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Original Article

Development of the Respiratory Capacity of Vocal Professionals and Wind Instrumentalists Using the Respiratory Threshold Device

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Abstract

During singing, inspiration and expiration are determined by muscular activity wich involves significant specific physical effort. Objectives: The respiratory muscle training aim to improve respiratory flow, increase respiratory muscle efficiency and decrease ventilatory work. Methods: The study subjects were 22 young musicians, divided into two groups; one group performed training with a threshold device, for 8 weeks, while the other carried out their daily activities. Subjects underwent spirometric tests VC, FVC, FEV1, FEV1/FVC, PEF, FEV6 at the beginning and end of each session; the collected data were processed by interpreting pulmonary function results and flow measurements. Results: The following variables showed significant differences: FVC – 10.7%, FEV1 – 11.3%, PEF – 2.9%, and FEV6 – 11%. Conclusions: This experiment can demonstrate that the acute effect of training with a respiratory threshold device results in a significant increase in flow utilization during singing and a greater increase in the parameters of lung function.

1. Introduction

During singing, both inspiration and expiration are determined by muscular activity. An experienced singer adjusts the volume of each breath to the length and requirements of the sung phrase, so that excess stale air (air with a high level of carbon dioxide) does not need to be expelled at the end of the breath before the next inspiration. To increase this volume, we need to use inspiratory muscles, and to reduce it, we use expiratory muscles. If we inhale as much as possible, and then exhale as much as we can, the volume of air expelled from the lungs is our vital capacity (VC), which is the maximum available to sustain a single spoken or sung

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phrase (Watson, 2014).

A good understanding of the physiological basis of respiration and the breathing strategies underlying singing is a necessary condition for personal exploration. One of the reasons why objective scientific studies of respiration are so important is that the sensations we receive from the respiratory system are incomplete and can lead us to incorrect conclusions. A recurring theme resulting from research on respiration in singers is that different individuals achieve similar goals through different means. Although differences in vital capacity are easily appreciated, the possibility that age, sex, and body type may influence optimal research strategies is recognized. Respiration is just one element of singing technique, and in the concept of support, it must be integrated with good use of the vocal source and efficient vocal projection to achieve a satisfactory result. While expiratory muscles control subglottic pressure, the actual level required depends on these other factors, so that respiratory technique cannot be viewed in isolation (Watson, 2014).

As a result, I have developed a muscular training program aimed at increasing expiratory muscle pressure, under the name of SHAM, which I have applied to young musicians from vocal and wind instrument sections. However, these results were not directly related to the performance of the produced sound and the quality of interpretation. In the specialized literature, I have not found previous studies directly correlating the effects of a respiratory muscle development program with musical parameters. Most studies on this topic focus on the rehabilitation of patients with chronic obstructive pulmonary disease (COPD) and the resulting clinical benefits (Lacasse Y, et al. 1996, Ries et al. 2007, Griffiths Tl., et al. 2000). Belman and Shadmehr (1988) were the first to use respiratory muscle training as a means to avoid respiratory impairment in lung patients and found that the use of such a respiratory threshold device increased muscle strength and endurance of the muscles involved in respiration.

2. Material and methods

Objectives

We propose that a consequence of a respiratory muscle training program using a threshold device could be a universal solution for respiratory development training for both singers and instrumentalists, as well as other categories of individuals in need of such improvements.

An increase in respiratory muscle strength and a strong focus on breathing technique through this non-musical exercise should allow a performer to expand and improve their repertoire of actions, resulting in more efficient singing technique, different sound possibilities, and increased performance comfort (Dries et al., 2017).

The key concept of respiratory strength training revolves around the idea that muscles need to be directly targeted during training to achieve functional results (specificity), and they must be sufficiently stimulated to gain strength and adapt to increased stress (overload). Exercises should be adjusted over time to avoid

plateaus and strength increases, and to overcome muscle adaptability through progressive resistance (McArdle, Katch, & Katch, 2007; Powers & Howley, 2002). The respiratory muscle training program utilizes a respiratory threshold device precisely to stimulate these muscles. During training, skeletal muscles adapt in response to increased workload (Bandy, Lovelace-Chandler, & McKitrick-Bandy, 1990) and must be forced to overload until hypertrophy occurs, or contract at near-maximum tensions to achieve significant growth (Fahey, 1998; Powers & Howley, 2002; McArdle et al., 2007).

