REFLECTION ARTICLE
OPEN ACCESS

REVISTA RIICS Investigación e innovación en ciencias de la salud

# Presentation of the ATLETAS DA VOZ™ Conditioning Program

## Presentación del programa de acondicionamiento ATLETAS DA VOZ™

**Flávia Badaró**[1], **Thays Vaiano**[1], **Mara Behlau**[1]

[1] *Centro de Estudos da Voz – CEV; São Paulo; Brazil.*



**Correspondence**
Flávia Badaró.
Email: fbadaro@cevbr.com

**Cite like this**
Badaró, Flávia; Vaiano, Thays; Behlau, Mara. (2024). Presentation of the ATLETAS DA VOZ™ Conditioning Program. *Revista de Investigación e Innovación en Ciencias de la Salud. 6*(1), 181-191. https://doi.org/10.46634/riics.237

**Received:** 06/15/2023
**Revised:** 09/04/2023
**Accepted:** 11/28/2023

**Editor**
Fraidy-Alonso Alzate-Pamplona, MSc.,



**Declaration of interests**
The authors have declared that there is no conflict of interest.

**Data availability**
All relevant data is in the article. For futher information, contact the corresponding author.

**Financing**
None. This research did not receive specific grants from funding agencies in the public, commercial, or nonprofit sectors.

## Abstract

**Objectives.** To present a simple form of vocal and breathing conditioning for voice professionals based on concepts from vocal science. The vocal conditioning program called Voice Athletes Conditioning uses the principles of exercise physiology to gradually improve vocal and respiratory overload to achieve endurance, power, and flexibility.

**Methods.** Due to our personal experience with high voice users, we synthesized a vocal conditioning program (AVCP) that combines voice science, exercise physiology, sports science and physical therapy principles. This is an 8-week program of daily vocal and breathing exercises with overload enhancement each week using different types of breathing devices and semi-occluded vocal tract exercises, designed and developed according to the specific requirements and performance of the voice professional.

**Reflections.** Professional voice users often experience episodes of vocal fatigue that can directly affect their performance and vocal health. As with physical training for athletes, voice exercises can also contribute to improving vocal conditioning, preventing voice disorders, as well as helping to obtain better performance, greater tolerance to fatigue and shorter recovery time.

**Conclusions.** AVCP is an approach that considers the principles of muscle training aimed objectively at the respiratory and vocal muscles, carried out with a variety of breathing devices and specific vocal exercises in search of greater performance time, less physiological stress, and shorter recovery time in the professional use of the voice.

## Keywords

Voice training; laryngeal muscles; breathing exercises; resistance training.

## Resumen

**Objetivos.** Presentar una forma sencilla de acondicionamiento vocal y respiratorio para profesionales de la voz, basada en conceptos de la ciencia vocal. El programa de acondicionamiento vocal denominado Voice Athletes Conditioning utiliza los principios de la fisiología del ejercicio para mejorar gradualmente la sobrecarga vocal y respiratoria, con el fin de lograr resistencia, potencia y flexibilidad.

**Métodos.** Debido a nuestra experiencia personal con usuarios de voz aguda, sintetizamos un programa de acondicionamiento vocal (AVCP) que combina principios de la ciencia de la voz, la fisiología del ejercicio, las ciencias del deporte y la fisioterapia.

**Contribution of the authors**
**Flávia Badaró:** Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, validation, visualization, writing – original draft, writing – review & editing.
**Thays Vaiano:** Conceptualization, data curation, formal analysis, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, writing – review & editing.
**Mara Behlau:** Data curation, investigation, methodology, supervision, validation, visualization, writing – original draft, writing – review & editing.

Se trata de un programa de 8 semanas de ejercicios vocales y respiratorios diarios con realce de sobrecarga cada semana utilizando diferentes tipos de dispositivos respiratorios y ejercicios semioclusivos del tracto vocal, diseñado y desarrollado de acuerdo con los requerimientos específicos y el rendimiento del profesional de la voz.

**Reflexiones.** Los usuarios profesionales de la voz experimentan a menudo episodios de fatiga vocal que pueden afectar directamente su rendimiento y salud vocal. Al igual que ocurre con el entrenamiento físico de los deportistas, los ejercicios vocales también pueden contribuir a mejorar el acondicionamiento vocal, prevenir trastornos de la voz, además de ayudar a obtener un mejor rendimiento, una mayor tolerancia a la fatiga y un menor tiempo de recuperación.

