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Perceptions of Ambient Noise Levels and Vocal Effort When Working as a Fitness Instructor

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PERCEPTIONS OF AMBIENT NOISE LEVELS AND VOCAL EFFORT WHEN WORKING AS A FITNESS INSTRUCTOR

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ABSTRACT

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There are 373,700 fitness instructors employed in the United States as of 2019. The percent change in employment from 2019 to 2029 is projected to increase by 15% (U.S. Bureau of Labor Statistics, 2020). It is important to know if this population is aware of the possibility of auditory damage due to exposure to high sound levels or are aware of the potential risk of laryngeal damage, such as vocal fatigue, when instructing a fitness class. The objectives for this project were to investigate the knowledge, attitudes, and self-reported behaviors relating to sound levels and vocal effort and describe the potential for laryngeal and/or auditory damage when working as a fitness instructor. In addition, another objective was to investigate symptoms of auditory or vocal damage fitness instructors have experienced immediately following fitness class instruction. Twenty-five fitness instructors completed an online questionnaire that contained 76 questions. Participants answered questions about their knowledge, attitudes, and self-reported behaviors regarding fitness class sound levels and vocal effort as well as their perceptions regarding any potential risks of hearing and laryngeal damage. Results suggested fitness instructors had some knowledge when it came to identifying what types of sounds were typically loud enough to potentially damage their ears and how to protect their ears when around loud sounds. However, the fitness instructors appeared to be lacking in their ability to identify where the damage occurred in their ears and what level of sound was high enough to cause hearing loss. Gym management and fellow instructor standards were not as important as their personal preferences or the class participants preferences when determining the volume setting of the music played during fitness classes. Fitness instructors were aware the fitness studio had high sound levels; however, they were not willing to protect their ears as 100% of the participants reported not utilizing hearing protection when instructing a fitness class and when asked if they would do something to protect their ears when around loud sounds during their next fitness class the majority (58.33%) reported "probably no." Participants seemed to have adequate knowledge about vocal effort and potential of laryngeal damage as all, but two participants reported appropriate methods when asked about ways they can preserve their voice after instruction. Most participants were correct when identifying symptoms of vocal problems, with the majority selecting hoarse voice and raspy voice, followed by coughing. However, over half (66.7%) reported they do not consider the risk of vocal fatigue when selecting the music volume for their classes. The average amount of participants reported utilizing a "somewhat severe-severe" vocal effort when instructing and 32% reported they never utilized a microphone. Over half (56%) of participants had experienced vocal problems after teaching and only five participants out of the 56% were adjusting their teaching methods due to their vocal problems. Overall, the study outcomes suggested many fitness instructors had adequate knowledge about sound levels and the risk of hearing damage as well as vocal effort and potential risk of laryngeal damage but they did not feel the necessity to develop behaviors or change their attitudes with regard to protecting their hearing or voice. The results from this study suggested fitness instructors could benefit from greater education and health promotion to increase their knowledge to possibly change their attitudes and behaviors to ones that could appropriately care for their hearing and vocal health.

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LIST OF ABBREVIATIONS

dB	decibel
dBA	decibel A-weighted
dB SPL	decibel sound pressure level
DPOAE	distortion product otoacoustic emissions
ER	exchange rate
Hz	hertz
kHz	kilohertz
LAeq	A-weighted equivalent continuous sound level
LAVG	average sound level
NIHL	noise-induced hearing loss
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEM	personal exposure meter
PTS	permanent threshold shift
REL	recommended exposure limit
SLM	sound level meter
SPL	sound pressure level
TTS	temporary threshold shift
TWA	time weighted average

For definitions of these terms, see the Glossary in Appendix A

CHAPTER I

STATEMENT OF THE PROBLEM

The demand and interest in becoming a fitness instructor has largely increased in the United States. According to the U.S. Bureau of Labor Statistics (2020), 373,700 fitness trainers and instructors were employed in 2019. The percent of employment in this industry is projected to increase 15% from 2019 to 2029 (U.S. Bureau of Labor Statistics, 2020).

Fitness instructors are dependent upon their voice for job performance. Several studies suggested sport and fitness instructors are at risk for vocal discomfort and possibly vocal injury due to high levels of vocal use (Fontan et al., 2016; Rumbach, 2013). In addition to vocal use, fitness instructors depend on a sound source, such as music, during instruction. Research suggested fitness instructors could be subjected to auditory damage due to being over exposed to high levels (amplitude) of sound (Sinha et al., 2017; Wilson & Herbstein, 2003; Zoe, 2015). Research studies on the types of fitness classes, music loudness (amplitude of the music), motivation changes with respect to the perceived music intensity, as well as ways to protect hearing in fitness instructors and patrons have been conducted (Beach & Nie, 2014; Sinha et al., 2017; Torre & Howell, 2008; Wilson & Herbstein, 2003).

Fitness instructors might be at risk for noise-induced hearing loss (NIHL) due to exposure to high sound levels over extended periods of time in their work environment such as music levels. The National Institute on Deafness and Other Communication Disorders (2015) defined NIHL as “sounds can be harmful when they are too loud, even for a brief time, or when they are both loud and long-lasting. These sounds can damage sensitive structures in the inner ear and cause noise-induced hearing loss” (p. 1).

