Evaluation of the Effectiveness of a Voice Training Program for Teachers

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Summary: Objectives. To investigate the effects of a voice education program to teachers on vocal function exercise and voice hygiene and compare a pre- and post-vocal exercise for the teacher’s voice quality.

Methods. A random sample of 102 subjects was divided into two groups: experimental group (29 women and seven men) with vocal hygiene and training exercises and control group (52 women and 14 men) with vocal hygiene. Two sessions were held about voice hygiene for the control group and five sessions for the experimental group, one being with reference to the vocal hygiene habit and four vocal exercise sessions. Acoustic analysis of the vowel [i] was made pre- and post-vocal exercise and for the situations of initial and final evaluation of the educational program. Student t test (paired) and Proc MIXED (repeated measures) were used for analyses with level of significance (α=0.05).

Results. The training exercises, posture and relaxation cervical, decreased the mean of fundamental frequency (f0) for men (P = 0.04), and for the phonation, intensity, and frequency exercises, there was a significant increase for f0 in woman (P = 0.02) and glottal to noise excitation ratio (P = 0.04). There was no statistically significant difference intergroup evaluations after 3 months. The control group presented increased mean voice intensity in the final evaluation (P = 0.01).

Conclusions. Voice training exercises showed a positive and immediate impact on the teacher’s quality of voice, but it was not sustained longitudinally, suggesting that actions for this purpose should be continued at schools.

Key Words: Teachers--Voice training--Health Education--Dysphonia.

INTRODUCTION

Vocal problems that emerge as a result of hyperfunctional vocal behavior are commonly present in professional voice users, particularly in teachers.1–2 Prevalence studies have demonstrated that teachers are the professionals who present the greatest risk for developing signs and symptoms of voice problems.3–5 Hoarseness, tiredness when speaking, fatigue, and temporary voice loss are the chief complaints reported by teachers in epidemiologic studies.6,6

The vocal disorders that teachers may experience represent a negative impact on lecturing, as they prevent the transmission of information from being made to students in a clear and effective manner.7 Therefore, it is necessary to prevent dysphonia to avoid negative effects on the docent’s quality of life and work.

The prevention of occupational dysphonia in teachers has been a focus of interest in various studies related to educational intervention programs.8–12 Most of these studies made comparisons of educational activities by means of guidance on vocal hygiene habits and voice training exercises, either with or without associating the two.9,11,13,14 Vocal hygiene habits are practiced by means of an indirect approach to educational actions, in which one helps the professional voice user to understand vocal use, how the environmental factors that may affect the voice, and healthy voice habits may lead prevention of vocal disorders.10 On the other hand, voice training exercises involve a direct therapy technique that aim to modify aspects of faulty voice production to promote appropriate and efficient voice production.11

To evaluate the efficiency of educational vocal health practices in the quality of the participants voice, studies have used the longitudinal application of techniques and clinical evaluations, such as acoustic analysis of voice quality.4,9,11 Most of these studies conducted longitudinal comparison of voice quality, before the process of educational actions and after a certain period have finalized the program. There are few studies that have made a comparison of vocal evaluation in a pre- and posttution of each specific activity applied in a program of vocal health. Therefore, immediate evaluations of the effects of activities with educational voice training exercises are important to verify the effectiveness of training on voice quality.

Thus, one would have a better prognosis of the benefits of vocal exercises for the participants, and a way to guide them with regard to the importance of practicing the exercises in their day-to-day routine. Moreover, there is the possibility of participants self-perceiving the quality of their own voices before and after training and arousing their interest in continuing with the training in their day-to-day routine, in view of the feeling of improvement perceived in the training.

From the foregoing discourse, the aim of this study was to make a longitudinal comparison of the effect of a program of vocal exercise training and vocal hygiene and evaluate the...
quality of voice of subject in the situation before and after each vocal exercise session.

MATERIALS AND METHODS

Subjects

The population of the present study comprised teachers from the public school network in the municipality of Piracicaba, São Paulo. In the sampling system, 11 public schools were selected by random draw of a total of 66 schools. The randomization process, using the school as the sampling unit, was chosen for two reasons: (a) teachers had socioeconomic (socio-economical status) and professional variables (workload in hours/week, number of years taught) very similar and did not differ significantly between schools ($P > 0.05$) and (b) teachers typically had a very high workload (most over 32 hours/week) and had only 2-hour meeting per week, in part, been met by the activities of the preventive program voice. Thus, it would be basically impossible to perform the randomization process by the teacher within each school because of logistical and ethical problems. The teachers were invited to participate and, those that agreed to, signed a term of free and informed consent, approved by the Research Ethics Committee of the Piracicaba School of Dentistry (Protocol No. 041/2009). Only teachers who met the inclusion criteria and those who made themselves available to frequent the activities of the educational program participated.