**Conclusiones.** El AVCP es un enfoque que considera los principios del entrenamiento muscular dirigido objetivamente a la musculatura respiratoria y vocal, realizado con diversos aparatos respiratorios y ejercicios vocales específicos en busca de un mayor tiempo de actuación, menor estrés fisiológico y menor tiempo de recuperación en el uso profesional de la voz.

## Palabras clave
Entrenamiento de la voz; músculos laríngeos; ejercicios respiratorios; entrenamiento de resistencia.

## Introduction
One of the biggest challenges for voice professionals is to live with situations of vocal fatigue, often only due to excessive use, without there necessarily being behavioral problems or vocal technique. As it is often not feasible or realistic to reduce the demand, one way to deal with this situation is to increase resistance so that the physiological capacity is adapted to the required vocal demand.

Our experience with high performance singers, from several musical genres — allied to the knowledge of exercise physiology, sports science, and physiotherapy— helped us to systematize a vocal conditioning program: ATLETAS DA VOZ™ CONDITIONING PROGRAM (AVCP).

In this text, we will share the fundamentals that underlie the AVCP and raise reflections on this possibility of acting with healthy professional voices.

As in physical conditioning, vocal conditioning involves knowledge, habits, focus, and continuous practice of specific exercises that favor desired changes in the musculature, resulting from muscle training. This happens since this training has enough intensity and frequency to break the muscular homeostasis, generate adaptations and consequent physiological changes in the involved systems [1].

Muscle training has long been the target of research in sports science, with many publications and several systematic reviews [1-3]. There is a consensus that properly trained muscles are more efficient and, therefore, become more tolerant to fatigue, besides developing greater recovery capacity. These aspects are highly desirable when thinking about muscle performance and high performance [1,3].

In the sciences that study vocal exercises and their effects on performance there is a certain lack of functional histochemical studies of the vocal folds, which limits the possibilities of establishing parameters to compose vocal conditioning programs with scientific foundation and based on evidence of this nature. Therefore, theoretical borrowings from related areas are used, comparisons are made, limitations are shared, and the result is disseminated as a strategy to advance knowledge and offer a more accurate practice. This happens mainly with scientific information coming from exercise physiology and physical education, to support and structure this demand. Thus, training principles arising from exercise physiology guide the development of muscular strength and endurance skills and can serve as a guide for vocal training [4].

Understanding that an important way to increase muscle performance, reduce fatigue, and speed up recovery is through targeted exercises, we structured a vocal conditioning program (AVCP) based on the fundamentals of muscle training: overload, specificity, reversibility, and individuality.

To this end, vocal conditioning will evolve over eight weeks, using breathing and vocal exercises that will be gradually modified during this period, thus providing a structured increase in the level of effort and complexity of these exercises. The respiratory exercises will mainly use air flow and pressure devices for inspiratory and expiratory training, and the vocal exercises will mainly involve the semi-occluded vocal tract (SOVTE), which will be specifically associated with the participant's professional vocal performance.

The suggestion of training, its systematization, incentive to daily practice, besides the validation of new vocal, nutritional and life habits, contributed to the success of the results obtained.

## Methods

The proportion of breathing exercises in AVCP is equal to the proportion of vocal exercises performed weekly. They evolve gradually, based on their continuous execution and consequent specific adaptation to the demand imposed. There may be a progression of effort through an increase in the number of repetitions performed, or in the intensity of the load, with modulation of the vocal pitch, associating body movements and in some respiratory devices used increasing their own load. All these possibilities are monitored and guided by the speech therapist and according to the progress made by the voice professional.

### Respiratory Conditioning

Initially, deep breathing exercises are performed to promote pneumophonic coordination, movement awareness, and control of unnecessary compensatory movements. All of these are achieved without the aid of any equipment or support material. Progressively, exercises are included with the support of portable manual equipment: for inspiratory airflow with the RESPIRON® incentive spirometer, which has an alinear load increment valve to stimulate overload, and expiratory airflow exercises with the ACAPELLA Choice® positive oscillatory expiratory pressure device, which also has an alinear load increment valve.

Sequentially, the POWER Breathe® Plus LR inspiratory muscle strength training device with a resisted linear load variation is used, as well as the EMST 150® expiratory muscle strength training device, also with the possibility of a resisted linear load variation. The progression of the load of this equipment is made by the speech therapist during the weekly meetings.

