through at least one pre-test session.

Rating of perceived exertion (RPE)

The rating of perceived exertion was measured immediately after the Yo-Yo Intermittent Recovery Test using the Borg scale (4), which was developed to describe individuals' perception of physical exertion in a wide range of exercises.

Airmax® Internal Nasal Dilator (IND)

The IND used in the study is the one commonly found on the market (Airmax®, Oegstgeest, BV, Netherlands). It is available in two sizes: small and medium, which may be used by children, adolescents, and adults (Figure 2). Figure 3 shows the Airmax® IND used in the study. Application of the IND was carried out according to the manufacturer's (26) instructions. It was inserted by one of the researchers to assess the size. The subjects were advised not to touch the device, which should be placed where they cannot see it.

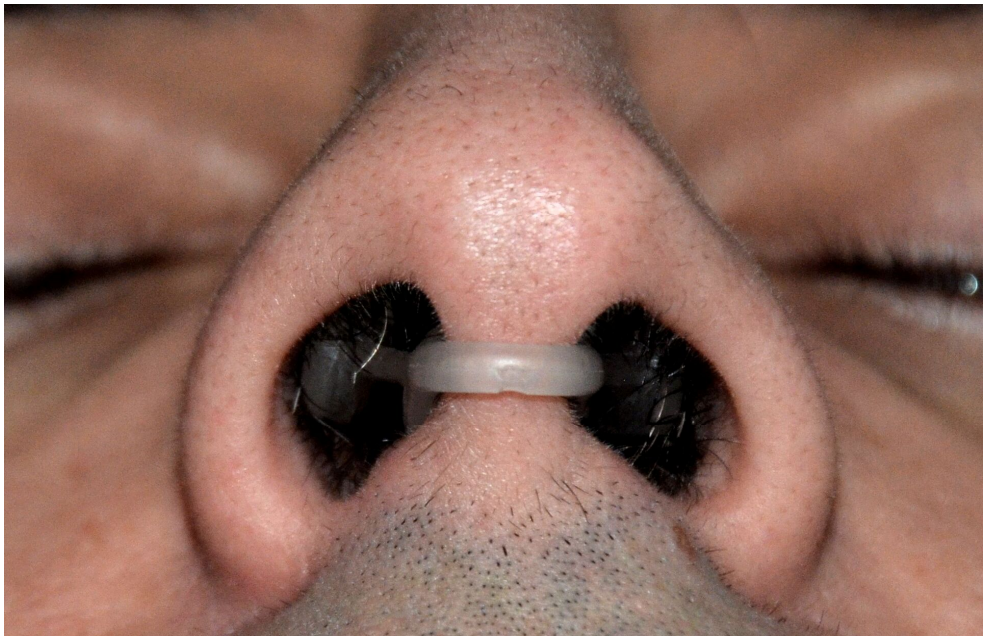

Figure 2. Front View of the Nose with the Internal Nasal Dilator Airmax®.

Figure 3. Internal Nasal Dilator Used in the Study.

Statistical Analyses

Descriptive data were presented as means and standard deviations. To evaluate the differences between the use and non-use of the IND regarding performance measurements, and between PNIF measurements in each of the studied groups, the Student *t*-test was used for paired samples. All results were considered important at a significance level of 5% ($P<0.05$). To evaluate whether the sample was satisfactory for comparison between the measurements with or without the internal nasal dilator, we considered a power equal to 0.80, effect size of 0.70 (high effect size according to Cohen's "d") and 5% error probability.

RESULTS

Thirty-two athletes were invited to participate in this study. Seventeen were excluded due to the following: two had altered rhinoscopy, four gave up on the cardio-respiratory test, two had musculoskeletal injuries, and nine did not return for assessment retesting. As such, the final sample consisted of 15 male athletes. The descriptive characteristics of the subjects are shown in Table 1.

Table 1. Descriptive Characteristics of the Athletes (N = 15).