Inclusion and exclusion criteria

The following inclusion criteria were used: Participants should be nonsmokers, not having a history of health related to the diagnosis or surgery of organic disease of the larynx, not doing speech therapy at the same time of educational program, report of persistent hoarseness for over 2 weeks, or not be over the age of 55 years. The age limit was established to prevent the characteristic of voice aging from being a study bias.

One hundred two subjects were selected, and the sample was divided into two groups: 66 subjects for the control group (52 women and 14 men) teachers at five schools and 36 subjects for the experimental group (29 women and seven men) teachers at six schools, with a mean age of $42.55 \pm 7.84$ (Figure 1). There was participation by six to 12 subjects from each school, totaling the sum of participant at schools for the final sample of both the control and experimental groups. For sample calculation, a minimum of 10 degrees of freedom was considered for the residue of the analysis of variance, with the minimum estimated size for each group being 13, which provided a test power of 0.8 for the level of significance of 0.05.

Three months after conclusion of the program, 73 subjects (30 from the experimental group, 26 women and four men, and 43 from the control group, 34 women and nine men) participated in the re-evaluation process.

METHODS

Acoustic analysis

Before beginning with the educational interventions, a vocal evaluation was made, using collection of emission of the vowel [i]. The subjects were instructed to emit twice the selected vowel in habitual frequency and intensity of speech with a minimum length of 6 seconds (measured time by the recorder). The vocal records were saved in a digital recorder (ZOOM, Handy Recorder H2); recordings were performed in mono stereo, wav format, with a sampling frequency of 44.1 kHz and 16 bit. The use of a stereophonic microphone, headset model (Plantronics model T-110) situated at a distance of 3 cm from the speaker’s mouth at a recording angle of 45° was applied.

The recordings were made individually in the classroom of the school, without soundproofing and recording beep occurred with sound pressure level of noise below 50 dB (average 43.34 dB, 49.7 dB maximum, and minimum 38.5 dB). The recordings were made individually in the classroom of the school, without soundproofing and recording beep occurred with sound pressure level of noise below 50 dB (average 43.34 dB, 49.7 dB maximum, and minimum 38.5 dB). For monitoring of noise,
we used a digital decibel Impac IP-900DL data logger type II, calibrated (Calibrator ND9 Impac), and programed in automatic level, considering a range of capture with the intensity of 30–130 dB (slow) in real-time mode, whose records were made on PC with Intel CoreTM 2 duo. It also monitored the temperature of the room acoustics and yielded an average of 26.2°C (27.43°C maximum and 25.54°C minimum) and humidity average of 45% (maximum 51.2% and minimum of 43%), which were measured and recorded by a digital portable thermohygrometer Impac TH02, adjusted in position “out.” The typical room used in this study has a size of 1.2 m² per student more 12 m² for teacher. Normally, we have 40 students per class, so we have a room with 60 m².

Acoustic analysis of the vowel [i] was performed using the program “VOX Metria da CTS Informática,” developed with a Brazilian database for vocal analysis, processed in a Semp Toshiba computer with an Intel Core 2 processor. The vowel [i] files were imported using a rate of 11 025 Hz, in accordance with the program specifications. Standard narrowband spectrographic analysis (25 Hz) was performed in the voice quality mode file, considering the entire samples, as the characteristics of instability at the beginning and end of the emission, which commonly occur, could provide important data to consider. By means of the statistical report provided automatically by the program, the following values were verified: fundamental frequency (f₀), mean, and mean intensity. The Vox Metria program provided capture patterns for the analyses. The parameters of normality considered for f₀ for men were from 96.44 to 143.88 Hz and for women between 215 and 244 Hz, whereas for the intensity voice, the values were between 63.5 and 72.5 dB SPL.

