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RESPIRATORY MUSCLE TRAINING METHODS FOR IMPROVING THE LUNG CAPACITY OF PROFESSIONAL VOCALISTS AND WIND INSTRUMENTISTS

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ABSTRACT. Introduction. Various muscle groups are involved in pulmonary ventilation, which play an essential role in maintaining proper breathing, their development being aimed at improving the physical, psychological and qualitative performance of the performance of professional singers and blowers in instruments. **Objectives**: The objectives of the training of the respiratory muscles are aimed at improving dyspnea, toning the respiratory muscles, increasing the efficiency of the respiratory muscles, increasing the volumes of air mobilized, decreasing the fan labor, controlling and coordinating the respiratory rhythm. **Methods**: The study subjects were 9 young musicians, students at the Conservatory in the singing and wind instruments sections, who performed workouts with a threshold device (POWERBreathe Inspirational Muscle Training IMT), five days a week, twice a day, for 6 weeks. Subjects performed spirometry tests VC, FVC, FEV1, FEV1/FVC, VF, FEV6 at each beginning and end of the meeting, the data collected were processed by interpreting the results of lung function and flow measurements. **Results**: The results obtained from the spirometry tests show us statistically significant differences between the initial (IT) and the final (IT) test. Thus, at the first sit, with the device adjusted to max.15% PI/PE (inspiratory – expiratory pressure), the average of the VC values, FVC, FEV1, VF, FEV6 (5.72 – 5.84l, l/s) increased by 2%, and at the end of the second session, with the device set to min.40-60% PI/PE, the average lung function values (5.72 – 6.14l, l/s) increased by 9.8%. **Conclusions**: This experiment can demonstrate that the acute effect of training with a breathing device (threshold) results in a significant increase in the use of flow during singing and blowing, leading to a sound with a higher acute sound and more activity.

Keywords: *respiratory muscle, training, exercise capacity.*

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REZUMAT. ***Metode de antrenament a musculaturii respiratorii pentru îmbunătățirea capacității pulmonare a profesioniștilor vocali și suflătorilor instrumentiști.*** **Introducere**. În ventilația pulmonară sunt implicate diverse grupe musculare care au rol esențial în menținerea unei respirații corespunzătoare, dezvoltarea lor fiind menită să îmbunătățească performanțele fizice, psihologice și calitative ale prestației cântăreților profesioniști și suflătorilor în instrumente. **Obiective**: Obiectivele antrenamentului mușchilor respiratori au ca scop ameliorarea dispneei, tonifierea musculaturii respiratorii, creșterea eficienței mușchilor respiratori, creșterea volumelor de aer mobilizate, scăderea travaliului ventilator, controlarea și coordonarea ritmului respirator. **Metode**: Subiecții studiului au fost 9 tineri muzicieni, studenți la Conservator la secțiile de canto și instrumente de suflat, care au efectuat antrenamente cu un dispozitiv threshold (POWERBreathe Inspiratory Muscle Training IMT), cinci zile pe săptămână, de două ori pe zi, timp de 6 săptămâni. Subiecții au efectuat teste spirometrice VC, FVC, FEV1, FEV1/FVC, PEF, FEV6 la fiecare început și sfârșit de ședință, datele colectate au fost prelucrate prin interpretarea rezultatelor funcției pulmonare și a măsurătorilor de debit. **Rezultate**: Rezultatele obținute la testele spirometrice ne arată diferențe semnificative statistic între testarea inițială (TI) și cea finală (TI). Astfel, la prima ședință, cu dispozitivul reglat la max. 15% PI/PE (presiune inspiratorie – expiratorie), media valorilor VC, FVC, FEV1, PEF, FEV6 (5.72 – 5.84l, l/s) a crescut cu 2%, iar la sfârșitul celei de-a doua ședințe, cu dispozitivul setat la min. 40-60% PI/PE, media valorilor funcției pulmonare (5.72 – 6.14l, l/s) a crescut cu 9.8%. **Concluzii**: Acest experiment poate demonstra că efectul acut al antrenamentului cu un dispozitiv de prag respirator (threshold) are drept consecință o creștere semnificativă a utilizării debitului în timpul cântului, ceea ce duce la un sunet cu o sonoritate acută mai mare și cu mai multă activitate.

Cuvinte cheie: *mușchi respiratori, antrenament, capacitate de efort.*

INTRODUCTION

Respiratory muscle training is the most innovative and up-to-date component of the pulmonary development program. The technique provides significant benefits when applied individually or when integrated into a respiratory empowerment program, improving muscle strength and resistance of the respiratory muscles and increasing the subject's exercise capacity (Postolache, Cojocaru 2013).