	Descriptive Measurements		
Variable	**Mean**	**± SD**	**Mean CI (95%)**
Age	26.5	4.7	23.6; 29.3
Body Mass (kg)	98.1	11.9	90.9; 105.3
Height (cm)	1.79	0.05	1.75; 1.82
BMI	30.8	3.6	28.6; 33.0

SD = Standard Deviation; **CI** = Confidence Interval; **BMI** = Body Mass Index

Table 2 shows the descriptive and comparative measurements of the subjects for results with and without the IND. There was no significant difference in the values for VO_2 max and in RPE with and without the IND. In regards to PNIF, significantly higher means were found when the subjects used the IND.

Table 2. Descriptive and Comparative Measures of VO_2 max, Travelled Distance, PNIF, and RPE between the Groups With and Without IND (mean ± SD and confidence interval).

Variables	With IND	Without IND	P Value
VO_2 max ($mL \cdot kg^{-1} \cdot min^{-1}$)	41.5 ± 2.5 (40.2; 42.9)	40.8 ± 1.3 (40.1; 41.6)	0.106
Travelled Distance (m)	613.3 ± 295.7 (449.6; 777.1)	528.0 ± 159.4 (439.7; 616.3)	0.105
PNIF	180.7 ± 55.1 (150.2; 211.2)	160.7 ± 54.7 (130.4; 190.9)	<0.001
RPE	8.3 ± 1.1 (7.7; 9.0)	8.9 ± 0.8 (8.4; 9.3)	0.104

PNIF = Peak Nasal Inspiratory flow; **RPE** = Rating of Perceived Exertion

DISCUSSION

The results of this study revealed a significant increase in peak nasal inspiratory flow (PNIF) when athletes used the internal nasal dilator. The action mechanism of the Airmax® internal nasal dilator is simple and practical. After insertion in the nostrils, it acts as a lever that dilates the nasal vestibule and the anteroinferior segment of the nasal cavity. The results of this study corroborate those found by Dinardi et al. (7) and Hellings and Trenité (11) for adolescent athletes and adults with nasal obstruction, respectively, with regard to the PNIF finding. These authors used the same device as used in the current study, but it is worth highlighting that they are different populations and methodologies. For practitioners of rugby, this finding is of fundamental importance, since the majority of athletes use the protective mouth guard, due either to recommendation or obligation, which has led to a belief that oral breathing is compromised. Nasal breathing is essential in preparing inhaled air and serves a protective function for the nasal cavity (19). A poorly functioning nasal passage can impact the performance of athletes (22).

Several authors (3,13,20), recommend and justify the application of PNIF as a form of assessing nasal patency in a quick and simple economical manner where results are easily interpreted. The current study is the first to use PNIF to assess nasal patency in rugby athletes. For this reason, comparison with the findings of other studies is limited. On the other hand, studies involving swimmers are frequent in the literature (1,5,19).

In the current study, in spite of the nasal function improving when the athletes used the Airmax® internal nasal dilator, after analyzing the performance variables, the results were contradictory. Recourses to achieve an improvement in nasal function and, consequently, performance in exercise have been studied. In a randomized, clinical trial, Goméz-Hervás et al. (10) assessed 8 adults with nasal obstruction due to hypertrophy of the lower cornet. The

purpose was to observe the effect of topical intranasal oximetazoline on nasal resistance and performance in aerobic exercise. Based on the PNIF, oximetazoline increased the nasal air flow at rest, but the increase did not improve the subjects' aerobic exercise and subjective perception of exertion parameters with hypertrophy of the lower cornet compared to the placebo.

Within this same perspective, Dinardi et al. (9) used the external nasal dilator (END) and noted significant improvements in nasal patency in healthy adolescent athletes, assessed by PNIF, and in performance parameters for aerobic exercise, compared to the placebo. However, Trocchio et al. (24) and Overend et al. (21) tested the same device and did not find any change in the performance of healthy adult athletes. Recently, Kam et al. (15) analyzed 9 caucasian and 6 asian healthy adults. The objective of the study was to observe if the dilation of the nasal valve with END interferes with nasal breathing, since it is postulated that there is a difference between the nasal structure morphology of the ethnicities. There was a significant improvement in the peak nasal inspiratory flow (PNIF), from the minimum cross section area and in the analogic visual scale values in both ethnic groups. However, when compared, it was noted that caucasians demonstrated a significant improvement in nasal resistance and peak nasal inspiratory flow using the END.