For the analysis in the vocal quality file, the beginning and end of sustained vowel emissions were eliminated because the instability of these stretches could prevent understanding of the information about the source of sound provided by the parameters. The following acoustic parameters were analyzed: jitter and shimmer and values of normality were those provided by the program itself with limit values of 0.6% and 6.5%, respectively. Harmonics-to noise ratio (HNR)—a test of proportion between harmonics and noise produced by the glottis, based on the hypothesis that pulses resulting from the collision of the vocal folds generate a synchronous excitation of different frequency band, was also evaluated. The program VOX established as the normal range between 0.5 and 2.5.

Educational activities applied to the control and experimental groups

The control group subjects participated in two lectures about guidance on the voice production mechanism and vocal hygiene habits. For the experimental group subjects, one lecture was held on vocal hygiene habits and four meetings about training exercises specifically for the voice. The guidance sessions had a 30-minute duration. The lecture meetings were held at each school separately, scheduled to take place every 15 days. There was participation by six to 12 teachers from each school. We present below the sequence of educational activities provided to the experimental group (Figure 1).

Vocal hygiene informations and group discussion

Initially, the participants were informed about how the voice is produced and which are the pathologies that may affect the vocal organ, harming the voice. Afterward, the subjects were instructed as regards the practice of healthy voice habits.

Typically, the goals of vocal hygiene include hydration during professional activity and eat apple between the intervals of the meals. The drinking water habits while speaking may reduce phonation vocal fatigue after prolonged reading. The apple has acting astringent of the vocal organ mucosa, reducing the viscosity of mucus, and decrease the effort to phonate. Initially, the participants were informed about how the voice is produced and which are the pathologies that may affect the vocal tract, harming the voice. Afterward, the subjects were instructed as regards the practice of healthy voice habits.

Information on strategies to obtain students attention in the classroom was discussed by the speech-language pathologist and participants. Among the strategies indicated were replacing the habit of shouting by other means, such as clapping or blowing a whistle to draw students attention in the classroom. In an addition, emphasis was laid on the importance of always expressing oneself facing the class during explanatory lesson, avoiding talking while writing on the blackboard, and reducing overload on the vocal tract caused by tension in the cervical region.

At the beginning of each meeting, a discussion was held between the participants of the group, with the purpose of reflecting about the subject that would be approached.

Multimedia resources were used to transmit the content of lectures. The participants received a folder containing explanatory matter on the subject and a plastic bottle to get used to the habit of drinking water while they were teaching. All the resources were applied both in the control and experimental groups.

Voice training exercises

In the experimental group, four voice training exercise sessions were applied. The sessions separately approached the following topics: (a) posture and cervical relaxation; (b) respiration; (c) phonation, frequency, and intensity; and (d) resonance and articulation. In each session, 15 minutes was devoted to a theoretical approach to the subject and 15 minutes to the training exercise. Three series of exercises were performed with intervals of 30 seconds. Each series, with 10 repetitions, totaling 30 repetitions of each approach. Sustained vowel [i] emission in habitual tone of speech was collected before and after training each session of exercises.

In the exercise training sessions, of the total of 36 subjects of the experimental group: seven men and 19 women participated in training relaxation and body posture exercises; seven men and 27 women in the respiration activity; seven men and 24 women in the phonation activity, intensity, and frequency; and four men and 25 women in the activity of resonance and articulation.

Body posture and cervical relaxation

Correct body posture related to the vertical axis of the spine and head during work activities was taught, demonstrating
figures of various teachers in classrooms, the participants were asked which of the characters were in a posture without an overload of tension during the activity of teaching. For the vocal system to operate efficiently, and free for unwanted tension, we define the establishment of good posture. The body is aligned efficiently when a plumb line can be shown to fall from the top of the head through the ear hole (external auditory meatus) the middle of the point of the shoulder (acromion), the highest point on the iliac crest, the knees, and just in front of the ankle. The chest and rib cage will be held in a comfortably high position; spine aligned; arms at your sides; the abdominal muscles should be relaxed, but not flaccid; the knees flexible, not locked and the feet may be perpendicular to each other. After reflecting about adequate posture in the work environment, training exercises were performed for relaxation of the cervical region and larynx with the object of diminishing local tension and favor loosening up voice production. Cervical relaxation exercises involved a sequence of rotating the shoulders backwards and forwards, movement of head flexion and extension, rotating the head to the left and right and vice versa. Relaxation can be defined as a decrease of excessive tension muscles without loss of muscle tone. Subjects were instructed to make rotary self-massaging movements in the region of the larynx, manual circumlaryngeal therapy.