The purpose of the research

The aim of this research is to investigate whether artistic performance can be enhanced in professional and semi-professional singers by implementing a protocol of respiratory muscle training. This protocol aims to strengthen the respiratory muscles and is expected to result in improved respiratory airflow in singers. It is anticipated that improved regulation of airflow and subglottal pressure will be manifested through increased maximum phonation time, increased frequency and/or intensity range, and improved consistency of airflow necessary for the length of sung phrases**.**

For this study, we recruited a cohort of 22 young musicians aged between 19 and 24 years, including tenors, baritones, sopranos, mezzos, and instrumentalists, whom we divided into two groups. One group, consisting of 11 subjects, underwent the SHAM training program using the Powerbreathe device (Tab.1), while the other group of 11 participants served as the control group (Tab.2). The control group did not undergo any intervention but continued their daily activities, which included classes and rehearsals. We conducted intermediate and final measurements only on this group for comparative data analysis.

Table 1. *Experimental Group*

SUBJECTS (study group)		AGE	WEIGHT	HEIGHT
S1	soprano (female)	22 years	61kg	1,72m
S2	mezzo (female)	23 years	84kg	1,68m
S3	alto (female)	21 years	55kg	1,64m
S4	countertenor(male)	19 years	64kg	1,77m
S5	tenor (male)	21 years	74kg	1,85m
S6	baritone (male)	20 years	96kg	1,74m
S7	bass (male)	23 years	115kg	1,80m
S8	flute (male)	22 years	86kg	1,71m
S9	clarinet (male)	21 years	75kg	1,81m
S10	oboe (male)	21 years	88kg	1,78m
S11	french horn (male)	24 years	81kg	1,83m

Table 2. *Control group*

SUBJECTS (control group)		AGE	WEIGHT	HEIGHT
S1	soprano (female)	21 years	58kg	1,61m
S2	mezzo (female)	22 years	78kg,	1,65m
S3	alto (female)	20 years	54kg	1,68m
S4	countertenor(male)	20 years	65kg	1,78m
S5	tenor (male)	19 years	75kg	1,83m
S6	baritone (male)	21 years	93kg	1,77m
S7	bass (male)	23 years	108kg	1,83m
S8	flute (male)	20 years	79kg	1,73m
S9	clarinet (male)	22 years	71kg	1,79m
S10	oboe (male)	24 years	85kg	1,80m
S11	French horn (male)	23 years	88kg	1,86m

Body weight (G) and body height (h) were measured using standardized anthropometric techniques.

We utilized an 8-week validated training program with a pressure threshold measurement device (Breathe Air® Powerlung®), designed for a combination of muscular and inspiratory training.

Fig. 1. *Powerbreath Device*
(source: https://www.breathewellphysio.com).

This handheld device (Fig.1) applies pressure against the flow of breathing during inhalation and exhalation, using the basic principles of resistance training. Just as we use weights to train arm muscles, by inhaling through POWERbreathe®, against resistance, we will train the respiratory muscles, increasing their strength and endurance.

The SHAM training (8 weeks) consists of a routine breathing exercise using the device, with resistance levels set at 15% - 40% - 60% of the maximum inspiratory and expiratory pressures (MIP/MEP) measured initially. We applied the following training scheme: for two weeks, five days a week, a set of 30 breaths (3

sets of 10 breaths, inspiration-expiration, with a 1-2 minute break between repetitions), twice a day with a 6-hour difference between sessions, with resistance set at a maximum of 15% MIP/MEP. This was immediately followed (without a pause period) by a 3-week training program, five days a week, with resistance set at a maximum of 40% of MIP/MEP, with breaks of two days at the end of each week. Additionally, another 3 weeks followed with the same regimen, with resistance set at a maximum of 60% of MIP/MEP. Adherence, time spent, and effort were individually monitored in a written journal.