A limitation of the current study was the non-classification of subjects with regard to ethnic group. The effect of nasal dilators could be different due to variations in nasal anatomy among different ethnicities, and also between individuals of the same ethnicity (23). Perhaps this explains the lack of improvement in performance from this study. Future studies should be conducted to reinforce and clarify current knowledge in relation to specific nasal structure variations.

Another limitation concerns the absence of the placebo. The decision not to use the placebo was made due to the probability of the placebo modifying the nasal valve region, or even dilating given that the device acts internally. In the same manner, Portugal et al. (23) performed a study on healthy adults involving four experimental situations: at rest with or without the END, and during exercise with or without the END. The same paradox occurred in this study. At rest and during exercise, there were significant changes in subjective sensation of nasal breathing. On the other hand, the subjective response was not consistent when associated with the objective improvement. In the studied sample, there were individuals who responded and did not respond to the device.

Recently, Whyte et al. (25) evaluated the effect of an internal nasal dilator on cycling performance in healthy adult men. The researcher's hypothesis was that the use of the internal nasal dilator would allow for greater aerobic potency and economy of exertion during continuous exercise. The findings suggested that the internal nasal dilator used in their study did not produce an effect on the performance parameters, which is in agreement with the current study.

The Yo-Yo Intermittent Recovery Test (Level 1) involves acceleration, deceleration, and change of direction, making it specific to the requirements of work on rugby. It is low cost, easily applied, and includes a prognosis near to ideal for implementation in training sessions (2,12). Recently, the Yo-Yo Intermittent Recovery Test (Level 1) was carried out in several studies involving rugby players, further showing the important of this test (6,12).

CONCLUSION

While the Airmax® internal nasal dilator resulted in a significant increase in peak nasal inspiratory flow (PNIF) in the healthy rugby players at rest, there was no significant difference in the values for VO_2 max and in RPE with and without the IND. The role of the Airmax® internal nasal dilator in athletes is not yet defined.

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REFERENCES

1. Alves A, Martins C, Delgado L, et al. Exercise-induced rhinitis in competitive swimmers. ***Am J Rhinol Allergy.*** 2010;24:114-117.

2. Bangsbo J, Iaia M, Krustrup P. The Yo-Yo Intermittent Recovery Test: A useful tool for evaluation of physical performance in intermittent sports. ***Sports Med.*** 2008;38(1):37-51.

3. Blomgren K, Simola M, Hytonen M, Pitkaranta A. Peak nasal inspiratory and expiratory flow measurements-practical tools in primary care. ***Rhinology.*** 2003;41:206-210.

4. Borg GA. Psychophysical bases of perceived exertion. ***Med Sci Sports Exerc.*** 1982; 14:377-381.

5. Bougault V, Turmel J, Boulet LP. Effect of intense swimming training on rhinitis in high-level competitive swimmers. ***Clin Exp Allergy.*** 2010;40:1238-1246.

6. Darrall-Jones JD, Jones B, Till K. Anthropometric, sprint, and high intensity running profiles of English academy rugby union players by position. ***J Strength Cond Res.*** 2016;30(5):1348-1358.

7. Dinardi RR, de Andrade CR, Martins-Costa HC, da Cunha Ibiapina C. Does the Airmax® internal nasal dilator increase peak nasal inspiratory flow (PNIF) in adolescent athletes? ***Int J Pediatr Otorhinolaryngol.*** 2016;84:37-42.

8. Dinardi RR, Andrade CR, Ibiapina CC. External nasal dilator: Definition, background and current uses. ***Int J Gen Med.*** 2014;7:491-504.