**Respiration**

It was explained to the participants that voice emission demands the coordination of various muscles, particularly the respiratory muscles, among these, the diaphragm, while voice production without tension, with breath and control of intonation of the discourse is fundamental to balanced breathing. The participants were instructed step by step to breath moving the diaphragm and abdominal region, feeling the entry, and output of air from this region. To increase the airflow, individuals were asked to inspire normally, hold their breath for 5 seconds and then slowly breathe out the air through their mouths. The same procedure was performed, continuously emitting the sound of vowels [s] and feeling the region of movement of the diaphragm.

**Phonation, frequency, and intensity**

With the aim of improving the amplitude of vibration of the vocal folds, favoring a balanced vocal production, it was proposed that participants make vibrant sounds of the tongue in the tone of habitual pitch of speech, in ascending and descending scales, and at both weak and strong intensity. The exercises of vibrant sound of the tongue and/or lips in habitual mode of frequency an ascending intensities, with weak or strong intensity, allowed greater flexibility of voice production, with an increase of undulating mucosa and effortless and tension-free sound projection.

**Resonance and articulation**

The work of resonance was performed to favor the adequate use of some of the bone and supraglottal cavities, such as the larynx and facial sinuses. The object of articulation was to favor an improvement in articulatory dexterity of the word in discourse and good harmony in vocal production. Sequences of resonant exercises were applied with nasal sound involving the association with other vowels (/[m]/, /[n]/, and /[N]/), and the teachers were encouraged to feel the sensation of the paranasal resonators when emitting the sound.

They were instructed to practice these exercises in the morning to improve the equilibrium of voice resonators. Emission of the humming sound was also practiced with the same objective as that of achieving equilibrium of resonance. To improve articulatory dexterity, the emission of each consonant with each vowel was requested, exploring the articulatory point projected, and ample masticatory movements associated with the nasal sound.

In the experimental group, the teachers were instructed to practice the vocal exercises during day-to-day routine, in addition to the vocal hygiene habits. A weekly time schedule containing the quantity and frequency of daily vocal exercise training was presented to the teachers, and they were instructed to practice them.

A partnership was established with the schools with the fixation of murals in the access to teachers’ meeting rooms, containing instructions as regards the practice of the program activities in professional routine.

A weekly schedule containing vocal exercises always referring to the last exercise session was handed over to experimental group. The teacher was instructed to practice the exercise once or twice a day. The schedule was intended to be used as a support and a reminder to participants on incorporating healthy habits and practices of exercises for the voice.

Three months after conclusion of the educational program, the teachers from the control and experimental groups were invited to participate in the re-evaluation of quality of voice.

**Statistical analysis**

After exploratory analysis of the data and selecting the best structure of covariance, according to Littell et al., the data were analyzed by the methodology of mixed models for repeated measures (PROC MIXED for repeated measures).

The SAS 9 documentation explains that the REPEATED statement is used to specify covariance structures for repeated measurements on subjects or, another way, is that the REPEATED statement controls the covariance structure of the residuals. Similar syntax is used for both.

Comparisons between before and after vocal exercises were made by the paired t test. For statistical analysis, the SAS program—Statistical Analysis System, Institute Inc., Cary, NC, Version 9.2, 2008 was used.

**RESULTS**

In analysis of the effects of voice training exercises on the experimental group, no significant difference was observed between pre- and posttraining for relaxation and body posture exercises. Change was observed for the acoustic parameter of $f_0$ for men in the exercise of relaxation and cervical posture ($P = 0.04$). In the phonation, intensity, and frequency exercises, there was statistically significant difference for the acoustic
DISCUSSION
In the present study, improvement in voice quality was observed in the group of the training program of exercises associated with vocal hygiene guidance. Changes were observed in the evaluation of the voice before and after each voice training exercise session.

Changes were observed in the evaluation of the voice before and after the training session exercises: cervical relaxation and good posture and phonation, frequency, and intensity.