Respiratory muscle training is divided into two categories: that of the inspiring muscle and that of the exhaling muscles.

Before starting the training program, the maximum inspirational pressure in the oral cavity, which is the exercise capacity of the respiratory muscles, will be evaluated.

OBJECTIVES

The objectives of the training of the respiratory muscles are aimed at improving dyspnea, toning the respiratory muscles, increasing the efficiency of the respiratory muscles, increasing the volumes of air mobilized, decreasing the fan labor, preventing premature closure of the airways in exhalation, controlling and coordinating the respiratory rhythm.

METHODS AND MATERIALS

The methods and equipment used for the two types of training differ significantly.

Endurance training, performed by maintaining forced hyperventilation for several minutes, trains both the inspiring and exhaling muscles. In this type of training, the respiratory muscles are forced to work at high, short speeds within an extended time frame (Jimborean, Ianosi, Croitoru 2017).

Devices that require increased resistance to the oral cavity are used for training based on increased muscle strength. Respiratory muscle training uses various devices, including stimulation spirometer, Pflex resistance breathing, Flutter valve and Threshold breathing (Szasz, Postolache 2017).

The stimulation spirometer (fig. 1) is a device that contains several balls that rise according to the power of the respiratory flow. During this workout, the subject must generate a target inspirational-exhaling flow that propels the balls to the top of the device. As respiratory capacity increases, the balls rise more. The advantage of this device is that it provides encouraging visual feedback for the subject in progress (Wesst, Taylor, Campbell, 2009).

Breathing against Pflex resistance (fig. 2) is a workout consisting of a series of repeated exhalations and inspirations against an increased resistance given by a fixed diameter hole on the inspiring circuit, having six levels of resistance. This technique depends on respiratory flow and 10–15 minutes per day is recommended throughout the respiratory rehabilitation program.

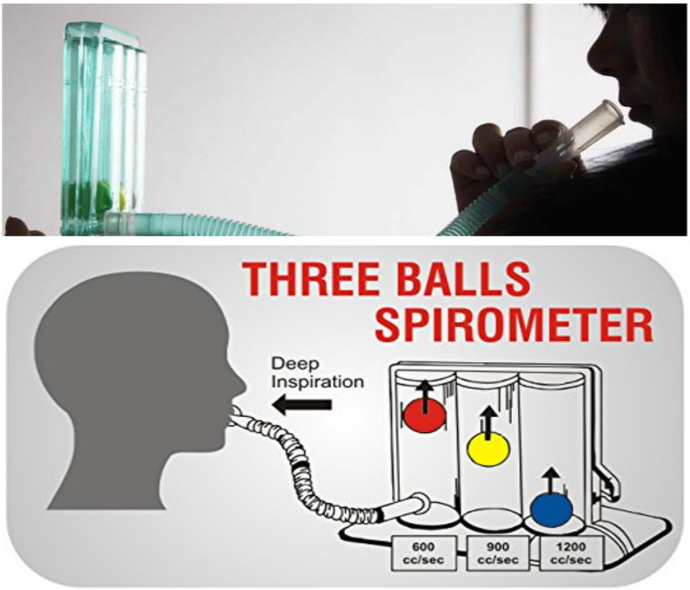

Fig. 1. Stimulation spirometer
(source: www.hitechtherapyonline.co.za)

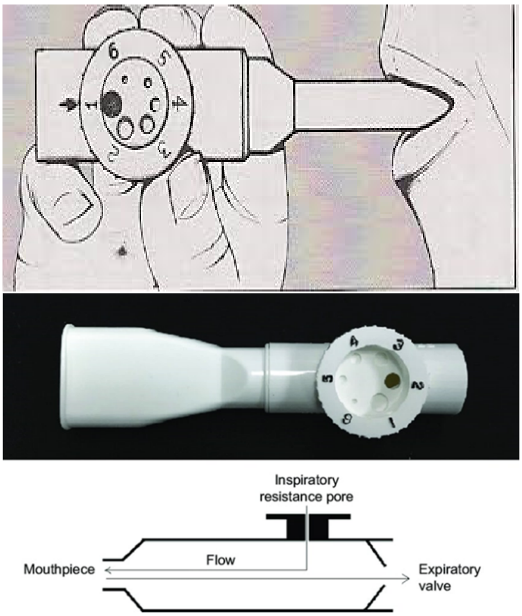

Fig. 2. Pflex Resistance
(source: www.researchgate.net)

Threshold training allows a charge at a variable, quantifiable intensity, the pressure adjusting easily, by simply rotating the distal end of the device. The device has a resistance level of 7 to 41 cm H_2O (fig. 3). Subjects will train with this device for 30 minutes daily at a resistance of 30%–60% of the initial value of maximum inspirational pressure in the oral cavity (McConnell, 2013).