Titze et al. (1997) defined occupational voice users as “those who depend on a consistent, special, or appealing voice quality as a primary tool of trade, and those who, if afflicted with dysphonia or aphonia, would generally be discouraged in their jobs and seek alternative employment” (p. 254). Vocal effort is described as “the perceived exertion of a vocalist’s response to a perceived communication scenario” (Hunter et al., 2020, p. 517). Vocal use is increased as a function of the time the voice is used and the vocal intensity (typically measured in decibels [dB] of sound pressure level [SPL]). Higher SPL results in greater vocal fold stress. Teachers, another profession that depends on their voice, have experienced auditory and vocal complaints such as hoarseness, discomfort, and increased effort while using their voice related to talking in the presence of high-sound levels (Hunter & Titze, 2010; Kristiansen et al., 2014; Lee et al., 2010; Roy et al., 2004).

Research Goal

Goals for this project were to investigate the knowledge, attitudes, and self-reported behaviors relating to sound levels and vocal effort and describe the potential risk for laryngeal and/or hearing damage when working as a fitness instructor. A questionnaire served as a way for healthcare professionals to better understand this population’s self-perception toward sound levels, vocal usage, and potential risks associated with this occupation.

Rationale

With a significant increase in employment as a fitness instructor according to the U.S. Bureau of Labor Statistics (2020), it was important to know if this population was aware of the possibility of hearing damage due to exposure to high sound levels. Also, it was important to know if fitness instructors were aware of the potential of laryngeal damage, such as vocal fatigue, when instructing a fitness class.

Purpose

Within the field of audiology, it is important to understand fitness instructors' knowledge, attitudes, and self-reported behaviors relating to sound exposure and vocal effort while instructing in order to best understand how to prevent hearing and/or vocal damage in this population.

Research Questions

Q1 What are fitness instructors' knowledge, attitudes, and self-reported behaviors relating to sound levels and potential risk of hearing damage for instructors of fitness classes?

Q2 What are fitness instructors' knowledge, attitudes, and self-reported behaviors regarding vocal effort and potential risk of laryngeal damage for instructors of fitness classes?

Q3 What symptoms of hearing or vocal damage have fitness instructors experienced immediately following fitness class instruction?

Summary

Fitness instructors could be at risk for vocal and/or auditory system damage due to increased vocal effort when exposed to high levels of sound present in fitness class sessions. Due to this possibility, it is important to ask this population specific questions relating to their own experiences and self-perceptions when instructing a class. Asking questions relating to their knowledge, attitudes, and self-reported behaviors as well as any symptoms they have experienced after instructing could provide healthcare professionals with further understanding about fitness instructors and the potential risks associated with this occupation in order to provide education/counsel patients on prevention of hearing and/or vocal damage.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction to the Literature

The current study involved research on the perceptions of sound levels and vocal effort when working as a fitness instructor. In an effort to understand sound levels and vocal effort, this literature review first discusses the two in detail and then provides literature that focuses on self-perceptions of sound levels and vocal effort.

Noise Exposure

According to the National Institute on Deafness and Other Communication Disorders (2015), approximately 15% of Americans between the ages of 20 and 69 have a high frequency hearing loss due to loud noise exposures at work or during non-occupational activities. In 1981, the Occupational Safety and Health Administration (OSHA, 1983) estimated 7.9 million U.S. manufacturing workers were exposed to daily noise levels of at least 80 decibel A-weighted (dBA). The National Institute for Occupational Safety and Health (NIOSH, 2018) estimated more than 22 million people are exposed to noise levels above 85 dBA at work each year.

The NIOSH (1998) and the OSHA (1983) are dedicated to preserving the health of American workers. The OSHA is part of the U.S. Department of Labor which covers most private sector employers and their workers. The NIOSH is part of the U.S. Centers for Disease Control. The NIOSH

> is charged with recommending occupational safety and health standards and describing exposure concentrations that are safe for various periods of employment—including but

> not limited to concentrations at which no worker will suffer diminished health, functional capacity, or life expectancy as a result of his or her work experience. (p. iii)
>
> Public Law 91-596 was created to assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health; and for other purpose. (OSHA, 1983, p. 1)

The OSHA's (1983) 29 CFR 1910.95 stipulated the regulation of occupational noise exposure and the requirements for a hearing conservation program for workers that are over-exposed. The NIOSH recommends best practice for the prevention of NIHL in the occupational setting.

Overall, both NIOSH (1998) and OSHA (1983) have protocols for noise measurement; however, OSHA provides legal authority to enforce occupational settings. Although NIOSH has a more conservative noise exposure criterion (explained below), it does not have authority to enforce the guidelines in occupational settings as it is only considered best practice based on current science.

To assess the possible risk of NIHL in workers, level, duration, and noise dose need to be measured, and noise dose is calculated based on those measurements. Noise dose is defined as "the amount of actual exposure relative to the amount of allowable exposure, and for which 100% and above represents exposures that are hazardous" (NIOSH, 1998, p. xii).

The legal requirements by OSHA (1983) mandate that workplaces institute a hearing conservation program when workers are exposed above 85 dBA time weighted average (TWA) or 50% dose. The TWA is used to quantify the maximum noise exposure a person can be exposed to over an eight-hour period. Exposure limit or dose refers to how much noise an individual could be subjected to for an eight-hour day. The noise dose would accumulate during the work shift and if it exceeded 100% dose based on OSHA requirements, the workers were potentially at risk for auditory damage when exposures were repeated over extended periods of time. The OSHA integrated the noise levels using a 5-dB exchange rate (ER). In this case, the ER specified halving the allowable exposure time for each 5-dB increase in SPL.