Relaxation and good posture training exercises provided improvement in voice quality for the male gender, as there was a reduction in the $f_0$ mean value. There is a hypothesis that cervical relaxation exercises, as the manual circumlaryngeal therapy can have action of the reduction of tension of the musculus of larynx. Although the same effects were not observed in the female gender, there is proof in the literature that the techniques of digital manipulation of the larynx may also favor the reduction of tension in the vocal folds and in soothing the voice in women.28,29 One explanation for the difference in the effect between men and women could be the values of frequency. Women in the experimental group had before the session of exercises a mean $f_0$ below the normal range, characterizing a deeper voice, suggesting that the relaxation exercises had no impact of the action of these exercises. The $f_0$ of voice when more severe than normal may indicate dysphonia organofunctional, for example, edema of the vocal cords or nodules.29 The mean $f_0$ in men was within the normal range in the pretest and the values showed a trend for high $f_0$, that is, a higher voice. The presence of laryngeal tension and stress is a factor that may affect the quality of the voice for producing a voice with a high $f_0$ and high acoustic notes.29 The practice of cervical relaxation exercises, specifically digital manipulation of the larynx, may have an effect of lowering the laryngeal framework, which was in a state of tension and as a result of this exercise, we can get the production of a deeper voice.

In the session of phonation, intensity and vocal frequency exercises, the vibrant sounds provided significant difference for $f_0$ with an increase in the mean value for the female gender.

Parameter of $f_0$ for women ($P = 0.02$) and HNR of the general group ($P = 0.04$). There was no statistically significant difference before and after training the groups of respiration and resonance-articulation exercises for the acoustic parameters analyzed (Table 1).

There was no significant difference for the mean intensity between the groups ($P = 0.5660$), nevertheless, the control group presented a higher mean in the final evaluation ($P = 0.0187$), whereas the experimental group presented no variation between the two evaluations ($P = 0.2981$).

There was no significant difference for the mean intensity between the groups ($P = 0.4245$) and between the evaluations ($P = 0.1986$), and this was repeated for HNR, without significance between the groups ($P = 0.5977$) and between evaluations ($P = 0.1003$). There was also no significant difference between the groups ($P = 0.1258$) and between the evaluations ($P = 0.8572$) for $f_0$ for both genders (Table 2).

Table 1. Mean and Standard Deviation Values of $f_0$, Shimmer, Jitter, GNE, and Mean Intensity of the Vowel [i], Before and After Vocal Exercise Training in the Experimental Group

<table>
<thead>
<tr>
<th>Acoustic Parameters</th>
<th>Experimental Group</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
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</thead>
<tbody>
<tr>
<td>$f_0$ Male (Hz)</td>
<td>121.42 ± 15.61</td>
<td>112.90 ± 7.09 *</td>
<td>123.17 ± 11.36</td>
<td>121.72 ± 9.41</td>
<td>119.07 ± 14.52</td>
<td>115.23 ± 11.56</td>
<td>120.69 ± 12.04</td>
<td>125.30 ± 17.67</td>
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<tr>
<td>$f_0$ Female (Hz)</td>
<td>199.60 ± 21.59</td>
<td>198.48 ± 19.44</td>
<td>207.05 ± 20.25</td>
<td>205.88 ± 24.30</td>
<td>201.94 ± 14.44</td>
<td>210.42 ± 19.49 *</td>
<td>208.99 ± 17.05</td>
<td>209.25 ± 17.67</td>
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<tr>
<td>Shimmer (%)</td>
<td>2.74 ± 1.60</td>
<td>2.57 ± 1.52</td>
<td>2.51 ± 1.33</td>
<td>2.50 ± 1.42</td>
<td>3.91 ± 4.62</td>
<td>2.68 ± 4.43</td>
<td>3.13 ± 4.24</td>
<td>2.92 ± 3.93</td>
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<tr>
<td>Jitter (%)</td>
<td>0.34 ± 0.47</td>
<td>0.28 ± 0.41</td>
<td>0.17 ± 0.16</td>
<td>0.20 ± 0.14</td>
<td>1.0 ± 2.44</td>
<td>0.32 ± 0.39</td>
<td>0.19 ± 0.15</td>
<td>0.26 ± 0.42</td>
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<tr>
<td>HNR (%)</td>
<td>0.80 ± 0.15</td>
<td>0.76 ± 0.20</td>
<td>0.79 ± 0.14</td>
<td>0.79 ± 0.16</td>
<td>0.73 ± 0.19</td>
<td>0.79 ± 0.17</td>
<td>0.78 ± 0.18</td>
<td>0.81 ± 0.16</td>
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<tr>
<td>Mean intensity (dB SPL)</td>
<td>72.99 ± 5.12</td>
<td>71.02 ± 6.89</td>
<td>75.62 ± 4.29</td>
<td>76.33 ± 4.47</td>
<td>75.44 ± 4.47</td>
<td>75.84 ± 5.36</td>
<td>76.08 ± 5.36</td>
<td>76.27 ± 5.57</td>
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</tbody>
</table>