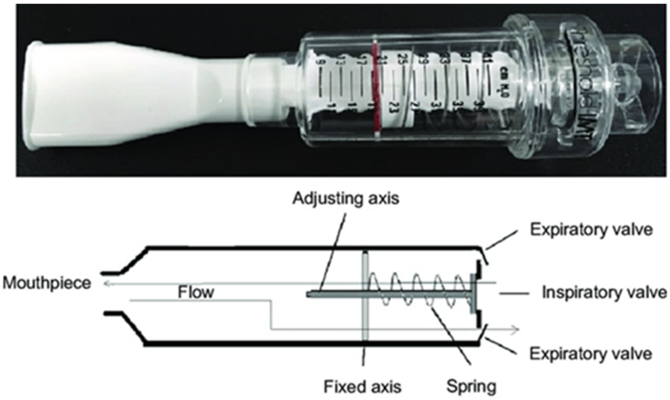

Fig. 3. Threshold Device
(source: www.researchgate.net)

The Threshold PEP (Positive Expiratory Pressure Device) has the same one-way flow valve system that opens with the subject's exhalation. This creates positive pressure that keeps the airways open.

Isocapnic ventilation training – also called endurance training – is a technique consisting of forced ventilation at increased flow sustained for several minutes. To train the inspiring muscles, the subjects will perform an inspiration through a device, usually POWERBreathe (fig. 4), which contains an electronically activated valve that resists inhalation and can automatically adapt to the increase in the strength of the inspiring muscles at the beginning of each training session. One of the advantages is that the results of the workout are displayed on a screen, allowing monitoring and optimization of the training technique. Cycles of 30 breaths are performed twice a day. Exercises will be performed for 30 minutes daily, six five-minute sessions, with two minutes break between sessions, increasing the resistance of the device by 5% per week (McConnell, 2013).

Fig. 4. POWERBreathe® Kinetic K3 is the ideal respiratory training device for professionals. It features a technology of self-regulation of opposing resistance during the training of the respiratory muscles, adapting specifically to each user and its respiratory functions. This perfected electronic training system is also recommended for all those who want to improve their respiratory capacity, requiring only two sessions per day of 30 breaths

(Source: www.respiracorect.ro)

Isocapnic hyperpnea is a physically demanding method that requires a high degree of involvement and motivation on the part of the subject.

The POWERBreathe device contains a valve that resists inhalation. The intensity and frequency of the exercises depend on the subject's tolerance and respiratory failure.

The most used device for training the exhaling muscles is Shaker Plus (fig. 5). Mobilizes secretions from the airways through vibrations and helps to eliminate them thus making breathing easier.

Fig. 5. Shaker Plus Device
(source: www.habdirect.co.uk)

SHAM method

We found a Dutch study (Dries Koen et al., 2017) that indicates a muscle training program determined on an increase in exhaling muscle pressure that can be applied to student musicians from the singing and wind instrument sections. However, these results were not directly related to the sound performance produced and the quality of the performance. In the literature we have not found previous studies that directly correlate the effects of a respiratory muscle formation program with musical parameters. We propose the hypothesis that a respiratory muscle training program using a *threshold* device could be a universal solution for breath development training in singers and instrumentalists. An increase in respiratory muscle strength and a strong focus on breathing technique through this non-musical exercise should allow a performer to broaden and improve his action repertoire, resulting in a more efficient singing technique, different sound possibilities and increased performance/comfort in interpretation.

The purpose of this study is to investigate whether artistic performance can be improved in professional and semi-professional singers if a muscle respiratory training protocol is required. This protocol aims at strengthening the respiratory muscles and should result in singers improving the respiratory flow so necessary for the length of the sung phrases.

For this pilot study we used a batch of 9 young musicians, aged 19 to 23, tenors, baritones, sopranos, mezzos and instrumentalists on which we will apply the SHAM training program, along with the initial, intermediate and final measurements. Due to the current situation, the pandemic, the quarantine areas, the online work and school, we did not have access to a larger number of subjects in order to be able to do comparative studies.