After the 8-week AVCP, there is a period of maintenance of the respiratory conditioning acquired by continuing the exercises carried out with the POWER Breathe® Plus LR and EMST 150® linear resistance load devices to gain or maintain inspiratory and expiratory strength respectively.

### Vocal Conditioning

The exercises proposed for vocal conditioning fall into the category of SOVTE, which, due to their natural characteristics, allow for a wide range of safe overload variations. Basically, they are lip/tongue vibrations, fricative sounds without and with frequency modulation, phonation in a polyethylene cup with a hole in the base, phonation inside a semi-occluded ventilation mask, resistance therapy in water with a slightly submerged flexible tube, phonation with frequency variation, phonation in large diameter tubes, resistance therapy in water with a slightly submerged flexible tube, hand over mouth occlusion technique, phonation in small, thin tubes with frequency, and intensity variation and in maximum phonation time (MFT).

In addition to these exercises, phonation tasks are also carried out in the specific performance function (speech/singing).

## Reflections

### Exercise Physiology and Muscle Conditioning

Concepts and principles of muscle training are being borrowed from the area of exercise physiology to compose the reflections raised here in parallel with the area of vocal science. However, it is known that not all principles of exercise physiology can be automatically transferred to vocal physiology, since the larynx has unique and specific characteristics. Nevertheless, understanding the physiological processes of exercise gives us an important and necessary direction to begin to comprehend the process of muscle conditioning.

Thus, moving on to muscle conditioning, in general, adaptations occur in the muscles due to new demands imposed on them by a properly structured conditioning process, with exercises of programmed intensity and frequency [1]. These are neurological, metabolic, and structural adaptations resulting from skeletal muscle training, which have already been studied and documented in humans [5,6].

The main adaptations and physical changes associated with exercise are the increase in size and quantity of mitochondria, increase in oxidative enzymes, capillary density, consumption of stored fat, ability to produce ATP, and optimization of oxygen use. Regarding these changes and muscular adaptations, the first ones start to be noticed after 2 weeks of training, while the first gains in strength are associated with neural adaptations that occur over a period of 4 to 5 weeks, and with 6 to 8 weeks of continuous training the adaptations are consolidated [3].

All these changes, when continuously stimulated by exercise, will promote better and greater muscle efficiency, delaying fatigue and accelerating the recovery process, aspects that are essential to any athlete and to voice professionals [3,7], constituting one of the important bases of muscle conditioning.

Exercise physiology is based on the premise that the more efficient the systems involved in the activity performed, the higher the level of physical conditioning and training capacity will be [1]. And, for this, four essential principles guide muscular training: overload, specificity, reversibility, and individuality [1,2,8].

These concepts are essential to build and structure muscle training, along with four other essential pillars. The first pillar is based on the 10 physical capacities or skills known by the world society of exercise physiologists, which can be improved through neurological and/or organic adaptations. These are cardiorespiratory endurance, muscular endurance, strength, power, flexibility, speed, coordination, agility, balance, and accuracy [1,2].

The more competent individuals are in each of these capacities, the better their physical conditioning is. Therefore, a good training program must contain exercises that develop each one of these physical abilities.

The second pillar encompasses respiratory training and the concept that individuals with good cardiorespiratory fitness tend to be more efficient in everyday activities and recover more quickly after intense physical exercise [1,9]. Obviously, it is not up to us to perform cardiovascular training and we do not do it. However, respiratory exercises directed to vocal production are evidently performed and, following the principle of specificity, respiratory training associated to movement corresponds much more to the reality of voice professionals than static training.

The third pillar encompasses the metabolic pathways that will provide energy for any type of physical action. The bioenergetic pathways that support muscle energy metabolism are dynamic and can be improved with muscle training by increasing resistance to fatigue [1].

In turn, the fourth pillar encompasses the relationship between movement efficiency and flexibility. Individuals who exhibit better levels of flexibility are less susceptible to injury when subjected to intense effort [1,2]. Thus, maintaining laryngeal muscles with good levels of flexibility is a way to save energy and thus delay fatigue.

The principles of exercise physiology applied to vocal conditioning proposed in this section are thought then for the intrinsic muscles of the larynx and for the respiratory muscles, which are known to adapt to an imposed demand [10].

Based on these precepts and considering the essential cellular changes, we understand that promoting continuous training of vocal and respiratory musculature represents the key to good vocal conditioning.

