Oxygenation and Exercise Performance-Enhancing Effects Attributed to the Breathe-Right Nasal Dilator

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ABSTRACT: Recently, many professional football players have elected to wear spring-loaded nasal dilators during competition. Many athletes believe that wearing the "Breathe-Right" nasal dilator will increase nasal gas conduction and oxygenation to their body, subsequently improving their performance. The purpose of this experiment was to investigate the advantages of wearing a nasal dilator while performing aerobic and anaerobic exercise, as opposed to not wearing a nasal dilator. It was hypothesized that the "Breathe-Right" nasal dilator, manufactured by CNS, Inc (Chanhassen, MN) would increase nasal gaseous conduction and increase oxygenation to the body. Nasal gaseous conduction and oxygenation are essential components for using aerobic power. We examined whether wearing a nasal dilator improves performance by using a ramped cycle ergometer stress test on athletes until they reached VO_2 maximum progressing from aerobic to anaerobic exercise. Baseline data were collected (ie, VO_2, VO_2/kg, respiratory exchange ratio, anaerobic threshold time, and onset of VO_2 max) using a MedGraphics CardiO_2 System. The subjects included 16 college-aged male athletes. Dependent *t*-tests implemented on each physiological response; VO_2 max, peak VO_2 kg, onset of anaerobic threshold, onset of VO_2 max, respiratory exchange ratio at VO_2 max, and maximum WATT output, showed there was no difference in the athletes' performance when they wore the nasal dilators and when they did not wear the dilators.

Professional football players attracted media attention last season by wearing what looked like a bandage for a broken nose. Athletic trainers working with the NFL tell us that many players believed wearing the "Breathe-Right" nasal dilator would increase their nasal gas conduction and subsequently improve performance.[3] Jerry Rice of the San Francisco 49ers was one of the first NFL players to bring notoriety to the "Breathe-Right" device (Fig 1).[9] The purpose of this experiment was to see if it is advantageous to wear a nasal dilator while performing aerobic and anaerobic exercise.

The "Breathe-Right" nasal strips, manufactured by CNS Inc, Chanhassen, MN, have been used to relieve nasal gas congestion, obstruction associated with allergic rhinitis, septal abnormalities, congestion, snoring, and sleep apnea. CNS claims that the "Breathe-Right" device reduces nasal airway resistance by 31%.[1] Since 1980, physicians have made significant progress in treating and managing conditions such as sleep apnea and hypopnea syndrome through the use of continuous positive airway pressure and the "Breathe-Right" device. Sleep apnea and hypopnea syndrome occur when there is a narrowing of the upper airway that stops or decreases breathing.[5,9,11,17] Apnea is defined as a cessation of oronasal airflow for at least 10 seconds in duration. When it occurs 30 or more times during a 7-hour period of nocturnal sleep, it is further defined as obstructive sleep apnea.[9,11,17] Given these manufacturer's claims, it was hypothesized that the "Breathe-Right" device would increase VO_2 max, peak VO_2/kg, onset of VO_2 max, and increase WATTs and the ability to tolerate increased respiratory exchange ratio levels, subsequently prolonging the onset of anaerobic threshold.

The medical conditions that the "Breathe-Right" nasal dilator were designed to treat will not be explored in this study. However, because the nasal dilator was designed to increase airway flow and theoretically increase oxygenation, it may now be classified as a performance-enhancing device. Cardiorespiratory responses such as VO_2 max, peak VO_2/kg, onset of anaerobic threshold, onset of VO_2 max, max WATTs, and respiratory exchange ratio toleration may be increased from wearing such a device. We tested whether the nasal device would enhance performance by measuring these cardiorespiratory responses.

Medium and large "Breathe-Right" nasal strips are recommended for adults with an average to above-average nose size. The "Breathe-Right" nasal strip is approved by the FDA as an over-the-counter device. No new claims regarding the effectiveness of the device have been made since athletes began using them. This small adhesive strip has a special backbone that mechanically opens the nasal passages. Each strip is lined with two parallel plastic strips. On the underside is a special adhesive, that when properly placed across the bridge of the nose, gently lifts the soft area above the flare of each nostril. As the plastic strips straighten, they provide approximately 25 grams of pulling force that carefully grabs and opens the nasal passages.[1]