Table 3. *Training Sessions*

Session 1 (2 weeks)	**Session 2 (3 weeks)**	**Session 3 (3 weeks)**
SHAM training (max 15% of MIP/MEP), 2nd week, 5 days/week, 2x/day with a 6-hour difference between sessions	SHAM training (max 40% of MIP/MEP), 3 weeks, 5 days/week, 2x/day with a 6-hour difference between sessions	SHAM training (max 60% of MIP/MEP), 3 weeks, 5 days/week, 2x/day with a 6-hour difference between sessions
Lung function testing		
SHAM training session (40 breaths at max 15% of MIP+MEP)	SHAM training session (40 breaths at max 40% of MIP+MEP)	SHAM training session (40 breaths at max 60% of MIP+MEP)
		Respiratory flow measurement tests

We conducted three training sessions with different levels of resistance. Before starting the training, we performed a series of tests to establish baseline values, and after completing the sessions, we conducted another series of tests to assess the influence of training on lung function and respiratory flow. During the first training session, the handheld device resistance setting was at the SHAM level (max. 15% MIP/MEP). During the second training session, the resistance setting of the handheld device was set to training level (max. 40% MIP/MEP), and during the third session, we set the device to training level (max. 60% MIP/MEP).

We performed spirometric measurements using the Vitalograph ALPHA Touch Spirometer (Ltd, Intl., Maids Moreton, U.K.), before and after each training session. Subjects were tested in a seated position, wearing a nose clip. After a maximal inspiration, they exhaled as forcefully and quickly as possible. They were encouraged to continue expiration for at least six seconds so that forced expiratory volume in one second (FEV1), forced expiratory volume in six seconds (FEV6), and forced vital capacity (FVC) could be measured. Tests were repeated three to five times until the two highest recorded values—forced vital capacity (FVC) and FEV1, FEV6—varied by less than 3%. Direct measurements included VC (vital

capacity—measured in liters), FVC (forced vital capacity—measured in liters), FEV1 (forced expiratory volume in one second—measured in liters), FEV6 (forced expiratory volume in six seconds—measured in liters), and peak expiratory flow rate (PEF) (liters/second). The forced expiratory ratio (FEV1/FVC × 100) was also calculated (percentage %). All measurements were conducted under standard environmental conditions by continuously measuring temperature, humidity, and atmospheric pressure, which ensured comfortable temperature (between 18°C and 22°C), atmospheric pressure of 760 mmHg, and relative atmospheric humidity of 30% to 60% (Miller et al., 2005).

Table 4. *Training sessions and measurements*

SESSIONS	SUBJECTS
	Initial measurements VC, FVC, FEV1, FEV1/FVC, PEF, FEV6
Session 1	SHAM Training (2 weeks) with breaths at max 15% MIP+MEP
Session 2	SHAM Training (3 weeks) with breaths at max 40% MIP+MEP
Session 3	SHAM Training (3 weeks) with breaths at max 60% MIP+MEP
	Final measurements VC, FVC, FEV1, FEV1/FVC, PEF, FEV6

Table 5. *Sessions*

Session	Duration	Resistance (%)
1	2 weeks	15
2	3 weeks	40
3	3 weeks	60

VC - Vital capacity (l)
FVC - Forced vital capacity (l)
FEV1 - Forced expiratory volume in one second (l)
FEV1/FVC - Forced expiratory ratio (percentage %)
PEF - Peak expiratory flow rate (l/s)
FEV6 - Forced expiratory volume in six seconds (l)

To complement this method, peripheral muscle toning exercises can be included to increase the elasticity of the chest cage. These exercises can be performed twice a week, for 50 minutes per session. They can be grouped into three types of breathing used by singers: subclavicular breathing (e.g., for the head, neck, and shoulders), costal-diaphragmatic breathing (e.g., for the trunk), and abdominal breathing (e.g., for the abdomen). The duration of a peripheral muscle training session can vary between 20 and 60 minutes per day, 3-4 days per week, at an intensity of 60-80% of the maximum working rate. Training sessions should start at low intensity and short duration, gradually increasing to the point of fatigue.

The measured indicators were analyzed descriptively by calculating and comparing the most important descriptive statistics (mean, median, etc.). The descriptive values obtained at each measurement were evaluated to see if there was an improvement in the subjects' performance from the initial measurement to the final one following the application of the method. Considering that repeated measurements were performed on small samples of subjects (11), non-parametric tests were necessary. The Wilcoxon test was applied for respiratory measurements (which totaled 2 - initial and final) to present the test values and the obtained probability (p-value), and to assess the significance level for validating the effectiveness of the applied method.