## Vocal Conditioning and Exercises

When designing and structuring any program of vocal training or even vocal rehabilitation, the demand imposed on the muscles needs to be well understood to establish desired levels of frequency and intensity of exercises. However, the ideal and precise way to calculate the dosage and load of vocal exercises in the context of voice training, in a direct and objective way, unfortunately has not yet been fully developed.

The management of the load used, and the number of repetitions performed in vocal exercise will distinctly characterize the training as being for major strength or endurance gain and should be carefully thought out for each individual and situation.

When thinking about strength training for the laryngeal and respiratory musculature, the basic reasoning is that adequate levels of strength make people capable of performing tasks with less physiological exhaustion and may function as a preventive factor of performance drop during activity due to muscle fatigue [10,11].

The progressive and gradual increase of the load, that is, of effort to the laryngeal musculature, is possible for both the speaking and singing voices, either for a longer time at moderate volume, or with greater frequency or by controlling the air flow and varying its resistance, as effective possibilities of progressing the effort, the demand imposed by the activity [12,13]. Thus, frequency, intensity, and load of vocal exercises should be thought together to achieve the appropriate overload [12].

Another fundamental aspect to compose a vocal conditioning program is the flexibility involved in muscular exercises, because muscles tend to improve their elasticity property when submitted to regular programs of physical activity that include stretching exercises. A good flexibility will result in greater efficiency of the system [14].

Before we move on to the demonstration of a complete training program, it is necessary to point out one more principle of exercise physiology that has been *borrowed* for vocal training: the principle of safety. This principle makes it clear that training should not expose the individual to risk of injury. In this way, all vocal exercises proposed in the AVCP are performed with a semi-occluded vocal tract, which by definition keeps the vocal folds slightly abducted by the retroflex action of the exercises decreasing the impact of vocal fold collision.

## AVCP's Elaboration

The AVCP was initially proposed for singers who interpret the theme sambas of Brazilian Carnival samba schools, which have a variable vocal demand throughout the year, an aspect that intensifies in the three months preceding Carnival and require extreme performance on the specific day of this spectacle. The initial formatting of the program was made for this target audience.

For over a decade working with this population, we understand that vocal conditioning is a process that must be built individually and in the long term, so that there is enough time for the expected neural, metabolic, and structural changes promoted by physical exercise to happen gradually and sustainably. Vocal conditioning mainly promotes neurological and metabolic adaptations in laryngeal muscle fibers [13].

Semi-occluded vocal tract exercises (SOVTE) are used for AVCP, as they promote laryngeal and supralaryngeal adjustments that are beneficial for vocal production, in an efficient and economical way, which results in increased source-filter interaction, keeping the vocal folds slightly abducted and with reduced collision impact between the vocal folds during phonation [15]. These effects happen as these exercises are performed with semi-occlusion of the vocal tract, through various postures that seek to widen or occlude the vocal tract, generating a change in the vibratory pattern of the vocal folds, the degree of glottal adduction, and the breathing pattern [16]. In this way, SOVTE reduces compression between the vocal folds, allowing for a more efficient vibratory pattern, with less energy expenditure, and favoring enlargement of the pharyngeal space and vocal tract [15,17-19].

It is possible to work with vocal conditioning, within the principles of overload, adaptation to the imposed demand, variation of intensity, frequency, duration, flexibility already mentioned here, with the SOVTE and phonatory tasks.

As well described by Titze and didactically organized by Aquiahuatl and Guzman, the SOVTE can be performed with and without the aid of instruments and with various phonatory tasks: hand over mouth occlusion technique, humming, closed vowels, labial and lingual

vibration at the same time, labial and lingual vibration, phonation of nasal consonants, phonation of sonorous fricative consonants, phonation in a Styrofoam cup with a hole, phonation inside a semi-occluded ventilation mask, and the use of glass, metal, silicone or plastic tubes, in different tubes with the free end or in air or in water [15,16,20]. The phonatory tasks are sustained tones, change of vocal tract shape with sustained tone, ascending or descending glissando, *messa di voce*, speech intonation, and singing [16].

These tasks and exercises are excellent possibilities to develop a program of individual and specific vocal conditioning for each need and, therefore, guide the AVC Program. This is a program that focuses on the conditioning of voices without injury, of individuals who have high professional demand, unlike other existing structured methods that propose a program of vocal care with other specific purposes, such as the methods of Vocal Function Exercises [21], Lee Silverman Voice Treatment - LSVT® [22], PIRV [23], PhoRTE [24], and Complete Vocal Technique - CVT [25].

