Comparison of Effects Produced by Physiological Versus Traditional Vocal Warm-up in Contemporary Commercial Music Singers

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Summary: Purpose. The present study aimed to observe whether physiological warm-up and traditional singing warm-up differently affect aerodynamic, electroglottographic, acoustic, and self-perceived parameters of voice in Contemporary Commercial Music singers.

Methods. Thirty subjects were asked to perform a 15-minute session of vocal warm-up. They were randomly assigned to one of two types of vocal warm-up: physiological (based on semi-occluded exercises) or traditional (singing warm-up based on open vowel [a:]). Aerodynamic, electroglottographic, acoustic, and self-perceived voice quality assessments were carried out before (pre) and after (post) warm-up.

Results. No significant differences were found when comparing both types of vocal warm-up methods, either in subjective or in objective measures. Furthermore, the main positive effect observed in both groups when comparing pre and post conditions was a better self-reported quality of voice. Additionally, significant differences were observed for sound pressure level (decrease), glottal airflow (increase), and aerodynamic efficiency (decrease) in the traditional warm-up group.

Conclusion. Both traditional and physiological warm-ups produce favorable voice sensations. Moreover, there are no evident differences in aerodynamic and electroglottographic variables when comparing both types of vocal warm-ups. Some changes after traditional warm-up (decreased intensity, increased airflow, and decreased aerodynamic efficiency) could imply an early stage of vocal fatigue.

Key Words: Semi-occluded vocal tract–Tube phonation–Singing voice–Warm-up–Aerodynamics.

INTRODUCTION

Although most singers and singing teachers agree on the importance of vocal warm-up before performing, there is no clear evidence to date regarding objective physiological effects that these voice exercises produce. Moreover, literature provides a wide variety of exercises that can be used as vocal warm-up.

Following Behlau, warm-up exercises can be classified into two different groups: (1) physiological and (2) technical or artistic vocal warm-up.[1] The latter is usually taught by singing teachers, and its purpose is to prepare technical aspects such as voice placement, breath support, and vocal timbre. For purposes of the present study, technical warm-up will be labeled traditional vocal warm-up. On the other hand, physiological warm-up is commonly provided by speech-language pathologists working with professional voice users. The goal of this type of warm-up is to prepare adequate physiological conditions of the phonatory system to avoid vocal fatigue during or after performance.[1] Several voice rehabilitation exercises could be used as physiological warm-up, one of the most commonly implemented being semi-occluded vocal tract exercises (SOVTE).

SOVTE are widely used in voice rehabilitation and voice training. This group of exercises is characterized by postures of vocal tract that include anterior constrictions (eg, lip buzz, lip trills, tongue trills) and artificial lengthening such as tube phonation with the distal end either in the air or into a recipient filled with water. Several benefits have been attributed to this type of exercises, such as an increase in vocal tract inertive reactance,[2–6] which may be favorable to voice production by decreasing the phonation threshold pressure (PTP)[5] and increasing skewing of the glottal flow waveform (faster cessation of the flow).[4,5] Increased skewing strength energy of higher spectral harmonics and, this in turn, should lead to a more resonant and economic voice production. An increased oral pressure and, consequently, an elevation of the intraglottal pressure[7,8] and subglottic pressure (Psub)[9–11] have also been reported during semi-occlusions. Several studies have also reported a change in the relative contact time of the glottis (contact quotient [CQ]) when semi-occlusion is compared with vowel phonation.[11–19] Variations of CQ are dependent on the type of SOVTE.[19] Outcomes related to changes on vocal tract shape as an effect of SOTVE have also been reported in the literature.[20–25]

Previous research has been conducted to compare the acoustic effect of different SOVTE versus traditional vocal warm-up. Most studies have used spectral measures by using long-term average spectrum.[26–28] A recent study aimed to explore the impact of traditional singing vocal warm-up compared with SOVTE (phonation into a plastic drinking straw) on voice spectrum, and perceived phonatory effort showed that warm-up exercises did not significantly affect either spectral characteristics or perceived phonatory effort by subjects.[26] A case-control investigation conducted by Guzman et al[27] compared the

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effect on spectral slope declination of traditional warm-up and vocal function exercises (VFE) (voice exercise program that uses some types of SOVTE) in vocally normal Contemporary Commercial Music (CCM) singers. Significant changes after practice were observed on alpha ratio (increase) and singing power ratio (increase) in speaking voice, and singing power ratio (increase) for VFE group in the singing voice.[27] The traditional vocal warm-up also showed pre-post changes for alpha ratio (increase). Moreover, significant differences between the VFE group and the control group for alpha ratio and singing power ratio were found in speaking voice samples (greater pre-post difference for VFE). Therefore, it is possible to assume that VFE produced a greater positive effect than traditional singing warm-up on the spectral slope declination in speaking voice analysis.[26] Acoustic effect of vocal warm-up with SOVTE in dysphonic teachers has also been assessed. Spectral tilt was measured after straw phonation exercises compared with vocal exercises with open vowel [a:]. The results showed that voice exercises with straw may have positive immediate acoustic effects (Guzman et al).[28]