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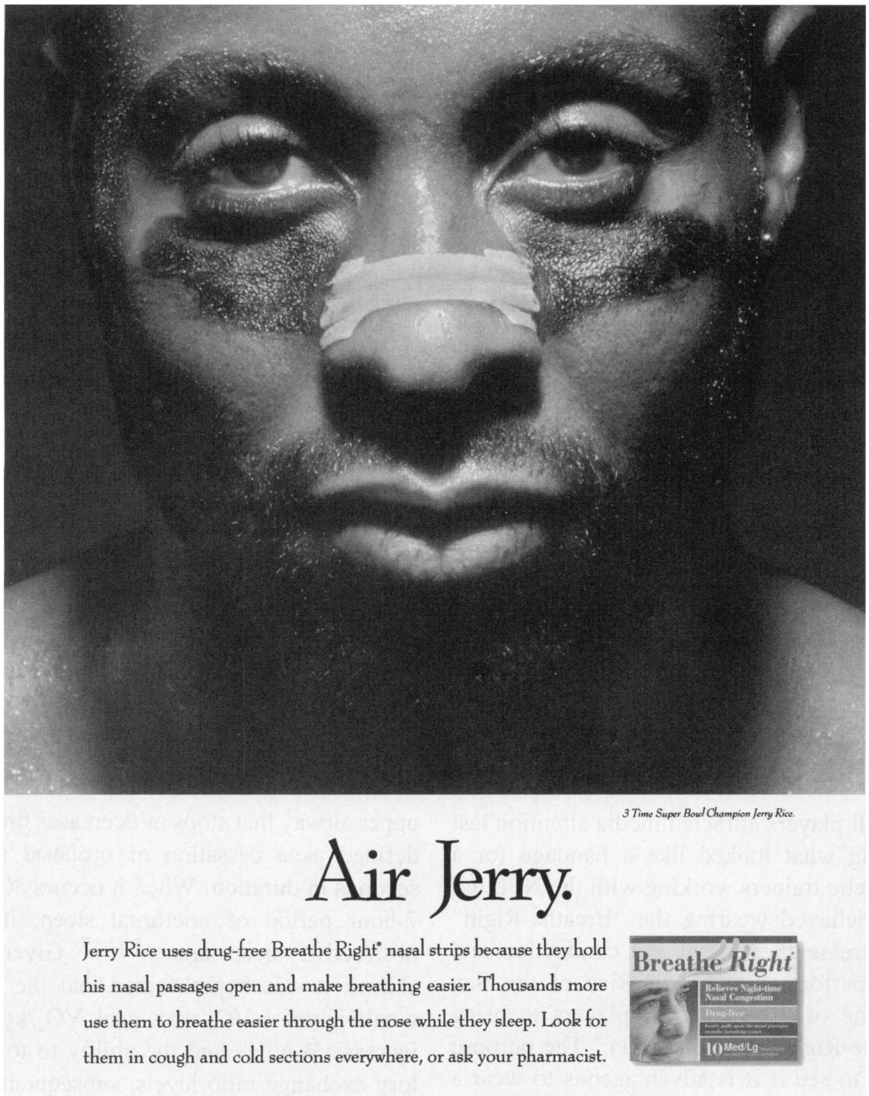

Fig 1. NFL football player Jerry Rice in "Breathe-Right" advertisement. (Reproduced with permission from CNS, Inc, Chanhassen, MN.)

Athletic trainers should consider the nose as a structure that affects performance. It can cause certain respiratory problems when structural abnormalities inhibit proper airway conduction. The nose should be capable of thoroughly warming and humidifying inspired air before it reaches the lungs.[10,14] With this in mind, one must consider the vast exercise benefits gained through nasal decongestion and increased airway flow during inhalation at high-intensity work.

Theoretically, increasing VO_2 and peak VO_2/kg would mean added energy due to increased fuel combustion. At the cellular level, oxidation of substrates occurs with the production of energy. Thus, the skeletal muscle gets its fuel from food substrates and uses the oxygen for combustion.[6] Increased oxygen levels could enhance the combustion of food substrates with increased VO_2. Ultimately, this would result in increased energy production and increased athletic performance.

Oxygen uptake is one of the most important metabolic measurements for accessing responses to acute exercise.[6,12,18] The traditionally accepted criterion measure of cardiorespiratory endurance is to directly measure maximal oxygen consumption (VO_2 max). Oxygen use can be used as a determinant of the total work done.[2,6,18] This study measured the difference in athlete's VO_2 max, peak VO_2/kg, onset of anaerobic threshold, onset of VO_2 max, max WATTs produced and respiratory exchange ratio level at VO_2 max, with and without the use of a "Breathe-Right" nasal dilator. Jardins[10] believed that no significant arterial oxygen pressure, arterial carbon dioxide pressure, or pH changes occur between rest and approximately 60% to 70% of maximum heart rate. This is also the average time in which the anaerobic threshold is met in aerobic exercise. Thus, we hypothesized that added nasal gaseous conduction or oxygenation may increase VO_2 and peak VO_2/kg due to the physical changes in the nasal pathway.