## AVCP's Evolution

The ideal duration of muscle training programs is still the subject of studies, but knowing that muscle gains and adaptations take between 6 and 8 weeks to occur [3], the AVCP takes this length of time into account to base real vocal conditioning on an exercise program.

AVCP has eight consecutive weeks of training, preceded initially by specific evaluation, performed by several professionals (speech therapist, physiotherapist, otorhinolaryngologist, nutritionist, and physical educator).

During these eight weeks, the client has a training session with the speech therapist, who will set up a weekly schedule of vocal exercises. The training is modified every week respecting the overload principle, thus varying the breathing and vocal exercises performed. After the eighth week of conditioning, the sequence of proposed exercises begins to be modified monthly, when the client returns for a maintenance session. During the program, the voice professional must perform the proposed sequence of exercises daily, with one day of rest per week.

Each program is individualized and, in all sessions during the eight weeks of AVCP, there will always be present exercises for respiratory fitness, strength exercises, resistance, and flexibility for the vocal and respiratory musculatures, as recommended by the physiology of exercise [1,3]. Invariably every week, changes will happen in the exercises, thinking on the overload principle, and the frequency or intensity of the proposed exercises may be modified [4].

Another possibility of load progression for vocal exercises, as difficulty or effort to be overcome, may also be the variation of vocal amplitude or volume used.

It is known that the learning process varies among individuals and, despite the proposal of AVCP being eight weekly sessions in addition to the exercises to be done at home, if necessary, the frequency of the program can be adapted according to the evolution of each client. After the initial evaluation with the several professionals involved in the program, the eight-week period of vocal and respiratory conditioning begins (Table 1).

**Table 1. AVCP Schedule.**

| Conditioning time | Respiratory conditioning | Vocal conditioning |
|---|---|---|
| Week 1 | – Complete nasal breathing.<br>– Awareness and control of accessory musculature.<br>– Manual diaphragmatic resistance | – Lips/tongue vibrations.<br>– Fricative sounds without and with frequency modulation.<br>– Phonation in the specific function of performance (speech/singing) |
| Week 2 | – Awareness of thoracic movement without and with associated effort.<br>– Manual diaphragmatic resistance (greater load).<br>– Inspiratory exerciser incentive spirometer RESPIRON® (air flow device) | – Fricative sounds with frequency modulation and in MFT.<br>– Phonation in a polyethylene cup with a hole at the base.<br>– Phonation in the specific function of performance (speech/singing) |
| Week 3 | – Diaphragmatic resistance with elastic band.<br>– Inspiratory exerciser incentive spirometer RESPIRON® (air flow device).<br>– Oscillatory positive expiratory pressure device – ACAPELLA Choice® | – Phonation inside semi-occluded ventilation mask.<br>– Resistance therapy in water with slightly submerged flexible tube (2-3cm) - phonation with frequency variation.<br>– Phonation in the specific performance function (speech/singing) |
| Week 4 | – Respiration in physiological proportion to cycle time.<br>– Inspiratory exerciser incentive spirometer RESPIRON® (air flow device).<br>– Oscillatory positive expiratory pressure device - ACAPELLA Choice® | – Phonation in large diameter tubes.<br>– Resistance therapy in water with slightly submerged flexible tube (2-3cm) - phonation with frequency variation.<br>– Phonation in the specific performance function (speech/singing) |
| Week 5 | – Respiration in physiological proportion to cycle time<br>– (Increasing time).<br>– Oscillatory positive expiratory pressure device - ACAPELLA Choice®.<br>– Expiratory muscle strength trainer EMST 150® (air pressure device) | – Phonation in medium diameter tubes (drinking straws).<br>– Resistance therapy in water with slightly submerged flexible tube (2-3cm) - phonation with frequency variation.<br>– Phonation in the specific performance function (speech/singing) |
| Week 6 | – Inspiratory muscle strength trainer POWER Breathe Plus LR® (air pressure device), with and without associated postural variation.<br>– Expiratory muscle strength trainer EMST 150® (air pressure device), with and without associated postural variation | – Resistance therapy in water with slightly submerged flexible tube (2-3cm) - phonation with frequency variation and in MFT.<br>– Phonation in the specific performance function (speech/singing) |
| Week 7 | – Inspiratory muscle strength trainer POWER Breathe Plus LR® (air pressure device), still and standing up postures.<br>– Expiratory muscle strength trainer EMST 150® (air pressure device), still and standing up postures | – Hand over mouth occlusion technique.<br>– Resistance therapy in water with slightly submerged flexible tube (2-3cm) - phonation with frequency variation and in MFT.<br>– Phonation in the specific performance function (speech/singing) |