Abbreviation: NS, not significant. * Values differ from Pre ($P < 0.05$).
To the voiced tongue trills exercises, there is a hypothesized action of the phonatory muscles with intense passive vibration of the cartilaginous skeleton of the larynx and its whole content. A complete glottal closure and soft mucosal wave vibration because of the small airflow outlet through the semi-occluded lips is hypothesized.\(^{30}\) According to Titze,\(^ {31}\) the reverse sound cause of the small airflow outlet through the semi-occluded complete glottal closure and soft mucosal wave vibration be- the cartilaginous skeleton of the larynx and its whole content. A tion of the phonatory muscles with intense passive vibration of To the voiced tongue trills exercises, there is a hypothesized ac- 

### TABLE 2
Mean and Standard Deviation Values for the Acoustic Parameters Analyzed in the Control and Experimental Groups in Comparison With the Initial and Final Evaluation, 3 Months After Conclusion of the Voice Training Program

<table>
<thead>
<tr>
<th>Variables</th>
<th>Control Group (n = 43)</th>
<th>Experimental Group (n = 30)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Evaluation Initial</td>
<td>Evaluation Final</td>
</tr>
<tr>
<td></td>
<td>Mean (SD)</td>
<td>Mean (SD)</td>
</tr>
<tr>
<td>Acoustic Parameters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean intensity (dB SPL)</td>
<td>75.66 (4.57)</td>
<td>77.26 (4.12)*</td>
</tr>
<tr>
<td>Jitter (%)</td>
<td>0.33 (0.70)</td>
<td>0.33 (0.70)</td>
</tr>
<tr>
<td>Shimmer (%)</td>
<td>2.34 (1.67)</td>
<td>2.31 (1.24)</td>
</tr>
<tr>
<td>HNR (%)</td>
<td>0.87 (0.11)</td>
<td>0.84 (0.13)</td>
</tr>
<tr>
<td>(f_0)—female gender (Hz)</td>
<td>202.44 (26.05)</td>
<td>194.96 (41.86)</td>
</tr>
<tr>
<td>(f_0)—male gender (Hz)</td>
<td>128.93 (28.80)</td>
<td>126.22 (18.21)</td>
</tr>
</tbody>
</table>

**Abbreviation:** SD, standard deviation.
* Differs from the initial evaluation within the same group.

significant reduction in the mean (improvement of voice quality); however, for the parameters jitter and shimmer, no statistically significant differences were observed between the control and experimental groups. Nevertheless, studies have suggested the inclusion of resonance and articulation exercises as routine practice of vocal exercises for professional voice users, as they favor better balance of voice production.\(^ {9,11,33}\)

Comparison of the results of acoustic parameters analyzed in the voice educational program, between the evaluation before and 3 months after the educational activities, shows that there were few changes in the quality of voice in the control and experimental groups. Statistically significant difference was observed only in the intragroup comparison for the mean intensity in the control group. In this group, there was an increase in the value of mean intensity in the evaluation of 3 months after the educational program and a small reduction in the mean of the experimental group, although the values were not significant. This shows that the individuals in the experimental group had better assimilation of control of vocal intensity, as the theoretical-practical educational practices may help in this sense. However, it is important to point out that in spite of the reduction in intensity, this parameter still continues to be above the normal, and this was also verified for the control group. In this case, there is an urgent need for an ongoing training program to achieve a balance of pitch vocal.