To date, no studies have been conducted to compare the possible differential effect of traditional versus physiological vocal warm-ups using aerodynamic and electroglottographic (EGG) measures in CCM singers. The question that motivates the present research is "Are there objective and/or subjective differences between physiological vocal warm-up (based on SOVTE) and traditional singing warm-up?" Therefore, the present study aimed to observe whether physiological warm-up using SOVTE and traditional singing warm-up differentially affect the aerodynamic, EGG, acoustic, and self-perceived parameters of voice in CCM singers.

Based on previous studies on SOVT exercises, we hypothesize that physiological vocal warm-up including SOVT exercises should lead to a more economic voice production if compared with traditional vocal warm-up (using an open vocal tract configuration). Specifically, physiological warm-up method should be expected to produce a greater perceived resonant voice quality compared with traditional warm-up. Moreover, objective measures should reflect a more economic voice production after physiological warm-up by increasing acoustic output and decreasing laryngeal effort (eg, lower CQ and lower Psub).

METHODS

Participants

A total number of 30 CCM singers were included in this study. CCM is used to denote nonclassical music. This term was created to include singing styles such as music theater, pop, rock, gospel, R&B, soul, hip-hop, rap, country, folk, experimental music, and any other styles not considered classical.[29]

Subjects were randomly assigned to two groups: an experimental group (n = 15) and a control group (n = 15). The total sample included 18 female participants (nine for each group) and 12 male participants (seven for the experimental group and five for the control group). The average age of the experimental group was 32 years, ranging from 24 to 39 years. The average age of the control group was 34 years, ranging from 27 to 38 years. The average time of singing training for the experimental and the control group was 4.8 and 5.2 years, respectively. Inclusion criteria for participants were as follows: (1) aged between 25 and 45 years, (2) no current or history of major voice problems based on participants' self-report, (3) perceptually normal voice, and (4) at least 3 years of formal singing voice training. Perceptual assessment was conducted by one of the authors of this paper with more than 15 years of experience in voice clinic. The grade of dysphonia, roughness, breathiness, asthenia, strain (GRBAS) scale was used. Participants in both groups were native speakers of Spanish and reported no hearing problems. The present study was approved by the institutional review board at University of Chile, and all participants signed informed consent.

Singing vocal warm-up

All participants were required to engage in a 15-minute session of vocal warm-up exercises.

The vocal warm-up program for the experimental group included the same three phonatory tasks used in a previous study by Guzman et al[27]: (1) to phonate a sustained vowel [u:]-like sound using habitual speaking pitch and loudness level, (2) ascending and descending glissandos through a comfortable vocal range (including falsetto), and (3) pitch and loudness accents (rapid fluctuations of pitch and loudness). All phonatory tasks were performed using a commercial plastic stirring straw (5 mm in inner diameter and 25.8 cm in length). Phonation into a straw is considered as a SOVTE. Participants were encouraged to feel vibratory sensations in the front part of the mouth and head. The entire exercise sequence lasted 15 minutes (5 minutes per phonatory task).[27]

Vocal warm-up for the control group consisted of traditional singing exercises using the vowel [a:]. The sequence used in the present study was based on a previous work.[27] Each participant sang a melody based on musical intervals of thirds. Musical pitch ranges were adapted to each participant's voice type (voice classification). For high male and female voices (tenor or soprano), the starting note was E3 and E4, respectively; for middle male and female voices (baritone or mezzo-soprano), the starting note was C3 and C4, respectively; and for low male and female voices (bass or alto), the starting note was A2 and A3, respectively. Voice type was determined from participants' self-report. The melody was repeated changing the musical tonality by semitones in an ascending and a descending manner, through a comfortable vocal range. Participants were encouraged to feel vibratory sensations in the front part of the mouth and head. The entire exercise sequence lasted 15 minutes.

Before data acquisition, explanation and demonstration of all exercises were provided to all participants by trained speech-language pathologists who authored the present study. To standardize demonstrations of exercises, all experimenters participated in a 3-hour training session. No voice rest time was considered between both instrumental voice assessments (pre and post warm-up) and warm-up session. Control of pitch was auditorily monitored by the experimenters using an electronic keyboard.