NPar Tests – Group Study

Wilcoxon Signed Ranks Test

Tabel 6. *Wilcoxon Signed Ranks Test*

Ranks

		N	Mean Rank	Sum of Ranks
VC_f - VC_i	Negative Ranks	0[a]	.00	.00
	Positive Ranks	11[b]	6.00	66.00
	Ties	0[c]		
	Total	11		
FVC_f - FVC_i	Negative Ranks	0[d]	.00	.00
	Positive Ranks	11[e]	6.00	66.00
	Ties	0[f]		
	Total	11		
FEV1_f - FEV1_i	Negative Ranks	0[g]	.00	.00
	Positive Ranks	11[h]	6.00	66.00
	Ties	0[i]		
	Total	11		
FEV1/FVC_f - FEV1/FVC_i	Negative Ranks	4[j]	5.38	21.50
	Positive Ranks	6[k]	5.58	33.50
	Ties	1[l]		
	Total	11		
PEF_f - PEF_i	Negative Ranks	1[m]	1.00	1.00
	Positive Ranks	10[n]	6.50	65.00
	Ties	0[o]		
	Total	11		
FEV6_f - FEV6_i	Negative Ranks	0[p]	.00	.00
	Positive Ranks	11[q]	6.00	66.00
	Ties	0[r]		
	Total	11		

a. VC_f < VC_i
b. VC_f > VC_i
c. VC_f = VC_i
d. FVC_f < FVC_i
e. FVC_f > FVC_i
f. FVC_f = FVC_i
g. FEV1_f < FEV1_i
h. FEV1_f > FEV1_i
i. FEV1_f = FEV1_i
j. FEV1/FVC_f < FEV1/FVC_i
k. FEV1/FVC_f > FEV1/FVC_i
l. FEV1/FVC_f = FEV1/FVC_i
m. PEF_f < PEF_i
n. PEF_f > PEF_i
o. PEF_f = PEF_i
p. FEV6_f < FEV6_i
q. FEV6_f > FEV6_i
r. FEV6_f = FEV6_i

The next table is the most important one, presenting the results of the Wilcoxon signed-rank test for each pair of differences. Thus, on the first row, we have the calculated test statistic (Z), and on the second row, the associated probability (Asymp. Sig. (2-tailed)) for each pair of differences. The test hypotheses (2-sided) are as follows:

a. The median difference is 0 (there is no significant difference in the final measurements of the studied indicator compared to the initial ones).

b. The median difference is different from zero (there is a significant difference in the final measurements of the studied indicator compared to the initial ones).

Tabel 7. *Test statistics*

Test Statistics[a]						
	VC_f - VC_i	FVC_f - FVC_i	FEV1_f - FEV1_i	FEV1/FVC_f - FEV1/FVC_i	PEF_f - PEF_i	FEV6_f - FEV6_i
Z	-2.937[b]	-2.934[b]	-2.940[b]	-.612[b]	-2.851[b]	-2.934[b]
Asymp. Sig. (2-tailed)	.003	.003	.003	.540	.004	.003

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

We observe that for a significance level set at 5% (α=0.05), the null hypothesis of a median difference of 0 is rejected (Asymp. Sig. < 0.05), meaning there is a significant difference in the final measurements compared to the initial ones for 5 out of the 6 studied indicators (highlighted in green).

On the other hand, the null hypothesis of a median difference of 0 is accepted for 1 indicator, indicating no significant difference in the final measurements compared to the initial ones for this indicator (Asymp. Sig. > 0.05) (highlighted in orange).

Furthermore, it's noted that the null hypothesis of a median difference of 0 is accepted for the indicator FEV1/FVC (forced expiratory ratio), for which descriptive statistics have highlighted a very small relative change for the two parameters of central tendency studied (mean and median).

Thus, we can conclude that the preliminary descriptive analysis is supported by the inferential one.

