Vocal Performance of Group Fitness Instructors Before and After Instruction: Changes in Acoustic Measures and Self-Ratings

Katherine Dallaston and Anna F. Rumbach, *Brisbane, Australia*

Summary: Objectives. (1) To quantify acute changes in acoustic parameters of the voices of group fitness instructors (GFIs) before and after exercise instruction. (2) To determine whether these changes are discernible perceptually by the instructor.

Study Design. This is a pilot prospective cohort study.

Methods. Participants were six female GFIs, based in Brisbane, Australia. Participants performed a series of vocal tasks before and after instruction of a 60-minute exercise class. Data were obtained pertaining to fundamental frequency (pitch), intensity (volume), jitter, shimmer, harmonic-to-noise ratio (HNR), maximum duration of sustained phonation (MDSP), and pitch range. Additionally, self-ratings of voice quality were obtained before and after instruction. Data were analyzed using the Wilcoxon signed rank test.

Results. Significant increases ($P \leq 0.05$) were found in fundamental frequency and intensity after instruction. No significant changes in jitter, shimmer, HNR, or MDSP were found before and after instruction. For the group, no significant change in self-ratings of voice quality occurred before and after instruction.

Conclusions. Statistically significant changes in pitch and volume were found on acoustic analysis. However, these subtle changes remained within the limits of what is considered normal and representative of the participant's age and gender. Further research into the effects of exercise instruction on the voice is needed.

Key Words: Professional voice use–Aerobics instructor–Group fitness instructor–Vocal loading–Voice disorder–Acoustics.

INTRODUCTION

Group fitness instructors (GFIs) use the voice to engage, motivate, and cue participants safely through an exercise routine. However, voice problems such as hoarseness, pitch changes, and vocal tract dryness are commonly reported by GFIs.[1–4] One recent study reported over 78% of GFIs experience acute voice symptoms during or immediately after instructing.[4] This may not be surprising considering the GFI's need to perform vigorous exercise and speak simultaneously. Additionally, the need to compete vocally with loud background music and environmental noise presents a combination of environmental and physiological stressors that may contribute to the development of voice problems. Despite a number of studies exploring GFIs' self-perception of voice difficulties,[1–4] there has been limited objective exploration of occupational voice changes in this population.

To date, only one study has reported objective data relating to acute voice changes during and immediately after instruction. The study, conducted by Wolfe et al,[5] assessed the vocal function of six female GFIs using measures of acoustic perturbation and electroglottography (EGG) before and after a 30-minute period of simulated exercise instruction. The subjects were randomly selected from the results of a previous study[2] to include three GFIs with few or no reported voice problems and an equal number with complaints of intermittent hoarseness, complete or partial voice loss, vocal fatigue, and strain. The study failed to elucidate any significant difference in acoustic parameters or EGG before and after instruction. However, significant differences were found in vocal behavior and function between the two groups. During the simulation, instructors who reported voice problems used a louder voice and phonated for a higher percentage of time, compared with instructors without voice problems. This is consistent with the hypothesis that vocal loading (ie, prolonged phonation at a higher than usual effort level) contributes to a GFI's risk of voice problems. Significantly, more jitter, lower harmonic-to-noise ratio (HNR), and less periodicity of vocal fold vibration were found in instructors with vocal problems. This finding suggests that self-report of vocal problems in GFIs will likely correlate with objective acoustic and instrumental measures, and that further investigation using these objective measures is appropriate.

The generalizability of Wolfe et al's[5] results is limited by the study design, which used a simulated 30-minute period of exercise instruction, rather than a real exercise class environment. Subjects were asked to perform as they would in a typical session, although were confined to a 4-ft area, asked to always face a freestanding microphone, and were without an audience or authentic background noise. Although one of the authors, a certified GFI, confirmed that each participant carried out the instruction in a realistic fashion, the degree to which the instruction was typical of each individual's usual performance was not reported. To obtain results that can be reliably extrapolated to the profession at large, objective measurements of vocal function of GFIs are required using a study scenario of an authentic group fitness class, rather than a simulation of one. Furthermore, developing methodology that can feasibly be used to

Accepted for publication February 12, 2015.

From the School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Australia.

Address correspondence and reprint requests to Anna F. Rumbach, School of Health and Rehabilitation Sciences, The University of Queensland, St Lucia, Brisbane 4072, Australia. E-mail: a.rumbach@uq.edu.au

Journal of Voice, Vol. 30, No. 1, pp. 127.e1-127.e8
0892-1997/$36.00

http://dx.doi.org/10.1016/j.jvoice.2015.02.007

elucidate changes in vocal performance across a large cohort, whose gender distribution reflects the profession, is important.