The NIOSH's (1998) recommended exposure limit (REL) for workers was daily exposures not to exceed 85 dBA TWA or 100% noise dose: "Exposures at and above this level are considered hazardous" (p. 1). The NIOSH integrated the noise levels using a 3-dB ER specifying halving the allowable exposure time for each 3-dB increase in SPL. The NIOSH recommended that when any worker's eight-hour TWA was ≥85 dBA, the employer should institute/provide a hearing loss prevention program that includes the following components: noise exposure assessment, engineering or administrative noise controls, hearing protector devices, audiometric monitoring, hazard communication (warning signs), program evaluation, and recordkeeping.

Auditory Damage from Hazardous Noise Exposure

Noise-induced hearing loss is caused by over-exposure to high level sound. Permanent hearing loss occurs due to damage to hair cells and other structures found in the cochlea. When a hearing evaluation is completed, the audiogram would show elevated hearing thresholds (softest sound a person could hear 50% of the time; American Speech-Language-Hearing Association [ASHA], 2005). In the early stages, a 'noise notch' is characterized by a V-shaped audiometric configuration due to decreased hearing thresholds at 3-6 kilohertz (kHz) as compared to higher and lower test frequencies (Coles et al., 2001). If a noise notch is present on an audiogram, it suggests the hearing loss might be due to hazardous noise exposure (Rabinowitz et al., 2006).

Exposure to high levels of sound could result in potential hearing loss; the extent and severity of the hearing loss would depend on the amount of time an individual was exposed and at what intensity the sound was heard. There are two types of NIHL: temporary and permanent. The OSHA (2002) described both: "temporary hearing loss results from short-term exposures to noise, with normal hearing returning after period of rest. Generally, prolonged exposure to high noise levels over a period of time gradually causes permanent damage" (p. 1). In addition to OSHA, NIOSH (1998) also provided definitions termed as temporary threshold shift (TTS) and permanent threshold shift (PTS); a TTS is defined as a "temporary increase in the threshold of audibility for an ear caused by exposure to high-intensity acoustic stimuli" (p. xiv) and a PTS is defined as "permanent increase in the threshold of audibility for an ear" (p. xv). A PTS might develop if hazardous unprotected exposures are repeated over time.

An individual with NIHL might seek out hearing accommodations such as hearing aids (NIOSH, 1998 p. 71). Workers with NIHL might also have an increased risk of accidents in the workplace; for example, individuals working in manufacturing or with heavy machinery run the risk of not hearing orders or machinery (Lusk et al., 1999). In the service industry, this might lead to misunderstanding patron and co-worker communications.

Workers do not need to put themselves at risk for hearing loss; preventive measures could be taken to avoid NIHL. Strategies to reduce risk of NIHL include noise control (turn the volume down), administrative control (walk away, change job duties, reduce the time of exposure), and utilizing hearing protection. Hearing protection should be fitted and worn if an individual's occupational exposure exceeds noise levels of 85 dBA TWA when measured according to

NIOSH (1998) sampling protocol. The NIOSH described hearing protectors as “any device designed to reduce the level of sound reaching the eardrum” (p. 61). Various styles of hearing protectors could be utilized such as earmuffs, formable earplugs, pre-formed earplugs, custom ear plugs, and ear canal caps to name a few. Specialized hearing protectors are specifically made for workers subject to high noise levels during their job and who also need to communicate. The next section of the literature review discusses occupational NIHL and sound exposures that could put a fitness instructor at risk of NIHL at work.

Occupational Noise-Induced Hearing Loss

Nelson et al. (2005) published an article that described the burden of occupational NIHL in the year 2000. Data from the distribution of the work force by occupational category and economic sector (agriculture, mining, manufacturing electricity, construction trade, transportation, finance, and services), and economic activity rates were utilized from the World Health Organization and noise exposure data was utilized from NIOSH (1998). Both of the data sets were used to estimate attributable fractions that researchers defined as “the proportion of adult hearing loss that was caused by occupational exposure to noise” (Nelson et al., 2005, p. 447). Researchers found that globally, an average of 16% of disabling hearing difficulties is due to excessive exposure to noise in their occupation. Researchers also found that males experienced more exposure to excessive occupational noise than females due to differences in occupational sectors and categories as well as how long they had been working. Nelson et al. concluded that although many factors could contribute to occupational NIHL, the largest was lack of hearing loss prevention. These researchers suggested that by reducing equipment noise, providing a hearing loss prevention program, using hearing protection devices, and improving overall education regarding the risk of NIHL could reduce the global burden of occupational

NIHL. Based on the study above by Nelson et al., there are people who are experiencing occupational NIHL. For the purpose of this project, the next section focuses specifically on the fitness sector as this occupation is known to be at risk of NIHL.

Noise Levels in Work Settings: Fitness Classes

Music volumes at levels that might be harmful to hearing are common in many fitness classes according to a study conducted by Beach and Nie (2014). These researchers compared a questionnaire relating to fitness classes and instructor sound level preferences and determined noise exposure for the instructors during fitness classes from two different time periods: 1997-1998 and 2009-2011 both time periods, researchers collected noise measurements for the instructor of the class as well as collecting noise measurements in the client exercise area to simulate client noise exposure. In the 1997 study, a Larson Davis personal exposure meter (PEM), type LD720 (Provo Utah) was used to assess instructor noise exposure and a hand-held Brüel & Kjær precision sound level meter (SLM), type 2231 (with Integrating SLM module BZ7100), calibrated with a Brüel & Kjær portable calibrator, type 4230 was used by the researchers. In the 2009 study, Casella CEL-350 dBadge PEMs (Buffalo, New York) were used and were calibrated using a CEL-110 acoustic calibrator for both instructor and researcher noise exposure measurements. For both time periods, instructors wore a microphone positioned on their shoulder with the PEM placed on their belt. For noise exposure in the client area, in the 1997 study, the microphone on the PEM was held out from body and at head height and in the 2009 study, the PEM microphone was positioned at the researcher’s shoulder.