NPar Tests – control group

Wilcoxon Signed Ranks Test

Tabel 8. *Wilcoxon Signed Ranks Test*

Ranks

		N	Mean Rank	Sum of Ranks
VC_f - VC_i	Negative Ranks	6[a]	4.67	28.00
	Positive Ranks	5[b]	7.60	38.00
	Ties	0[c]		
	Total	11		
FVC_f - FVC_i	Negative Ranks	5[d]	6.50	32.50
	Positive Ranks	6[e]	5.58	33.50
	Ties	0[f]		
	Total	11		
FEV1_f - FEV1_i	Negative Ranks	6[g]	7.17	43.00
	Positive Ranks	5[h]	4.60	23.00
	Ties	0[i]		
	Total	11		
FEV1/FVC_f - FEV1/FVC_i	Negative Ranks	1[j]	1.00	1.00
	Positive Ranks	0[k]	.00	.00
	Ties	10[l]		
	Total	11		
PEF_f - PEF_i	Negative Ranks	7[m]	5.79	40.50
	Positive Ranks	4[n]	6.38	25.50
	Ties	0[o]		
	Total	11		
FEV6_f - FEV6_i	Negative Ranks	5[p]	6.70	33.50
	Positive Ranks	6[q]	5.42	32.50
	Ties	0[r]		
	Total	11		

a. VC_f < VC_i
b. VC_f > VC_i
c. VC_f = VC_i
d. FVC_f < FVC_i
e. FVC_f > FVC_i
f. FVC_f = FVC_i
g. FEV1_f < FEV1_i
h. FEV1_f > FEV1_i
i. FEV1_f = FEV1_i
j. FEV1/FVC_f < FEV1/FVC_i
k. FEV1/FVC_f > FEV1/FVC_i
l. FEV1/FVC_f = FEV1/FVC_i
m. PEF_f < PEF_i
n. PEF_f > PEF_i
o. PEF_f = PEF_i
p. FEV6_f < FEV6_i
q. FEV6_f > FEV6_i
r. FEV6_f = FEV6_i

The following table represents the results of the Wilcoxon signed-rank test for each pair of differences. The first row contains the calculated test statistic (Z), while the second row contains the associated probability (Asymp. Sig. (2-tailed)) for each pair of differences. The hypotheses for the test (2-sided) are as follows:
a. The median difference is 0 (there is no significant difference between the final measurements of the studied indicator compared to the initial ones).
b. The median difference is different from zero (there is a difference between the final measurements of the studied indicator compared to the initial ones).

Tabel 9. *Test statistics*

Test Statistics[a]						
	VC_f - VC_i	FVC_f - FVC_i	FEV1_f - FEV1_i	FEV1/FVC_f - FEV1/FVC_i	PEF_f - PEF_i	FEV6_f - FEV6_i
Z	-.449[b]	-.045[b]	-.893[c]	-1.000[c]	-.668[c]	-.045[c]
Asymp. Sig. (2-tailed)	.653	.964	.372	.317	.504	.964

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.
c. Based on positive ranks.

We observe that for a significance level set at 5% (α=0.05), the null hypothesis of a median difference of 0 is accepted for all indicators, meaning there is no significant difference between the final measurements compared to the initial ones for these indicators (Asymp. Sig. > 0.05) (highlighted in orange).

Furthermore, it is noted that the descriptive statistics have revealed a very small or negative relative change for both parameters of central tendency studied (mean and median) for all indicators.

Therefore, we can conclude that the preliminary descriptive analysis is supported by the inferential analysis.

3. Results and discussions

Interpretation (GE): Based on the central tendency indicators (mean, median), it can be observed that the final *vital capacity* has increased compared to the initial one. For example, the relative change for the mean is approximately 10.70%, while for the median it is approximately 15.20%.

Interpretation (GC): Based on the central tendency indicators (mean, median), it can be observed that the final *vital capacity* has increased compared to the initial one. For example, the relative change for the mean is approximately -0.02136%, while for the median it is approximately 0.22172%.