Table 1. Anthropometric measurements

Subjects	
1 tenor (male): 19 years, 64kg, 1.77m	S1
1 tenor (male): 21 years, 74kg, 1.85m	S2
1 baritone (male): 20 years, 96kg, 1.74m	S3
1 baritone (male): 23 years, 115kg, 1.80m	S4
1 soprano (female): 21 years, 55kg, 1.64m	S5
1 soprano (female): 22 years, 61kg, 1.72m	S6
1 mezzo (female): 23 years, 84kg, 1.68m	S7
1 clarinet (male): 21 years, 75kg, 1.81m	S8
1 oboe (male): 21 years, 88kg, 1.78m	S9

Body mass (G) and body height (h) we measured using standardized anthropometric techniques (Table 1).

We used a 5-week validated training program with a Breathe Air® Powerlung®) designed for a combination of muscle and inspirational training (fig.6).

Fig. 6. POWERBreathe Device
(source: www. henrotech.be)

This small hand held device exerts pressure against breathing flow during breathing and exhalation. SHAM training (5 weeks) consists of a routine workout, breathing in the device, with resistance levels set at 15% - 40% - 60% of the maximum inspiring and exhaling pressure MIP/MEP (MIP - maximum inspiration pressure/ MEP - maximum expiratory pressure) measured at the initial level. I applied the following training scheme: one week, for five days a set of 40 breaths (4 times 10 breaths, inspiration-breathing), twice a day, with resistance set at max.15% MIP/MEP, followed by two days of non-activity. The adherence, time spent and effort will be monitored with a written journal. This followed immediately (without a break period) a real training program (4 weeks) consisting of the same routine training, with the resistance progressively established by min. 40 – 60% of MIP / MEP.

Table 2. Training sessions

Session 1 (baseline)	**Session 2 (4 weeks)**
SHAM training (max 15% of MIP/MEP), 1 week, 5 days/week, 2x/day with a difference of 6 hours between sessions	SHAM training (min 15% - max 100% of MIP/MEP), 4 weeks, 5 days/week, 2x/day with a difference of 6 hours between meetings
1. lung function testing	1. lung function testing
2. SHAM training session (40 breaths at max.15% of MIP+MEP)	2. SHAM training session (40 breaths at min. 40-60% of MIP+MEP)
3. tests to measure respiratory flow	3. tests to measure respiratory flow

We performed two sessions: baseline (heating training), and SHAM training. At each session we carried out a series of tests to assess the influences of training on lung function and respiratory flow. During the first workout, the resistance setting of the hand device was at the level of SHAM (max.15% MIP / MEP). During the second training, the strength of the hand device was established at the training level (min. 40% - 60% MIP / MEP).

We performed spirometric measurements with Vitalograph ALPHA Touch Spirometer (Ltd, Intl., Monkeys Moreton, U.K.), before and after each training session. Subjects were tested in a sitting position, carrying a clip on their noses. After maximum inspiration, they expired as loud and as quickly as possible. They were encouraged to continue expiring for at least six seconds so that the forced exhaling volume for one second (FEV1), the forced exhaling volume for 6 seconds (FEV6) and the forced vital capacity (FVC) could be measured. The tests will be repeated three to five times until the two higher values recorded - forced life force (FVC) and FEV1, FEV6 will vary by less than 3%. Direct measurements include VC (vital capacity – liters), FVC (liters), FEV1 (liters), FEV6 (liters) and peak-PEF exhaling flow (liters/second). The forced expiring ratio (FEV1/ FVC × 100) will also be calculated (%). All of the above measurements will be made under standard environmental conditions by continuously measuring temperature, humidity and atmospheric pressure allowing comfort temperature (between 18 °C and 22 °C), atmospheric pressure of 760 mmHg and a relative atmospheric humidity of 30 to 60% (Miller M., et al. 2005).

Table 3. Training sessions

Sessions	Subjects
Session 1	Initial measurements VC, FVC, FEV1, FEV1/FVC, VF, FEV6
	SHAM 1 week-hand workout with breathing at max. 15% MIP+MEP
	Control measurements VC, FVC, FEV1, FEV1/FVC, VF, FEV6
Session 2	SHAM 2 week-to-week workout with breaths at min. 15% - 40% MIP+MEP
	SHAM 2 week-to-week workout with breaths at min. 40% - 60% MIP+MEP
	Final measurements VC, FVC, FEV1, FEV1/FVC, VF, FEV6

Note: VC – vital capacity (l); FVC – forced vital capacity (l); FEV1 – forced exhaling volume for one second (l); PEF – peak expiring flow (l/s); FEV6 – forced exhaled volume for 6 seconds (l)

Before the start of the training, we performed a series of initial measurements for the assessment of lung function (Table 4).