Therefore, the present study acted to pilot methodology that was able to (1) quantify any acute changes in acoustic parameters in the voices of GFIs before and after a period of authentic exercise instruction and (2) to determine whether these changes are discernible perceptually by the GFIs. In view of the high vocal demands of the profession and the high prevalence of self-reported acute vocal symptomatology, it was hypothesized that some degree of measurable vocal change at the acoustic level would be detected. Furthermore, understanding whether GFIs could perceptually discriminate acute voice changes was considered important as it has been hypothesized that self-awareness of subtle voice change may reflect their capacity to self-manage ongoing vocal health.

METHOD

Procedure

A total of six female GFIs aged between 21 and 46 years (median = 40 years) participated in this study. All participants were certified and registered GFIs and were currently earning income from teaching at least one type of group fitness class per week at a university-based fitness center located within Brisbane, Australia. Recruitment of participants was conducted in cooperation with the fitness center's manager, who distributed invitations to participate to all staff via e-mail and/or verbal discussion. Recruitment was conducted over a 1-month period (August 2014) that aligned with the commencement of the university semester—a time that typically offers consistency in regards to size and number of classes taught by GFIs each week. On recruitment, participants provided informed consent and were assigned a de-identified participant number to ensure participant confidentiality.

Each participant underwent a voice evaluation before and after instruction of a 60-minute group exercise class that was part of their regular teaching schedule at this facility. For this reason, the study was not able to control for the time of the scheduled class. All classes were conducted in a purpose-built, air-conditioned, group fitness studio that was able to accommodate up to 50 exercise class participants. All GFIs had access to a surround sound stereo system and a headset microphone. However, microphone use was not mandatory in this facility. As the aim of the study was to examine GFIs' voice use in an authentic setting, the researchers did not control variables surrounding vocal hygiene and teaching practices that would alter their usual teaching behaviors (eg, classes taught per day or week, level of hydration before and during exercise instruction). Vocal use before the voice assessments was reported to be consistent with normal daily vocal use for each individual.

Ethical approval to conduct this research was obtained from the University of Queensland's Behavioural and Social Sciences Ethics Committee.

Questionnaires. Before voice assessment, participants were asked to complete two questionnaires: (1) a previously published questionnaire that gathered information regarding GFI demographics, lifestyle, teaching practices, and experience of voice symptomatology[4] and (2) the Voice Handicap Index (VHI)[6] to determine the impact of voice difficulties on the participants' daily functioning and quality of life.

Voice self-rating. Participants were asked to rate their voice quality before and after instruction using a scale of 1 to 10, with 1 representing worst or most abnormal voice and 10 representing best or most normal voice. After instruction, participants were also asked to comment on any voice changes that occurred during the period of instruction and, if any were experienced, to elaborate on exactly which sensory and/or perceptual changes they perceived.

Voice assessment. Each participant's vocal function was assessed twice, once before and once after a 60-minute period of exercise instruction by a qualified speech-language pathologist. Recordings were obtained within 30 minutes before and after instruction and not before the participant's respiratory rate, as perceived by the GFI, had returned to resting rate. Assessments were conducted face-to-face in a small room with low ambient noise (<50 dB), as measured by a sound pressure level meter,[7] and each session took approximately 20 minutes to complete.

Participants were seated for the duration of the assessment and asked to perform a series of vocal tasks. Audio recordings were captured using a head-mounted condenser microphone (AKG C544L), positioned 5 cm from the lips to the side of the mouth, to minimize air burst noise.[8] A Micro Mic Phantom Adapter (AKG MPA VL) was used to connect the microphone to a Korg MR-1000 Professional 1-Bit Digital Audio Recorder, which digitized the microphone signals at a sampling rate of 48 000 Hz. To obtain accurate measures of vocal intensity, calibration of the microphone was conducted before data collection using a comparison method.[9]

Vocal tasks included maximum duration of sustained phonation (MDSP), maximal pitch range, oral passage reading, and conversational speech. The order in which vocal tasks were performed and the use of standardized verbal instructions (and demonstrations when applicable) were consistent across both data collection time points for all participants.

MDSP on the vowel /a/ was performed under two conditions: comfortable (ie, modal) intensity and minimal intensity (MI). Participants were required to perform five trials of the task in each condition to optimize the reliability of the data.[10] To determine maximal pitch range, participants were instructed to glide or step from one end of their pitch range to the other, following a model from the assessor. Participants performed the task in both ascending and descending directions (sustaining the highest and the lowest pitch for 5 seconds if able). A total of five trials in each direction were performed to allow participants opportunity to demonstrate the true limits of their phonation range.[11]

As prior research has shown vocal behavior to vary depending on elicitation method,[12] more than one task was used to obtain recordings of connected speech. First, an oral passage reading task was conducted using a passage of text containing a representative phonetic sample (the Grandfather passage[13]). Participants were instructed to familiarize themselves with the text before reading the passage aloud using a comfortable,