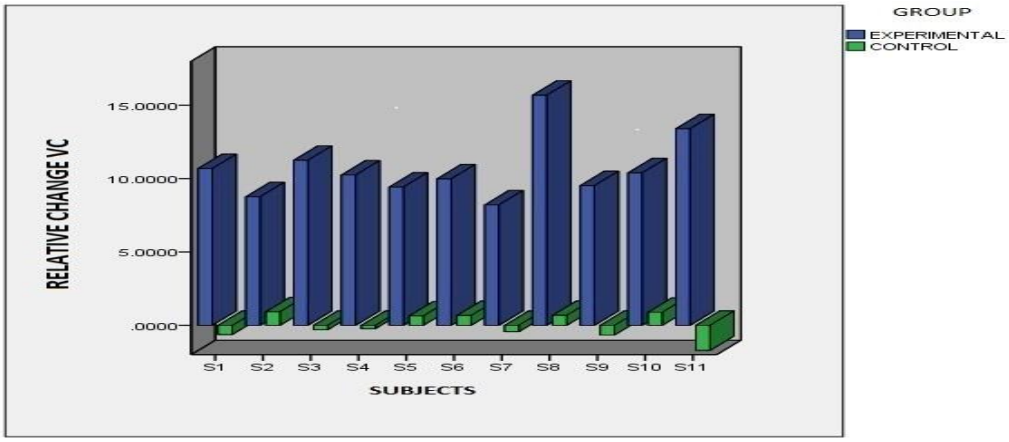

Fig. 2. *Relative change VC*

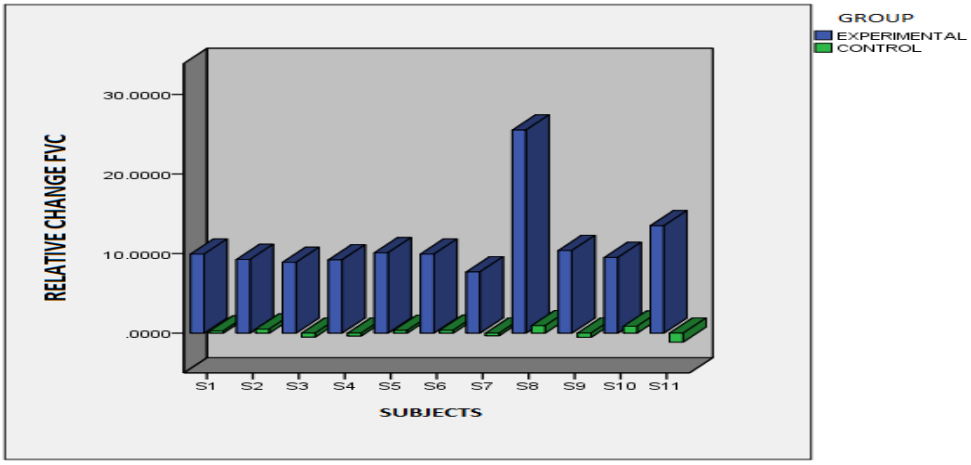

Fig. 3. *Relative change FVC*

Interpretation(GE): Based on the mean and median indicators, it can be observed that the final *forced vital capacity* increased compared to the initial value. For instance, the relative change for the mean is approximately 11.30%, while for the median, it is around 12.40%.

Interpretation(GC): Based on the central tendency indicators (mean, median), it can be observed that even the *forced vital capacity* has not undergone significant changes. For example, the relative change for the mean is approximately 0.02%, while for the median it is approximately -0.4%.

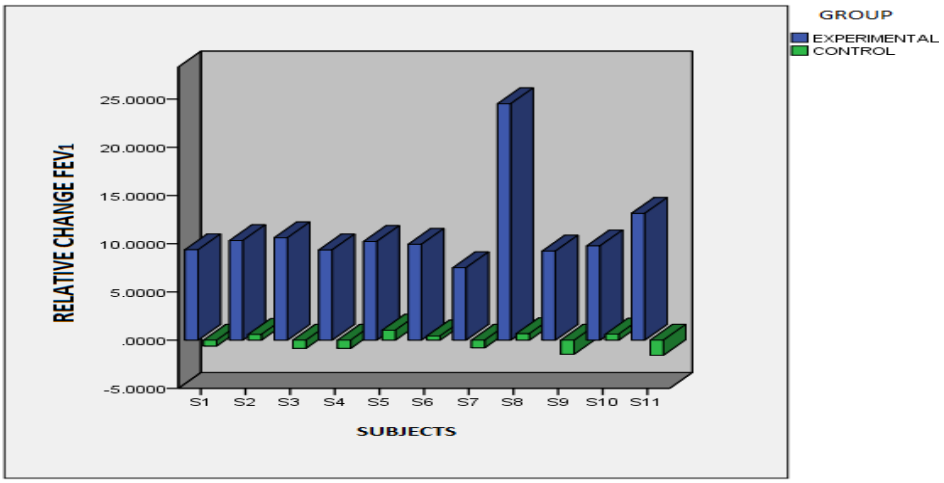

Fig. 4. *Relative change FEV1*

Interpretation(GE): Based on the mean and median indicators, it can be observed that the final value of *forced expiratory volume* in one second has increased compared to the initial one. For example, the relative change for the mean is approximately 11.30%, while for the median it is approximately 12.05%.