Poiseuille's gas law states that pressure is directly proportional to flow, length, and velocity and inversely proportional to the radius cubed of a tube.[10] In other words, an increase in the radius of a tube will decrease the pressure in the tube and increase the flow rate at that given pressure. The opposite is also true. Pressure will increase in response to a decreased radius. Considering Poiseuille's law, the "Breathe-Right" nasal dilator should increase nasal tube radius, and thus increase the nasal flow rate. Decreased nasal tube pressure should result in an increased nasal flow, increased VO_2 max, and increased peak VO_2/kg.

In humans, the respiratory quotient or respiratory exchange ratio is a useful indicator of maximal exercise.[18] The body becomes less efficient when respiratory exchange ratio reaches 1.0 CO_2:O_2 during continuous exercise. Most people will discontinue exercise within 3 minutes after reaching 1.0 CO_2:O_2 and are unable to continue immediate exercise due to increasing lactic acidosis at respiratory exchange ratio levels above 1.10 CO_2:O_2.[6,18] Ventilatory anaerobic threshold usually occurs at a work rate that corresponds closely to that at which lactic acid begins to accumulate in the blood.[2] Most people who exercise regularly are able to perceive ventilatory anaerobic threshold and respiratory exchange ratio as the exercise intensity increases and breathing becomes labored.[6,18] Although ventilatory anaerobic threshold was not measured for this study, the "Breathe-Right" nasal dilator may in effect change individual ventilatory anaerobic threshold levels.

METHODS

The subjects for this study included 16 college-age male athletes (age = 20.1 ± 1.5 yr, wt = 167.1 ± 17.3 lb, and ht = 70.4 ± 2.9 inches). All subjects participated in collegiate varsity athletics. They were tested at a respiratory care lab under the supervision of a registered respiratory therapist on a MedGraphics Cardio2 system (Medical Graphics Corporation, St Paul, MN) integrated with a Invivo finger probe pulse oximeter. A 10-lead ECG and ramped bicycle ergometer were used. Two individual trials were conducted at the same time of day and after similar daily events (ie, amount of sleep the night prior and approximate time after the ingestion of meals). Each subject was randomly assigned to a condition on whether they exercised while wearing the nasal dilator during the first trial or the second trial. Nine subjects completed their first exercise test with the nasal dilator applied to their nose. Seven subjects completed their first test without the "Breathe-Right" device. Thirty-two individual bicycle ergometer tests were done (16 subjects × 2 trials).

The goal of cardiorespiratory exercise testing was for the subject to achieve a maximum test as defined by Wasserman[18]; a maximum cardiorespiratory stress test that induced respiratory exchange ratio values above 1.10 CO_2:O_2. Subjects who did not reach these criteria were rejected.

Each subject filled out a written consent form before the test. Subjects were scheduled and arrived for testing at set times. The second test was performed 48 hours after the first. Each subject had no prior history of circulatory problems or insufficiencies, no history of smoking or nasal passage problems, and had passed a physical exam within the past year. The manufacturer's instructed procedures for the "Breathe-Right" device include: *Wipe excessive skin oils from sides of nose. Remove backing, center the Breathe Right device between the bridge and the end of the nose, fold both sides down so the lower spring strip is positioned on the nasal crease above the flare of each nostril. Press firmly in place.*[4] This procedure was followed for each athlete.

Subjects were connected to the 10-lead ECG machine in standard 10-lead stress testing fashion. Subjects were instructed to perform as vigorously as they could tolerate. The cycle ergometer was increased at 30 WATTs per minute while maintaining at least 50 to 70 RPM. This was done until maximum VO_2 was reached. Subjects were told that the test was to quantify effects of the "Breathe-Right" device on the body.

Breath by breath, VO_2 and other gas exchange data (respiratory exchange ratio, ventilatory equivalent, and respiratory rate/heart rate) were collected in real time with the MedGraphics Cardio2 system (Fig 2). The functional capacity of the entire circulatory system was accurately quantified when combined with 10-lead ECG stress testing system.[4,12,16] The pulse oximeters interfaced with the computer system and the information was automatically added to the gas exchange data.[12,16] ECG monitoring was performed not only during the test, but also for 4 to 5 minutes afterward to monitor any exercise-induced abnormalities under the supervision of a registered respiratory therapist. A digital sampling rate of 500/sec/channel was used for recording and analysis. The computer software program provided a signal every second to adjust for breaking force generated by the cycles flywheel.

A pneumotach was also used for testing. It is a bidirectional flow device validated to meet American Thoracic Society guidelines in measurements of flow and volume in cardiorespiratory testing (Fig 3).[12,18] Subjects placed the pneumotach fitted face mask onto their faces and breathed normally. Each person was told not to remove the pneumotach fitted face mask until completion of the test. No verbal communication occurred during the procedure between subject and tester.