The instructor questionnaire included questions about personal demographic details, work as a fitness instructor, other paid work, leisure activities, and hearing health (Beach & Nie, 2014). The client questionnaire included questions about personal demographic details, participation in fitness classes, and hearing health. Identical questionnaires were administered to instructors and clients during both time periods. During the 1997-1998 time period, 27 instructors and 280 clients completed the questionnaire and during the 2009-2011 time period, 49 instructors and 137 clients completed the questionnaire.

Both time periods measured sound levels and instructor noise exposure during various types of fitness level classes categorized as low-intensity and high-intensity. Beach and Nie (2014) defined low intensity classes as “classes that focus on strength exercises such as “Pump” classes in which participants used weights and dumbbells while making simple repetitive movements” (p. 224) and described high intensity classes as “classes tend to be faster paced with a greater emphasis on cardio fitness, such as ‘Circuit,’ ‘Power Hour,’ and ‘Step’ classes. These high-intensity workouts frequently used complex choreography and fast transitions from one exercise to the next” (p. 225). At least two sound measurements were made of each class type for the first time period and at least three measurements were made of each class type for the second time period.

For both time periods, 35% of classes were classified as low-intensity and the remaining 65% of classes were classified as high-intensity. Results from the 1997-1998 questionnaire indicated the average duration of the class was 51.5 minutes and 96.5% of the instructors and 98.4% of researchers (who were taking measurements in the client area) were exposed to ≥85 dBA sound levels with the highest sound level recorded at 98 dBA. Results from the 2009-2011 study indicated the average class duration was 52.8 minutes and 86.5% of all instructors and 81.8% of all researchers (who were taking measurements in the client area) were exposed to ≥85 dBA sound levels; the highest sound level recorded was 98.8 dBA during cycle-based classes. To compare the two data sets, an analysis of variance (ANOVA) was conducted, and researchers stated there were no significant differences between sound level measurements for both time periods.

Beach and Nie (2014) focused on three main areas of the questionnaire: the instructors' and clients' perceptions of increased volume and the instructors' perception of the effect of increased volume on clients. All participants rated these areas utilizing a 7-point scale where 1 equaled *soft* and 7 equaled *loud*. For both data sets, instructors preferred a higher volume level for high-intensity, low-intensity, and warm-up exercises than clients and clients preferred a higher volume in the cool-down exercises. The questionnaires from 1997–1998 indicated the instructors' and clients' average preference rating for low-intensity exercises was higher (4.2–4.5) than 2009–2011 (3.6-4.0), which corresponded to the noise data and showed low intensity classes were 3.3 dBA louder in 1997–1998 than in 2009–2011. For high-intensity classes, clients' and instructors' average preferred volume for these classes was between 5.1 and 5.5. Beach and Nie noted, "It is commonly assumed that higher volumes during exercises are motivating. Certainly, the instructors who participated in this study considered high volumes motivating and believed to be the same for their clients" (p. 229). Questions about the effects of increased volume were asked and data suggested that instructors were more likely than clients to find louder music motivating with about 20% of clients reporting it was "stressful" with similar results when comparing the two time periods. In addition, very few instructors recognized that clients might find the increased volume stressful. Overall, this study indicated sound levels in a fitness class had the possible risk of causing hearing damage for instructors and patrons who attended the class if exposed over extended periods of time. In addition, it was also important to note the instructors preferred higher amplitude music levels when teaching high-intensity classes. The researchers concluded the fitness instructors were at risk of hearing damage if teaching two or more classes in one day. In addition, Beach and Nie encouraged the fitness industry to reexamine the music preferences during a class and to seek other ways to motivate patrons.

Wilson and Herbstein (2003) investigated the role of music amplitude in aerobics classes and the implications for hearing conservation. The objective was to measure participants' perceptions of the loudness levels of aerobics classes in four high intensity aerobics classes. Results suggested the amplitude of the music increased the enjoyment and motivation to exercise. The median music intensities in four classes were measured at 80-, 85-, 89-, and 97 dBA. Fifty-one percent of participants had previous knowledge that being exposed to loud sounds could permanently damage their hearing. The researchers concluded a hearing conservation program needed to be implemented in aerobics classes to educate fitness class attendees as well as instructors on the importance of protecting their hearing.

Torre and Howell (2008) measured noise exposure in 50 patrons who attended an aerobics class. In addition to measuring patron noise exposure, they also investigated weather an aerobics class sound levels effected the auditory system by measuring distortion product otoacoustic emissions (DPOAEs) in one ear before and after an aerobics class. Although not a true test of hearing, DPOAEs assess cochlear outer hair-cell function. Distortion product otoacoustic emissions are typically present when peripheral hearing sensitivity is normal or near normal and are typically absent in presence of significant cochlear or conductive hearing loss. A personal noise dosimeter (NoisePro DLX, Quest Technologies) was placed on the participant's collar on the same side the DPOAEs were taken. Then the noise dosimeter was set according to OSHA (1983) requirements measuring the average sound level (LAVG) in dBA for the length of the class. The DPOAEs were measured utilizing a GSI 60 system before and immediately after a 50-minute aerobics class over the frequency range of 1,200 to Hz-6,000 Hz. The aerobics classroom had hardwood floors and four loudspeakers—one was placed near the ceiling in each corner. In addition, each participant completed a questionnaire that provided information on whether they felt they had a hearing loss, the number of aerobics classes taken daily/weekly, how the music loudness level influenced their enjoyment of the class, if they had concerns related to hearing damage as a direct result from the music intensity, and if they had ever experienced tinnitus after a class. The average sound level for all participants measured was 87.1 dBA with a range of 83.4–90.7 dBA. The average DPOAEs taken after the class were 0.3-1.4 dB lower than the DPOAEs taken prior to the class. The researchers concluded the study did not provide significant evidence that the combination of exercise and exposure to sound had effects on patrons' DPOAEs. Key findings from the questionnaire indicated 20.4% of participants reported the music was too loud, 55% reported the loudness level of the music influenced their enjoyment during the class, and 81.6% of the participants reported they "thought the loudness of the music during aerobics class does affect their hearing" (Torre & Howell, 2008, p. 505).