Interpretation(GC): Based on the central tendency indicators (mean, median), it can be observed that even the *forced expiratory volume* in one second has not undergone significant changes. For example, the relative change for the mean is approximately -0.3%, while for the median it is approximately -0.9%.

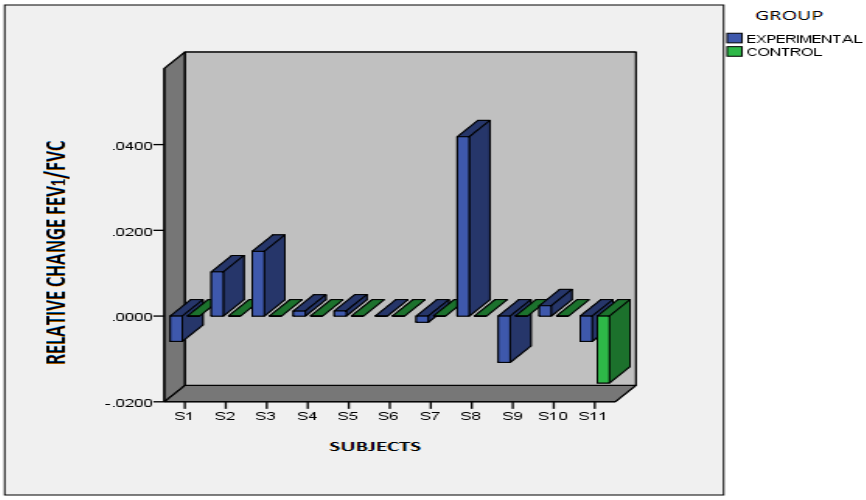

Fig. 5. *Relative change FEV1/FVC*

Interpretation(GE): Regarding the *forced expiratory ratio*, no significant differences were found between the initial and final values.

Interpretation(GC): The median value of the *forced expiratory ratio* has not changed, while the mean has increased by approximately 0.15%.

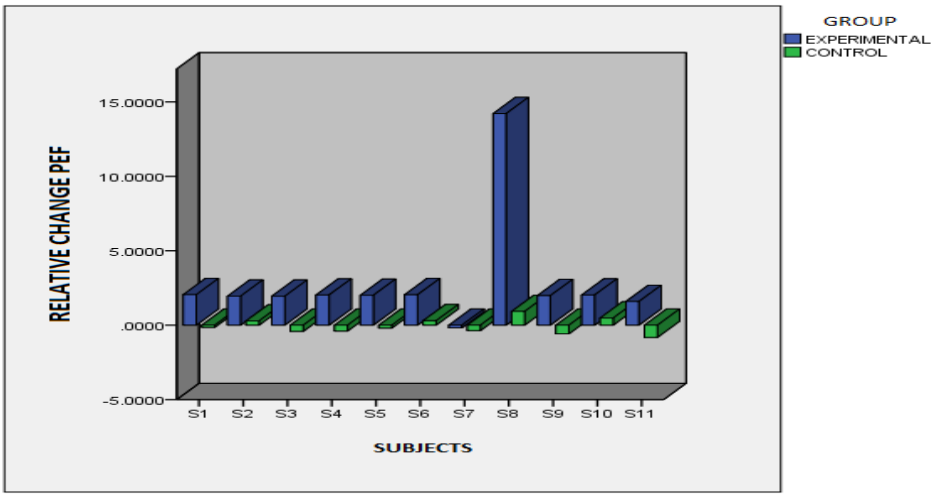

Fig. 6. *Relative change PEF*

Interpretation(GE): Based on the indicators, it can be observed that the final value of the *peak expiratory flow* mean has increased by approximately 2.9%, while the median value has increased by approximately 3%.

Interpretation(GC): For the *peak expiratory flow*, we have negative values for both the mean and the median.