Table 4. Initial measurements

Subjects	Vc	FVC	FEV1	FEV1/FVC	Pef	FEV6
S1	4.49	5.54	4.81	86.80%	9.87	5.59
S2	4.67	6.24	5.28	84.60%	10.96	6.31
S3	4.41	5.74	4.73	82.40%	10.26	5.73
S4	4.58	5.96	4.98	83.60%	10.62	5.97
S5	3.29	4.16	3.58	86.10%	7.19	4.13
S6	3.37	4.53	3.84	84.80%	7.81	4.52
S7	3.31	4.21	3.68	87.40%	7.69	4.21
S8	3.57	5.97	4.98	83.40%	10.56	5.93
S9	3.56	5.89	4.91	83.40%	10.36	5.84
Average	3.91	5.36	4.53	84.72%	9.48	5.35
Total average				5.72		

Note: VC – vital capacity (l); FVC – forced vital capacity (l); FEV1 – forced exhaling volume for one second (l); PEF – peak expiring flow (l/s); FEV6 – forced exhaled volume for 6 seconds (l)

After a week of breathing with the device set to max.15% MIP/MEP, we performed another series of measurements to assess pulmonary flow and function (Table 5).

Table 5. Intermediate measurements

Subjects	Vc	FVC	FEV1	FEV1/FVC	Pef	FEV6
S1	4.56	5.61	4.94	88.06%	10.09	5.71
S2	4.74	6.38	5.37	84.17%	11.16	6.41
S3	4.51	5.84	4.84	82.88%	10.46	5.89
S4	4.63	6.11	5.06	82.82%	10.85	6.03
S5	3.39	4.21	3.66	86.94%	7.36	4.24
S6	3.41	4.66	3.91	83.91%	7.99	4.65
S7	3.37	4.27	3.77	88.29%	7.81	4.27
S8	3.61	6.08	5.09	83.72%	10.78	6.03
S9	3.66	6.03	5.03	83.42%	10.54	5.95
Average	3.98	5.46	4.63	84.90%	9.67	5.46
Total average				5.84		

Note: VC – vital capacity (l); FVC – forced vital capacity (l); FEV1 – forced exhaling volume for one second (l); PEF – peak expiring flow (l/s); FEV6 – forced exhaled volume for 6 seconds (l)

Following the measurements we observed an increase of 2% (5.72 – 5.84) in lung function parameters, due to the difference in the mean between the two tests. After two days of inactivity, the 4-week program began with resistance set to min. 40 – 60% MIP/MEP, gradually increasing. At the end we made the final measurements (Table 6):

Table 6. Final measurements

Subjects	Vc	FVC	FEV1	FEV1/FVC	Pef	FEV6
S1	4.95	6.05	5.26	86.94%	10.07	6.14
S2	5.11	6.87	5.82	84.72%	11.18	6.93
S3	4.85	6.31	5.20	82.41%	10.47	6.29
S4	5.01	6.58	5.44	82.67%	10.83	6.56
S5	3.66	4.53	3.96	87.42%	7.33	4.53
S6	3.73	4.98	4.20	84.34%	7.97	4.96
S7	3.60	4.60	4.06	88.26%	7.84	4.62
S8	3.91	6.59	5.44	82.55%	10.77	6.51
S9	3.93	6.45	5.39	83.57%	10.57	6.41
Average	4.30	5.88	4.97	84.76%	9.67	5.88
Total average				6.14		

Note: VC – vital capacity (l); FVC – forced vital capacity (l); FEV1 – forced exhaling volume for one second (l); PEF – peak expiring flow (l/s); FEV6 – forced exhaled volume for 6 seconds (l)

Measurements showed an increase in respiratory parameters of 9.8% (5.72 – 6.14) compared to baseline testing, and 5.13% (5.84 – 6.14) compared to intermediate testing. Although there was a slight increase in peak expiring flow (PEF) in the 1st preparatory meeting, no significant change in the EF was found after the 4-week program.