It is clear that when healthy adults are asked to phonate “at comfortable loudness and pitch,” voice intensity varies considerably between individuals.\(^ {34}\) Across several speaking conditions, a range of 63–75 dB between health adults should be expected, whereas “comfortable” voice intensity of both women and men lies below the above-described critical threshold of 80 dB.\(^ {35}\) Hunter and Titze\(^ {36}\) verified that when they compared variations in vocal loudness in teachers, they observed that in the period of nonoccupational voice, the vocal intensity was 60 dB SPL, when using occupational voice was approximately 71 dB SPL. The vocal demand made by the teacher’s routine, associated with the excessive number of students per
group, frequently in addition to students’ undisciplined behavior, may lead to the teacher’s accentuated vocal effort. In this study, the teachers showed vocal intensity above of 71 dB SPL. Although the experimental group, there was a slight reduction in the intensity habitual vocal in the final evaluation, this results showed the need for training programs for voice for teachers with periods of long duration for best effects. Additionally, we may take into consideration that in all voices, some perturbation and noise is present and that these values also tend to vary with $f_0$ and SPL.

When verifying the effect of the interaction of time on the results of educational actions of both programs, it was observed that there was no statistically significant difference for jitter, shimmer, $f_0$, and HNR. These parameters measure the degree of disturbance of the vocal fold vibrations, as the regards, the presence or absence of hoarseness in the voice. All acoustic parameters analyzed were within the pattern of normality for both groups in the initial evaluation and were maintained at the end of the educational program. It suggests that there was no worsening in vocal quality, and educational actions may contribute to the prevention of development of frames dysphonia. This conclusion corroborates the study of Timmermans et al, who developed a short-term vocal health program for future teachers. On the other hand, another short-term study developed by Iلومaki et al concludes that in the experimental group, there was a significance difference for jitter and shimmer after the period of intervention. Thus, it suggests that when the incentive to practice the exercises in day-to-day routine is applied in a disciplined manner for a sufficient length of time, so that the participants practice at home, they may have a better additional effect on the improvement in voice quality.

An important finding of this study is that exercises can have immediate effect and improves the acoustic analysis of voice, which may not persist for a long time. Hypothetically, this could be the explanation of why systematic reviews find no impact of prevention programs to dysphonia, while treatments are effective. Another observation is that there were no differences between the results of the experimental group compared with control. This could be related to use of a positive control group, which received two sessions with information on prevention of voice disorders, and these can have a positive impact momentary, like that seen in the experimental group.

The acoustic parameters of $f_0$ for women in both groups were found to be below the mean value of normality. There was no significant difference between the final and initial value of for women in both groups, corroborating the study of Bovo et al. Therefore, it is suggested that the women in the experimental group did not frequently put into practice the vibrant sound exercises that were trained during the educational program, and exercises when combined in the ascending scale may affect the increase of $f_0$ for acoustic notes more high.

We know that changes in behavior after health education actions occurs in a complex process that includes subjective and objective factors, such as the social, economic, and cultural context as well as individual motivations. Thus, it makes sense to say that the workplace environment and their routines sometimes impose limitations on choices of teachers with regard to change their health styles. Therefore, encouraging the independence and critical consciousness of subjects in the process by means of health education does not guarantee that they will change their lifestyle, and health promotion actions that make healthy choices the easier choices are necessary through healthy public policies. Thus, it is important that educational activities aimed at the prevention of communication disorders, such as dysphonia, be incorporated continuously into the environment of schools.

One of the interesting points of this study was the randomization process. Initially, schools were randomly selected and then a general questionnaire, concerning socioeconomic and professional information, was applied to all teachers. Based on the results, we found no differences between the characteristics of teachers in different schools. Thus, there was the final draw of the schools, divided into experimental and control groups. This option was due to the fact that teachers have their workload too long (most with more than 32 h/wk) and they have only 2 h/wk available for meetings, part of this time in which the activities were carried out in the study. In practical terms, it would be almost impossible to divide the sample into two study groups for ethical and logistical reasons. This form of randomization was similar to the study of Pasa et al and different of other studies. Limitations of this study should be mentioned: reduced number of male included in the experimental group ($n = 7$), and this is explained by low number of male teaching in public schools (less than 15% of the total) and low level of adhesion by male in the selected schools. Another topic to point out was a return rate of volunteers in the control group smaller than the experimental one, which was expected, because due to the degree of involvement of teachers in the experimental group (performing vocal exercises), this fact creates a degree of affection and hosting that increases the percentage of return. Finally, possibly, there were a low number of training sessions in the experimental group, suggesting future studies to an ongoing program of long-term studies to measure the impact of interventions.

CONCLUSION

The training exercises specifically for the voice presented a positive impact on the acoustic variables after exercises, but this impact was not possible to see prospectively. It is suggested that actions directed toward improvement in voice quality should be performed on a continuous basis.

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