| Conditioning time | Respiratory conditioning | Vocal conditioning |
|---|---|---|
| Week 8 | – Inspiratory muscle strength trainer POWER Breathe Plus LR® (air pressure device), associated with vocal performance movement.<br>– Expiratory muscle strength trainer EMST 150® (air pressure device), associated with vocal performance movement | – Phonation in small, thin tubes (lollipop sticks) – phonation with frequency and intensity variation and in MFT.<br>– Phonation in the specific performance function (speech/singing) |

**Note.** MFT: Maximum Phonation Time.

## AVCP Clinical Indications

AVCP is indicated for voice professionals who wish to improve their vocal condition. Thus, they are vocally healthy individuals, who wish to improve their vocal performance, with better performance, less energy expenditure during performance, longer time to reach vocal and respiratory fatigue and, mainly, less time for recovery being the voice able to the new demand in a few hours.

Currently, AVCP is used with several voice professionals who benefit from muscle training, increasing vocal performance. They are singers, actors, lecturers, teachers, lawyers, and many other professionals who have in the voice their main work tool.

It is interesting to remember that vocal training is also suggested as primary prevention strategies to reduce the risk of vocal disorders in voice professionals from various fields of work [26].

## Implications for clinical practice and research

It is essential that randomized and controlled clinical studies are performed to determine the level of effectiveness of the vocal conditioning program in relation to the amount, dose, and frequency of the exercises proposed.

The influence of nutritional habits and lifestyle are factors that need to be explored because they directly interfere with the results of training.

# Conclusions

The AVCP systematizes the knowledge of more than two decades of vocal conditioning work of the most varied voice professionals. The proposal offers eight weeks of consecutive training with weekly training change, followed by follow-up and monthly training change. It is an approach that considers the principles of muscle training aimed objectively at the respiratory and vocal muscles, favoring greater performance time, with less physiological stress and shorter recovery time in the professional use of the voice.

# References

1. Powers SK, Howley ET. Fisiologia do exercício: Teoria e aplicação ao condicionamento e ao desempenho. 8th ed. Santana de Parnaíba: Manole; 2014. 672 p.
2. McCardle WD, Katch FI, Katch VL. Exercise physiology: Nutrition, energy, and human performance. 7th ed. New York: Lippincott, Williams, & Wilkins; 2010. 1038 p.

3. Lieber RL. Skeletal muscle structure, function &plasticity: The physiological basis of rehabilitation. 3rd ed. Baltimore: Lippincott, Williams & Williams; 2010. 304 p.

4. Sandage MJ, Pascoe DD. Translating Exercise Science into Voice Care. Perspectives on Voice and Voice Disorders [Internet]. 2010;20(3):84-9. doi: https://doi.org/doi:10.1044/vvd20.3.84

5. Brooks GA, Fahey TD, Baldwin KM. Exercise Physiology: Human Bioenergetics and its Applications. 4th ed. New York: McGraw-Hill; 2005. 876 p.

6. MacIntosh BR, Gardiner PF, McComas AJ. Skeletal muscle: Form and function. 2nd Ed. Champaign: Human Kinetics Publishers; 2006. 432 p.

7. Sale D. Neural adaptation to resistance training. Med Sci Sports Exerc [Internet]. 1988;20(Suppl 5):135-45. doi: https://doi.org/10.1249/00005768-198810001-00009

8. Barbanti VJ. Treinamento Físico: Bases Científicas. 3rd ed. São Paulo: CLR Balieiro; 2001.

9. Guedes DP, Araújo CE, Araújo CSG. Atividade física e exercício físico na promoção da saúde [Internet]. 1st ed. Londrina: UNOPAR; 2021. 312 p. Available from: https://unigra.com.br/ler/96_atividade-fisica-e-exercicio-fisico-na-promocao-da-saude

10. Menezes KK, Nascimento LR, Ada L, Polese JC, Avelino PR, Teixeira-Samela FR. Respiratory muscle training increases respiratory muscle strength and reduces respiratory complications after stroke: a systematic review. J Physiother [Internet]. 2016 Jul;62(3):138-44. doi: https://doi.org/10.1016/j.jphys.2016.05.014