Table 7. Centralized parameters VC / FVC / FEV from reference values to intermediate values and final values

Subjects	VC (0)	VC (test I)	Vc (Test II)	FVC (0)	FVC (test I)	FVC (test II)	FEV 1 (0)	FEV 1 (test I)	FEV1 (test II)
S1	4.49	4.56	4.95	5.54	5.61	6.05	4.81	4.94	5.26
S2	4.67	4.74	5.11	6.24	6.38	6.87	5.28	5.37	5.82
S3	4.41	4.51	4.85	5.74	5.84	6.31	4.73	4.84	5.2
S4	4.58	4.63	5.01	5.96	6.11	6.58	4.98	5.06	5.44
S5	3.29	3.39	3.66	4.16	4.21	4.53	3.58	3.66	3.96
S6	3.37	3.41	3.73	4.53	4.66	4.98	3.84	3.91	4.2
S7	3.31	3.37	3.6	4.21	4.27	4.6	3.68	3.77	4.06
S8	3.57	3.61	3.91	5.97	6.08	6.59	4.98	5.09	5.44
S9	3.56	3.66	3.93	5.89	6.03	6.45	4.91	5.03	5.39
Average data	3.91	3.98	4.3	5.36	5.46	5.88	4.53	4.63	4.97

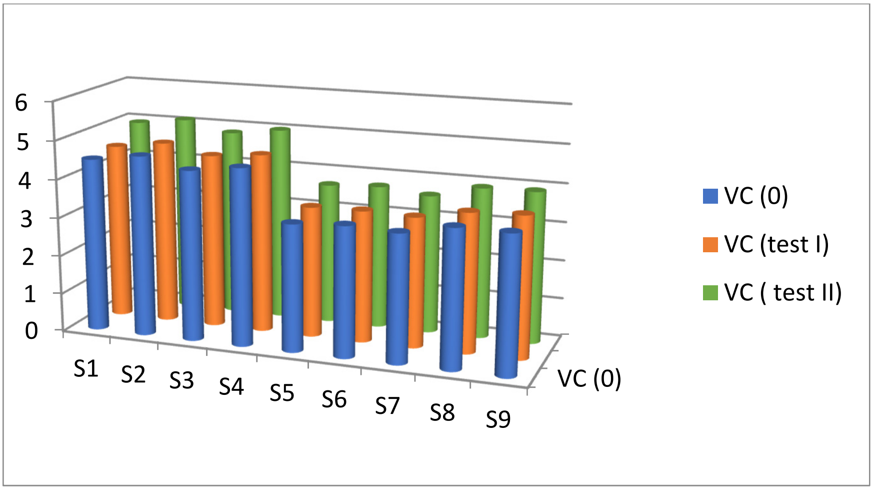

Fig. 7. Evolution of VC from initial to final testing

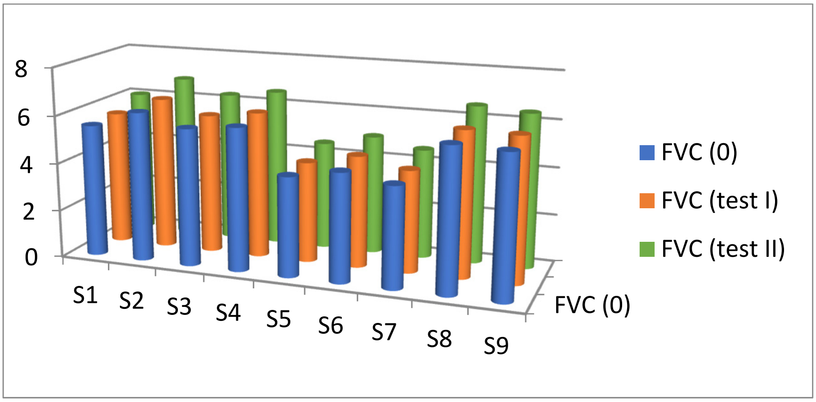

Fig. 8. Evolution of FVC from initial to final testing.

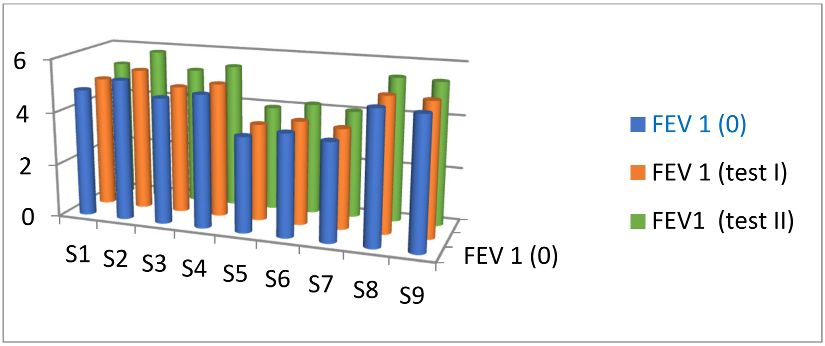

Fig. 9. Evolution of FEV1 from initial to final testing.