9. Dinardi RR, Ibiapina CC, Andrade CR. Evaluation of the effectiveness of the external nasal dilator strip in adolescent athletes: A randomized trial. ***Int J Pediatr Otorhinolaryngol.*** 2013;77(9):1500-1505.

10. Gómes-Hervás J, García-Valdecasas BJ, Fernández-Prada M, Palomeque-Vera JM, Garcıa-Ramos A, Fernandez-Castanys BF. Effects of oxymetazoline on nasal flow and maximum aerobic exercise performance in patients with inferiorturbinate hypertrophy. ***Laryngoscope.*** 2015;125(6):1301-1306.

11. Hellings PW, Trenité GJN. Improvement of nasal breathing and patient satisfaction by the endonasal dilator Airmax®. ***Rhinology.*** 2014;52(1):31-34.

12. Higham DG, Pyne DB, Anson JM, Eddy A. Physiological, anthropometric, and performance characteristics of rugby sevens players. ***Int J Sports Physiol Perform.*** 2013;8(1):19-27.

13. Ibiapina C, Andrade CR, Camargos PAM, Alvim CG, Cruz AA. Reference values for peak nasal inspiratory flow in children and adolescents in Brazil. ***Rhinology.*** 2011;49-3:304-308.

14. Kiyohara N, Badger C, Tjoa T,Wong B. A comparison of over-the-counter mechanical nasal dilators. ***JAMA Facial Plast Surg.*** 2016;18(5):385-389.

15. Kam AW, Pratt E, Harvey RJ. Comparing the effectiveness of nasal dilator strips: Does race play a role? ***J Laryngol Otol.*** 2015;129:51-56.

16. Kobal R, Nakamura FY, Moraes JE, Coelho M, Kitamura K, Cal Abad CC, Pereira LA, Loturco I. Physical performance of Brazilian rugby players from different age categories and competitive levels. ***J Strength Cond Res.*** 2016;30(9):2433-2439.

17. Marfell-Jones M, Olds T, Stewart ALC. ***International Standards for Anthropometric Assessment.*** South Africa: Potchefstroom, 2006.

18. Nunes VNG, Barbosa DCS, Damasceno WC, Fonseca M, Andrade AG, Vieira ER, et al. External nasal dilator strip does not affect heart rate, oxygen consumption, ventilation or rate of perceived exertion during submaximal exercise. ***J Exerc Physiol.*** 2011;14(1):11-19.

19. Ottaviano G, Staffieri A, Stritoni P, Ermolao A, Coles S, Zaccaria M, Marioni G. Nasal dysfunction induced by chlorinate water in competitive swimmers. ***Rhinology.*** 2012; 50(3):294-298.

20. Ottaviano G, Scadding GK, Coles S, Lund VJ. Peak nasal inspiratory flow: Normal range in adult population. ***Rhinology.*** 2006;44:32-35.

21. Overend T, Barrios J, McCutcheon B, Sidon J. External nasal dilator strips do not affect treadmill performance in subjects wearing mouth guards. ***J Athl Train.*** 2000;35 (1):60-64.

22. Passali D, Damiani V, Passali GC, et al. Alterations in rhinosinusal homeostasis in a sportive population: Our experience with 106 athletes. ***Eur Arch Otorhinolaryngol.*** 2004;261:502-506.

23. Portugal LG, Mehta RH, Smith BE, Sabnani JB, Matava MJ. Objective assessment of the breathe-right device during exercise in adult males. ***Am J Rhinol.*** 1997;11(5):393-397.

24. Trocchio M, Fisher J, Wimer JW, Parkman AW. Oxygenation and exercise performance enhancing effects attributed to the breathe-right nasal dilator. ***J Athl Train.*** 1995;30(3):211-214.

25. Whyte DG, Whitty A, Rice VJ. The effect of a novel mechanical nasal dilator on cycling performance. ***J Sports Med Phys Fitness.*** 2016;56:949-950.

26. www.airmax.nu