This section of the literature review focused on the effect high sound levels have on the auditory system and the potential risks associated with being over-exposed to high amplitudes of sound across studies about fitness instructors. For specific noise level measurements across the studies discussed in this section as well as another study (Zoe, 2015) mentioned later in the literature review, see Table 1.

Table 1

Noise Level Outcomes from Fitness Instructor Studies

Authors	Fitness Class Type		Noise Levels
Beach and Nie (2014)	Low-Intensity (1997-1998)		LAeq
		Low-Impact and Body Shape	87.8
		Fat Burner	88.4
		Pump	91
		Light and Low	85.5
	Low-Intensity (2009-2011)		
		Body Balance	77.6
		Pump	86.6
	High-Intensity (1997-1998)		
		Power Hour	90.2
		Cross-Training	90.1
		Step	90.9
		Circuit Aerobic	92.3
	High-Intensity (1997-1998)		
		Body Combat/Attack	90.7
		Cycle, RPM, Spin	94
		Step	86.2
		Zumba	90.3
		Basic Training/Circuit	90.3
Wilson and Herbstein (2003)	Aerobics Classes (Fixed Music Intensities)		Median dBA
		Very Low-Risk	80
		Low-Risk	85
		At-Risk	89
		High-Risk	97
Torre and Howell (2008)	Aerobics Classes (12 measured)		LAVG
		1	88.4
		2	90.2
		3	89.4
		4	84.1
		5	83.4
		6	84.3
		7	85.1
		8	85.6
		9	87.6
		10	88.9
		11	87.1
		12	90.7

Table 1 continued

Authors	Fitness Class Type	Noise Levels
Zoe (2015)	Group Fitness Instructors (Intervention)	LAVG
	Baseline	95.9
	Post-Intervention	95
	Follow-Up	94.7
	Group Fitness Instructors (No-Intervention)	
	Baseline	97
	Follow-Up	97.5

The next section describes how human speakers communicate in the presence of high amplitude sound; particularly what changes are made vocally. This phenomenon is described as the *Lombard* Effect.

The Lombard Effect and Vocal Effort

The Lombard effect was first described as a phenomenon in which speakers modified their voice to communicate effectively in noisy environments (Lombard, 1911). However, researchers have more recently defined the Lombard effect as "the tendency for speakers to increase vocal pitch, intensity, and duration in the presence of noise" (Patel & Schell, 2008, p. 209).

Stowe and Golob (2013) suggested the presence of the Lombard effect in humans was due to both reflexive and communicative factors. The objective of their study was to test the hypothesis that the Lombard effect was affected by the frequency content of background noise. It was hypothesized that the Lombard effect was not a non-specific response to ambient noise but instead happened due to the masking of specific acoustic correlates of suprasegmental speech parameters (Stowe & Golob, 2013). A picture naming task was used to collect vocal output data (intensity, duration, and fundamental frequency) in silence as well as in the presence of multiple noise conditions. Two experiments were conducted: the pilot experiment and the main experiment. The pilot experiment consisted of five conditions—one quiet and four background noise conditions. The conditions varied by intensity level 75 dB SPL and 90 dB SPL and two types of noise were used: broadband noise containing frequencies of 0.02-20 kHz, and notched broadband noise filtered from 0.5-4 kHz. The main experiment had a total of seven conditions—one quiet and six background noise conditions. The same broadband and noise conditions as the pilot study were used for the main experiment; however, researchers added a bandpass noise mask to the main experiment, which was the inverse of the notched noise (0.5-4 kHz). Results of the pilot study suggested the broadband noise containing the speech-similar frequencies increased the participants' vocal intensity, duration, and fundamental frequency. However, when the majority of the speech-similar frequencies were removed during the notched noise task, there was no effect on vocal intensity, duration, or the fundamental frequency of the participants. This suggested the Lombard effect was evident when speech frequencies (0.5-4.0 kHz) were present in the ambient noise but it was not evident when the background/ambient noise did not include those speech frequencies. For the main experiment, the ambient noise conditions consisted of a broadband noise containing frequencies 0.02-20 kHz, notched noise filtered from 0.5-4.0 kHz, and a bandpass noise mask from 0.5-4.0 kHz. Each noise condition was measured at two different intensity levels (75- and 90 dB SPL). Exposure to broadband noise resulted in an increase in suprasegmental speech parameters such as vocal intensity, duration of voicing, and fundamental frequency. Also, exposure to notched noise had no effect on speech and exposure to bandpass noise yielded a decrease in participants' vocal intensity and duration but had no effect on their fundamental frequency of voicing. These results suggested ambient noise containing speech-similar frequencies, such as those in the broadband condition, could yield significant parameter changes in a person's speech output such as intensity and duration. Broadband noise was further associated with an increase in vocal fundamental frequency.