Table 8. Centralized parameters PEF / FEV6 from reference values to intermediate values and final values

Subjects	PEF (0)	PEF (test I)	PEF (test II)	FEV6 (0)	FEV6 (test 1)	FEV6 (test II)
S1	9.87	10.09	10.07	5.59	5.71	6.14
S2	10.96	11.16	11.18	6.31	6.41	6.93
S3	10.26	10.46	10.47	5.73	5.89	6.29
S4	10.62	10.85	10.83	5.97	6.03	6.56
S5	7.19	7.36	7.33	4.13	4.24	4.53
S6	7.81	7.99	7.97	4.52	4.65	4.96
S7	7.69	7.81	7.84	4.21	4.27	4.62
S8	10.56	10.78	10.77	5.93	6.03	6.51
S9	10.36	10.54	10.57	5.84	5.95	6.41
Average data	9.48	9.67	9.67	5.35	5.46	5.88

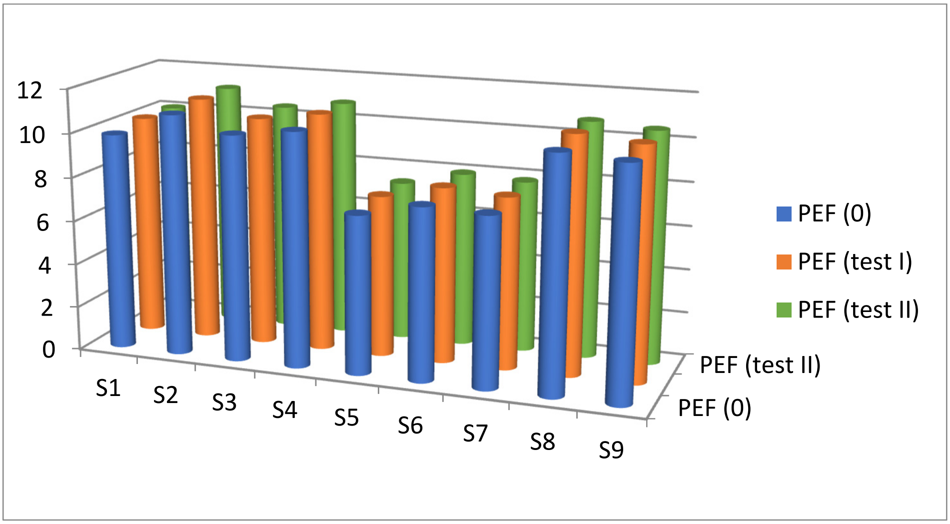

Fig. 10. Evolution of the EF from initial to final testing.

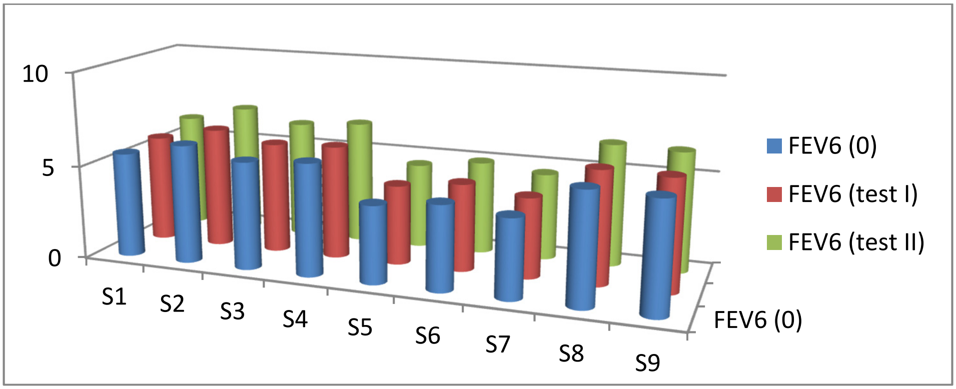

Fig. 11. Evolution of FEV6 from initial to final testing.

Table 9. Final Average Centralizer

	Evolution of the parameters analyzed
Basic measurements (initial point)	5.72
Intermediate measurements	5.84
Final measurement (final point)	6.14