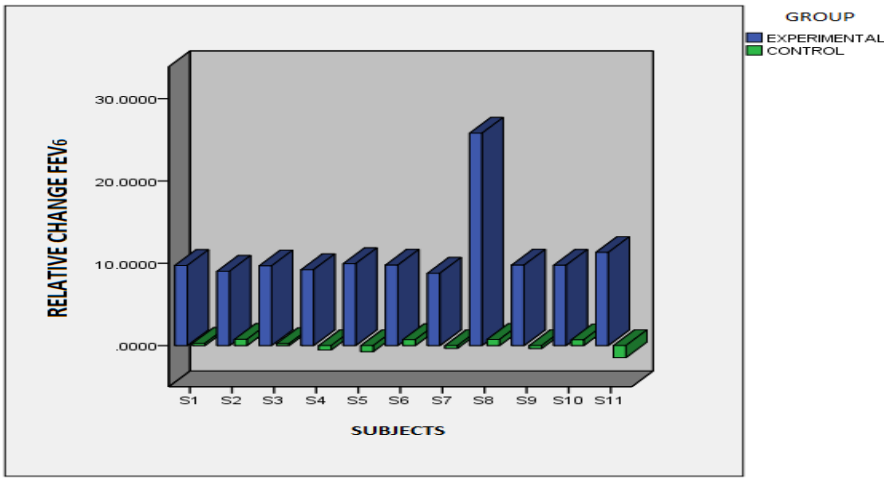

Fig. 7. *Relative change FEV6*

Interpretation(GE): Based on the mean and median indicators, it can be observed that the final value of *forced expiratory volume over 6 seconds* has

increased compared to the initial one. For example, the relative change for the mean is approximately 11%, while for the median it is approximately 12%.

Interpretation(GC): Additionally, we have negative values for *forced expiratory volume over 6 seconds*.

GE – experimental group

GC – control group

During the three training periods, participants were asked to track their progress in a journal, including the documented length of each training session, the number of completed breaths, and a perceived effort sensation (rated on a scale from 1 to 5) using a visual analog scale (Drummond et al., 2015). Participants reported that during respiratory muscle training at 40-60% MIP/MEP, there was a stronger resistance for both inspiration and expiration compared to low-resistance respiratory training at 15% MIP/MEP.

Discussions

When performing long or demanding phrases or projecting their voice, singers use a significant percentage of their vital capacity. Additionally, maintaining sound at a high intensity requires a substantial improvement in respiratory flow, which should enable a wind instrument player or opera singer to expand and enhance their performance repertoire. This results in a more efficient singing technique, varied sound possibilities, and increased comfort during performance.

The measurement of respiratory flow is performed by evaluating the maximum expiratory flow rate, also known as peak expiratory flow rate (PEFR). This represents the maximum amount of air you can exhale within a specific time frame, usually within one second. PEFR is often expressed in liters per second (L/s) or liters per minute (L/min).

Thus, by using a spirometer and measuring PEFR, the respiratory flow of singers can be assessed and monitored to identify improvements in respiratory performance that help them sustain a powerful sound and high intensity during performances.

The absence of changes in the control group strongly supports a genuine increase in expiratory muscle strength among the trained subjects.

The complementary analysis of the differential changes in the training and control groups also indicated that the improvements were greater in the first group regarding the maximum workload achieved over the eight weeks of training with the respiratory threshold device.

The specialized literature (Beckerman et al., 2005) indicates that long-term respiratory muscle training, when the training stimulus is adequate to enhance inspiratory muscle strength, can increase exercise capacity, improve quality of life, and reduce dyspnea.

4. Conclusions

This experiment demonstrates that the acute effect of training with a respiratory threshold device (Threshold) results in a significant increase in airflow

utilization during singing. Additionally, there is an increased use of respiratory flow after completing the SHAM training program. Although inspiratory and expiratory pressures increased for participants, the effect was not considered significant for peak inspiratory and expiratory flows during SHAM training. There could be several reasons for these observations. The low-resistance settings for MIP/MEP training may lead to a smaller increase in pulmonary function parameters.

Although the level of stimulus provided by the training program used in the present study is theoretically capable of inducing aerobic adaptation in muscle fibers (Ramirez-Sarmiento, et al., 2002), the methodological approach required to test this hypothesis would necessarily require further studies.

A training program with a higher register setting would lead to a greater increase in respiratory muscle strength and peak flows, as demonstrated in the specialized literature (DePalo et al., 2004).

Through this method, it can be clearly indicated that a respiratory muscle training program utilizing a threshold device set at a medium level of resistance increases respiratory flows and, implicitly, pulmonary function. Additionally, it can be demonstrated that immediately after a training session, airflow increases and pressure control is easier, resulting in a sound quality conforming to specialized standards and increased acoustic efficiency.

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