Lindstrom et al. (2011) conducted a study on ambient noise and voice use of preschool teachers. Their project had two specific objectives. The first was to investigate the relationship among ambient noise SPL, voice SPL, and fundamental frequency. Secondly, researchers wanted to see if patterns or vocal behaviors could be seen when studying the vocal behavior of each teacher. Speech SPL and ambient noise SPL were captured using a recording device worn by participants. To measure average noise SPL, a microphone was placed near the mouth and to measure average voice SPL, a vocal accelerometer was placed on the sternal notch. Speech SPL was obtained by the accelerometer recordings detecting the presence or absence of phonation. The ambient noise SPL was obtained by averaging across 180-second intervals containing sufficient voicing. Based on the results, the authors concluded no direct relationship existed between ambient noise levels and vocal intensity level. Lindstrom et al. suggested the results could have been due to drastic changes in environmental noise, non-accurate obtaining of noise SPL, and changes observed that might have been due to specific individual tendencies such as the differences in reaction to the noise exposure (amount of vocal effort to raise their voice to talk over the noise).

Relating the Lombard effect to everyday situations, Shewmaker et al. (2010) conducted a study focusing on changes in vocal production in multiple conversational situations when talking on a cellular device. The researchers hypothesized the properties of the phone itself such as poor reception and poor sound transmission might lead to users increasing their vocal intensity so they could be understood by the listener. Twenty-one volunteers without any history of a voice disorder participated in this study that included 14 women and seven men between the ages of 20 and 45 years old. Conversational situations of face-to-face conversation, phone communication, using a cellular phone, and using a cellular phone with an ear piece were assessed in two environmental locations: a sound treated audio room (quiet background noise condition) and on a city sidewalk near busy automotive traffic (noisy condition). For each specific conversational condition at each location, participants performed three speech tasks. First, they were asked to describe how to make a peanut butter and jelly sandwich in order to obtain a free-flowing speech measurement. Next, they read the *Rainbow Passage* (Fairbanks, 1969). Finally, they sustained the phonemes of /i/, /a/, and /o/ for three seconds. Following each condition, participants rated their perceived effort of voicing in each speaking scenario from 1 to 100. Data were collected using an Ambulatory Phonation Monitor (APM; KayPentax, Inc., New Jersey) that sensed vibration of the skin overlying the larynx during speech and derived vocal parameters such as phonation time, dB SPL, and fundamental frequency. The location of the sensor was adhered to the skin of the neck directly superior to the sternal notch. Results indicated that both vocal intensity and fundamental frequency were increased for each participant in the noisy location as compared to the quiet location, providing evidence for the Lombard effect. Results further showed that vocal intensity did not increase during any of the conversational conditions in the quiet location, suggesting cellular phone devices were unlikely to induce changes in vocal intensity during usage. However, when using a cellular phone with an earpiece in the noisy condition, participants increased their vocal intensity and their vocal fundamental frequency, leading to perceived vocal strain as found from the participants' report of increased vocal effort. Fundamental frequency was also increased when participants were in the noisy condition relative to the quiet condition. Overall, the participants' perceived vocal effort was highest for the tasks in the noisy location.

Patel and Schell (2008) investigated the influence of linguistic content on the Lombard effect by seeking to determine whether the increase in vocal intensity was applied to all words in the utterance or whether it was specifically evident during content rather than the function words. Sixteen participants were grouped into pairs having eight speakers and eight listeners. Each pair was asked to participate in a cooperative computer game. The participants were separated in two separate rooms and the speaker communicated with the listener via a headset microphone. Multitalker noise was presented to the speaker via supra-aural headphones. The listener also heard the noise through built-in audiometer monitors and received the communication from the speaker through a separate monitoring system. The goal of the computer game was for the speaker to instruct the listener to perform a series of actions with the characters on the computer screen. Three phases of different noise levels were performed (quiet: ≤40 dB SPL, multitalker noise: 60 dB SPL and multitalker noise of 90 dB SPL. Thirty trials were completed in each phase. To maintain consistency across the phases and trials, the multitalker noise was calibrated and speech output levels were measured using a sound-level meter positioned at the listener's ear. Results indicated all three areas studied—vocal fundamental frequency, intensity, and duration—increased simultaneously as the ambient noise level increased. Patel and Schell reported that both content words and function words were affected in the presence of a higher intensity of noise. Although they found all words were spoken at a higher intensity with the increase in noise, they also found the speakers prolonged the duration of the content words longer than function words.

Vocal Use: Vocal Demand, Vocal Effort, and Vocal Fatigue

Hunter et al. (2020) published a review article aiming to form a consensus description of commonly utilized vocal terms. The purpose of the review article was to review vocal use terms utilized in literature, determine a "linguistically modeled" summary of each, and propose conceptualized definitions of the same terms. Terms used to describe vocal use were "vocal load," "vocal loading," "vocal effort," and "vocal fatigue." The researchers suggested these terms are often defined inconsistently, have overlap and redundancy, and are used interchangeably, leading to confusion in the literature. Specifically due to the blurred distinctions between vocal load and vocal loading, Hunter et al. proposed two new terms: "vocal demand" and "vocal demand response." They did not propose new terminology for vocal effort and vocal fatigue but did propose an updated definition of both. The terminology of all four vocal use definitions is explained below.