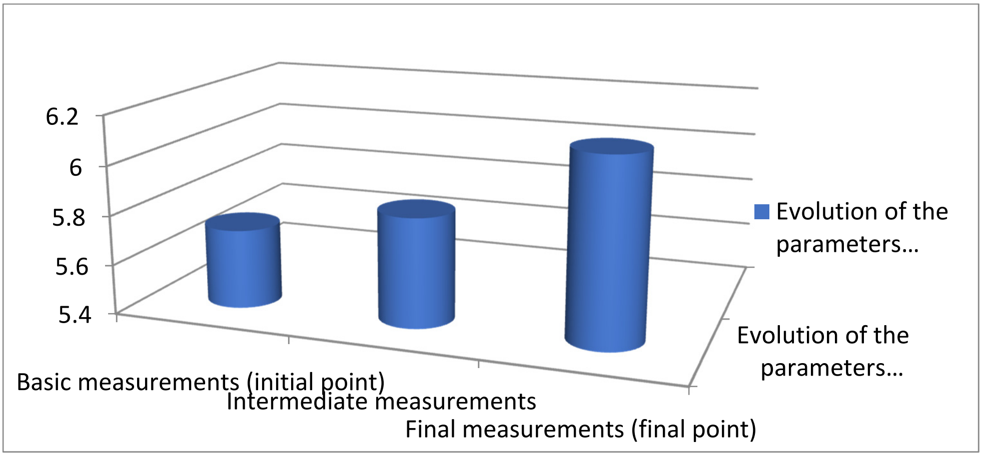

Fig. 12. Evolution of the parameters analyzed.

During the two training periods, participants were asked to track their progress in a journal and the documented length of each training session, the number of breaths completed and a feeling of effort (1-5) on a visual analog scale (Drummond et al., 2015). Participants reported that at resistive breathing training 40-60% MIP/MEP, respiratory muscle training demonstrated stronger resistance for both inspiration and exhalation compared to low resistive breathing training of 15% MIP/MEP.

The literature (Beckerman M, et al., 2005), shows that a longer-term respiratory muscle workout, up to 12 months, when the training stimulus is suitable for increasing the inspiring muscle strength, would increase exercise capacity, improve quality of life and decrease dyspnea.

CONCLUSIONS

This experiment can demonstrate that the acute effect of training with a breathing threshold device, results in a significant increase in the use of flow during singing. Increased use of respiratory flow after completion of the SHAM training program may also be observed. Although the inspirational and exhaling pressures for participants increased, the effect was not considered significant for the peak inspirational and exhaling flows at SHAM training. There may be several reasons for these observations. Low strength settings for MIP/MEP training may lead to a smaller increase in lung function parameters. A training program with a higher registry setting would lead to a greater increase in respiratory muscle strength and peak flows, as demonstrated in the literature (DePalo, et al. 2004).

This method can clearly indicate that a respiratory muscle formation program using a device (threshold) with a medium-strength threshold increases respiratory flows and hence lung function. In addition, it can be shown that immediately after a training session, the flow increases and pressure control is easier, which leads to a sound with a sound conforming to specialized standards and an increased acoustic efficiency.

REFERENCES

1. Beckerman, M, Magadle, R, Weiner, M, Weiner, P. (2005). The effects of 1 year of specific inspiration muscle training in patients with COPD. *Chest*, 128(5):3177-3182.
2. DePalo, V.A., Parker, A.L., Al-Bilbeisi, F., & McCool, F.D. (2004). Respiratory muscle strength training with nonrespiratory maneuvers. *Journal of Applied Physiology*, 96, 731–734.
3. Drummond, M.F., Sculpher, M.J., Claxton, K., Stoddart, G.L., & Torrance, G.W. (2015). *Methods for the economic evaluation of health care programs*. Oxford, UK: Oxford University Press.
4. Jimborean G, Ianosi E.S., Croitoru A, Szasz S, Postolache P. (2017). Respiratory muscle training in chronic obstructive pulmonary disease. *Pneumology*, 66(3): 128–30.
5. Koen, D., Walter, V., Loeckx, J., Schuermans, D., Dirckx, J. (2017). Effects of a respiratory muscle training program on respiratory function and musical parameters in saxophone players*. Journal of new music research*, 46(4): 381-393.
6. McConnell, A. (2013). *Respiratory Muscle Training.* Churchill Livingstone - ISBN: 9780702054556.
7. Miller MR, Hankinson J, Brusasco V, Burgos F, Casaburi R, CoatesA, et al. (2005). ATS/ERS Task Force. Standardization of spirometry. *Eur Respir J.*, 26 (2):319-38.11.
8. Postolache P, Cojocaru DC. (2013). Pulmonary rehabilitation--from guidelines to practice. *Rev Med Chir Soc Med Nat Iasi/The Medical Surgical Journal*, 117(2): 380–87.
9. Wesst C.R., Taylor B.J., Campbell I.G. et al. (2009). Effects of inspiratory muscle training in Paralympic athletes with cervical spinal cord injury. *Med. Sci. Sports Exerc*, 41: S31–S32.