Calibration of the MedGraphics Cardio2 system was performed before testing. A set-up calibration was done before all tests to verify room temperature, barometric pressure, relative humidity, ambient oxygen, ambient carbon dioxide and pneumotach volume measurements.[13] The actual procedure consisted of pedalling until VO_2 max was reached, at which time the face mask was removed and the trial was deemed complete. Throughout each test, subjects' ECG, blood pressure, and oxygen saturation were monitored as a safety precaution.

A matched paired *t*-test (dependent *t*-test) was used to compare the mean difference between the two groups (ie, wearing and not wearing the "Breathe Right") for VO_2 max, onset of VO_2 max,

Fig 2. Testing an athlete wearing the "Breathe-Right" nasal dilator.

Physiological Responses of the Subjects While Wearing and Not Wearing the "Breathe-Right" Nasal Dilator (Mean ± SD)

	VO_2 Max	Peak VO_2/kg	Onset of VO_2 Max	Max Watt Output	Respiratory Exchange Ratio	Onset of Anaerobic Threshold
Units	L/Min	mLO_2kg	Seconds	Watts	CO_2:O_2	Seconds
Without Breathe Right	3326 ± 520	44.0 ± 6.7	13.2 ± 1.9	291 ± 37	1.2 ± .1	7.4 ± 2.1
With Breathe Right	3367 ± 615	43.8 ± 6.5	13.2 ± 2.0	280 ± 40.2	1.2 ± .1	7.5 ± 2.1
Difference	41.4 ± 438.3	.2 ± 3.9	.02 ± 2.9	11.6 ± 39.5	.008 ± .07	.09 ± 1.8

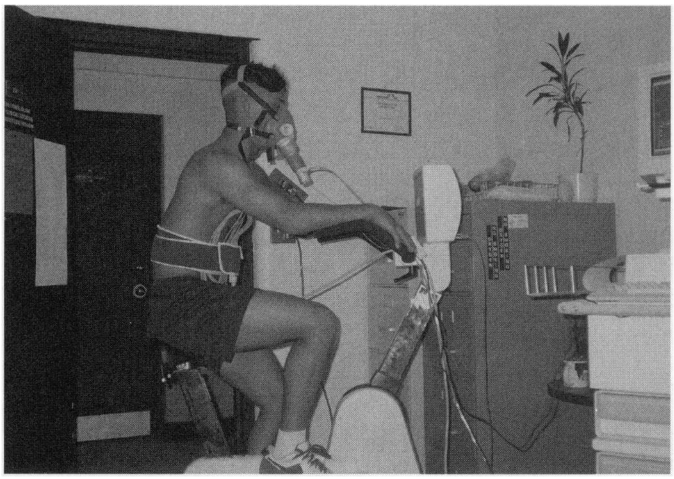

Fig 3. Pneumotach-fitted face mask.

peak VO_2/kg, respiratory exchange ratio at VO_2 max, onset of anaerobic threshold and maximum WATT output. We used the MYSTAT computer program for all statistical analysis.

RESULTS

Means and standard deviations of the six variables are in the Table. Wearing the "Breathe-Right" nasal dilator does not significantly improve any of the performance variables measured in this experiment (p values ranged between .26 to .84).

DISCUSSION

While all statistical tests show that there were no significant physiological findings, all 16 subjects mentioned that the "Breathe-Right" device in some way opened up their nasal passages. Although physiologically the "Breathe-Right" device does not seem to enhance exercise performance, the psychological edge of having open nasal airways may dictate the reason that athletes have come to depend on the "Breathe-Right" device during competition. For many athletes, the comfort associated with decongested nasal passages is priceless, especially for those who suffer from upper respiratory dysfunctions such as allergies. All in all, the psychological and nasal decongestion benefits of wearing a "Breathe-Right" device are appealing to many athletes and will probably attract many more athletes from all realms of competition to the product. Future study should explore the "Breathe-Right" device's attributed effects on exercise performance and oxygenation in nasal-congested subjects of different genders. The possibility of significant physiological findings may improve by testing congested subjects versus decongested subjects.

The MedGraphics Cardio2 bicycle ergometer was used because of its true zero work rate and 1000 WATT peak power range.[6,12,15,18] Therefore, the cycle enabled us to assess aerobic capacity using a 30 WATT ramping protocol. The 30 WATT ramp protocol exercise is a preferred method of cycle exercise.[6,12,18] It consists of continuous increased work rate over work rate maximum. The major advantages of the ramp test are: 1) The production of a linear VO_2 response, 2) the yield of large amount of data in a short period of aerobic function, and 3) good acceptance by subjects because of a smooth transition to higher work loads without a sudden noticeable increase in pedal resistance.[12,18]

CONCLUSION

This study suggests that wearing a "Breathe-Right" device will not significantly increase oxygenation, and, therefore, will not enhance exercise endurance.

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