As stated previously, vocal demand is the "vocal requirement for a given communication scenario, and it is independent of the vocalist's physiology, production technique, or perception of the scenario" (Hunter et al., 2020, p. 515). Vocal demand can be thought of in terms of the description of the scenario (environment, number of listeners) as well as in terms of vocal content necessary to satisfy a communicative scenario. Taking a classroom scenario, for example, the vocal demand could include quantities of the amount of material to convey orally, duration of the class, and the level of background noise (Hunter et al., 2020). Vocal demand response was defined as

> the way voicing is produced by an individual in attempt to responds to a perceived 'vocal demand' within a communication scenario. 'Vocal demand response' is defined to include the process and product of phonation as determined by individual factors (e.g., physiological and psychological capacity of phonation). (Hunter et al., 2020, p. 516)

For example, vocal demand response for a classroom teacher would be the specific vocal production to the perceived vocal demand of the classroom situation (noise, attentiveness of the students). The teacher would likely increase vocal duration as well as increase vocal level due to background noise and to obtain student attention (Hunter et al., 2020). However, in this section, previous research utilized the term “vocal load” rather than vocal demand.

According to Hunter et al. (2020), vocal effort was defined as

> the perceived exertion of a vocalist’s response (“vocal demand response”) to a perceived communication scenario (“vocal demand”). Vocal effort is thought of as the perceptual phenomenon rather than the physiological phenomenon that is experienced by the speaker, and not the listener. (p. 517)

For example, a classroom teacher trying to communicate in the presence of a noisy classroom could require a higher “vocal effort.” The increased exertion the teacher feels and at the same time reports in order to produce increased vocal loudness would in turn be an increase of vocal effort (Hunter et al., 2020). Hunter et al. described vocal fatigue as

> the perceived measurable symptom that influences vocal task performance and is individual specific; it is a multifaceted concept integrating self-perceived vocal symptoms and/or physiological deficit which may be a result of high “vocal demand response,” high “vocal effort,” or neuromuscular deficit. (p. 518)

An example of vocal fatigue would be a physical education teacher using a loud voice while also being physically active with students throughout the day and/or week.

Bottalico (2016) conducted a study entitled *Speech Adjustments for Room Acoustics and Their Effects on Vocal Effort*. The first aim of this study was to analyze the effects of the acoustical environment and voice intensity (intensity differences between normal and raised vocal levels) on time dose and fundamental frequency while considering the effect of short-term vocal fatigue. Second, Bottalico aimed to predict the self-reported vocal effort from the voice acoustical parameters. Muscle fatigue could cause increased tension in the vocal folds due to depletion or accumulation of biochemical substances in the muscle fibers. Tissue fatigue takes place in the non-muscular tissue layers and is caused by changes in the molecular structure that results from mechanical loading and unloading. To address the second aim of the study, Bottalico reported the effects of room acoustics, vocal intensity (normal and raised), and short-term vocal fatigue on SPL centered per subject, self-reported vocal effort, control, and clarity. Ten male and 10 female subjects between the ages of 18 and 30 years old who had self-reported normal speech and hearing were included for this study. Each subject was required to complete 12 tasks. Each was to read a text in two different speech styles (normal and high intensity) in three different rooms: anechoic, semi-reverberant, and reverberant. In each environmental condition, subjects read with and without a reflective panel. After the reading tasks, subjects were then asked how effortful it was to speak in those conditions. Results showed the phonation time was higher in the high intensity speech than for the normal intensity conditions. Fundamental frequency was higher in the high intensity condition, reflecting an increase in the amplitude of vocal fold vibration caused by an increase in lung pressure. From Task 1 through Task 12, all three voice parameters (change in SPL, change in fundamental frequency, and change in the fundamental frequency standard deviation) were shown to increase as the number of tasks increased which, as Bottalico stated, indicated an effect of vocal fatigue. Researchers concluded the vocal effort during the phonation tasks as well as the increase in fundamental frequency strongly influenced the perception of vocal effort.

Nacci et al. (2013) reported on the use and role of ambulatory phonation monitors. They described that the devices were used for unobtrusive monitoring of vocal load from occupational voice users by capturing skin vibration data from tissues overlying the larynx. Nacci et al. stated that due to vocal loading playing a significant role in the cause of vocal disorders, clinicians and researchers have now moved their attention to *how* a voice is used. A vocal dosimeter device such as an APM measures phonation duration as well as vocal intensity (dB SPL) and vocal fundamental frequency. Phonation time is expressed as the total duration and the percentage of time spent phonating for the recording period. Nacci et al. concluded that APMs could provide clinical applications by measuring vocal load, providing real-time biofeedback of voice performance, and obtaining parameters related to vocal performance.

Hunter and Titze (2010) used vocal dosimetry to evaluate characteristics of teachers' voices during occupational and non-occupational activities. They used the National Center for Voice and Speech voice dosimetry databank to calculate voicing percentage per hour (9:00 am to 3:00 pm weekdays and 4:00 pm to10:00 pm weekends) as well as the average dB SPL and fundamental frequency. Teachers were taught how to attach and use the dosimeter and wore it for the allotted time; each wore two dosimeters to minimize the potential loss of data collection during the non-occupational and occupational measurements. Several times throughout the day, teachers were asked to do vocal tasks: sustained soft phonation, soft upward pitch glide, five syllables repeated softly and at a high pitch, and to sing a portion of "Happy Birthday," softly and at a high pitch, as well as count "1, 2, 3," in their normal speaking voice. Background questions were asked before the study that asked about their years spent teaching, their teaching schedule, their percent voicing at work and not at work, as well as their class size. Key findings revealed that teachers' voicing percentage per hour was more than twice that of when they were not teaching, teachers produced vocalization at a level that was 1dB higher during work than during non-occupational activities, and they exhibited an increased fundamental frequency of voice as the work day progressed. It was stated that teachers might not have adequate recovery time necessary to prevent a significant vocal health issue. The researchers' recommendations for future research were to determine whether voice breaks and frequency of such breaks could improve vocal health.