11. Kendall FP, McCreary EK, Provance PG. Músculos: provas e funções. 4a ed. São Paulo: Manole; 1995. 453 p.

12. Saxon KG, Schneider SM. Vocal Exercise Physiology. 1st ed. San Diego: Singular Publishing Group; 1995. 157 p.

13. Saxon KG, Berry SL. Vocal exercise physiology: same principles, new training paradigms. J Singing [Internet]. 2009;66(1):51-7. Available from: https://tinyurl.com/yocozhq8

14. Corbin CB, Noble L. Flexibility: a major component of physical fitness. Journal of Physical Education and Recreation [Internet]. 1980;51:23-60. doi: https://doi.org/10.1080/00971170.1980.10622349

15. Titze IR. Voice training and therapy with a semi-occluded vocal tract: rationale and scientific underpinnings. J Speech LangHearRes [Internet]. 2006;49(2):448-59. doi: https://doi.org/10.1044/1092-4388(2006/035)

16. Aquiahuatl CM, Guzman M. Rehabilitación vocal fisiológico com ejercicios de tracto vocal semiocluido. Rev Investig Innov Cienc Salud [Internet]. 2021;3(1):61-86. doi: https://doi.org/10.46634/riics.68

17. Laukkanen AM, Pulakka H, Alku P, Vilkman E, Hertegård S, Lindestad P-A, et al. High-speed registration of phonation-related glottal area variation during artificial lengthening of the vocal tract. Logoped Phoniatr Vocol [Internet]. 2007;32:157-64. doi: https://doi.org/10.1080/14015430701547013

18. Laukkanen A-M, Horáček J, Krupa P, Švec JC. The effect of phonation into a straw on the vocal tract adjustments and formant frequencies. A preliminary MRI study on a single subject completed with acoustic results. Biomed Signal Process Control [Internet]. 2012;7(1):50-7. doi: https://doi.org/10.1016/j.bspc.2011.02.004

19. Guzman M, Laukkanen AM, Krupa P, Horáček J, Švec JC, Geneid A. Vocal tract and glottal function during and after vocal exercising with resonance tube and straw. J Voice [Internet]. 2013;27(4):523.e519-523.e534. doi: https://doi.org/10.1016/j.jvoice.2013.02.007

20. Titze IR. Phonation Threshold Pressure Measurement with a Semi-Occluded Vocal Tract. J Speech Lang Hear Res [Internet].2009;52:1062-72. doi: https://doi.org/10.1044/1092-4388(2009/08-0110)

21. Stemple JC, Lee L, D'Amico B, Pickup B. Efficacy of vocal function exercises as a method of improving voice production. J Voice [Internet]. 1994;8(3):271-8. doi: http://dx.doi.org/10.1016/S0892-1997(05)80299-1

22. Ramig LO, Countryman S, Thompson LL, Horii Y. Comparison of two forms of intensive speech treatment for Parkinson disease. J Speech Lang Hear Res [Internet]. 1995;38(6):1232-51. doi: http://dx.doi.org/10.1044/jshr.3806.1232

23. Behlau M, Pontes P, Vieira VP, Yamasaki R, Madazio G. Presentation of the Comprehensive Vocal Rehabilitation Program for the treatment of behavioral dysphonia. CoDAS [Internet]. 2013;25(5):492-6. doi: http://doi.org/10.1590/s2317-17822013000500015

24. Ziegler A, Verdolini-Abbott K, Johns M, Klein A, Hapner ER. Preliminary data on two voice therapy interventions in the treatment of presbyphonia. Laryngoscope [Internet]. 2014;124(8):1869-76. doi: http://dx.doi.org/10.1002/lary.24548

25. McGlashan J, Aaen M, White A, Sadolin C. A mixed-method feasibility study of the use of the Complete Vocal Technique (CVT), a pedagogic method to improve the voice and vocal function in singers and actors, in the treatment of patients with muscle tension dysphonia: a study protocol. Pilot Feasibility Stud [Internet]. 2023;9(1):1-18. doi: https://doi.org/10.1186/s40814-023-01317-y

26. Duffy OM, Hazlett D. The impact of preventive voice care programs for training teachers: a longitudinal study. J Voice [Internet]. 2004;18(1):63-70. doi: https://doi.org/10.1016/S0892-1997(03)00088-2