Kristiansen et al. (2014) measured noise exposure when working as a teacher. To measure noise exposure, a Bru¨el & Kjær Type 4445 noise dosimeter was utilized and was calibrated daily before and after the measurements. The microphone was positioned at the shoulder. The researchers found the average ambient noise level during teaching was less than 72 dBA but noted a correlation between an increase in voice symptoms during the workday and ambient noise level. In this study, it was reported that the vocal load increased by 0.65 dBA per 1 dBA increase in the ambient noise level. The authors concluded that although there was no risk of NIHL, there was evidence that vocal load increased during work, suggesting there might be a relationship between occupational noise exposure and development of vocal symptoms. Roy et al. (2004) also concluded that teaching is a high-risk occupation for voice disorders.

A study conducted by Titze et al. (2007) aimed to determine how various voicing periods and rest periods were distributed in a teacher's workday. The researchers utilized data from the National Center for Voice and Speech to examine voicing and silence periods and how both were distributed during work and after work as well as workdays versus weekends in 31 teachers over the duration of two weeks. Workday activities included all times at school, meetings, and any after school or school-related activities. Not-at-work time was any other time the dosimeter was active, which included weekends and evenings. The National Center for Voice and Speech voice dosimeter calculated and stored the data in 30-minute intervals calculating phonation, skin acceleration intensity, fundamental frequency, and voice duration. Based on the data utilized, each worker had a daily log recording their work and after work activities. It was reported that when individuals were teaching, their vocal folds vibrated 23% of the time as opposed to 12% of the time when they were not teaching. Voicing was not continuous for long periods of time so distribution of voicing periods and silence periods were important. For teachers, voicing turned on and off about 20,000 times a day leading to a fatigue factor, meaning the teachers could not talk in a consecutive manner for a whole day without feeling fatigued. It was also reported that on weekends, their vocal rest times increased in comparison to the weekdays. This study highlighted the importance of vocal rest for teachers. Although the majority of vocal use was during school related activities, it was also important that researchers collected vocal data during their activities outside of school that could contribute as a factor for vocal fatigue.

Based on the literature in this section, it is clear there was a potential risk of vocal fatigue that could happen due to increased vocal demand and vocal effort. Vocal demand and perceived vocal effort increased in various occupational settings that relied on vocal use to do their job. This specific project intended to explore the effects of both in the industry of fitness instructors.

Fitness Instructors' Vocal Use

Fontan et al. (2016) studied the prevalence of vocal problems and risk factors in sports and fitness instructors as well as their expectations regarding vocal injury prevention and vocal care. This research was conducted through a questionnaire that addressed self-reported vocal difficulties, probable risk factors, and healthcare history. Participants were also given the Voice Handicap Index assessment (Jacobson et al., 1997) that had the participant describe their voice and the effects of their voice on their lives, indicating how often they experienced various situations with poor vocal health. Results showed 54.7% of participants reported experiencing voice difficulties such as vocal loss or a sore throat. The researchers found a significant difference in music loudness that was dependent on the use of shouting habits by the instructor. Data suggested the music was significantly higher in intensity in the group of instructors who shouted. Fontan et al. stated, “Shouting behavior was directly linked to work environment variables such as the music loudness and the number of noise sources competing with voice” (p. 261). This study indicated sports and fitness instructors were at risk for vocal discomfort and possibly vocal injury due to high levels of vocal use that suggest high levels of vocal demand.

Dallaston and Rumbach (2016) researched changes in acoustic parameters of group fitness instructors’ voices before and after a class session to determine whether the changes recorded were discernible by the instructor. Six female participants performed vocal tasks before and after a one-hour class session. Fundamental frequency (pitch), intensity (volume), and maximum duration of sustained phonation were measured in addition to self-ratings of vocal quality before and after instruction. Vocal tasks included maximum duration of sustained phonation, maximum pitch range, verbal passage reading, and conversational speech. Before the voice assessment, two questionnaires were given to participants. The first was a previously published questionnaire that assessed demographics, lifestyle, and teaching practices (Rumbach, 2013). The second was the Voice Handicap Index (Jacobson et al., 1997) to determine the impact on vocal difficulties in their daily life. Results showed increases in measured fundamental frequency (pitch) and intensity (volume) but no changes in self-ratings of vocal quality following instruction.

A study conducted by Rumbach (2013) assessed voice problems in 38 fitness instructors who had been diagnosed with a voice disorder and had received treatment complete an online questionnaire. The types of vocal problems were vocal strain and muscle tension dysphonia without concurrent vocal fold pathology, vocal fold nodules, vocal fold cysts, vocal fold hemorrhage, and recurrent laryngitis. The therapy treatments were either voice therapy, surgery and voice therapy, or voice therapy and medication. The questionnaire had three objectives: to determine the cause of the vocal problems, to assess the impact the vocal problems had on their quality of life, and to assess their perceived support and attitudes from the fitness industry in response to their disorders and treatment needs. Results indicated 82% of participants altered their fitness class due to their vocal disorders and half of participants reported their vocal problems had negatively affected their emotions and quality of life. When asked about their perceptions toward the fitness industry and fellow fitness instructors support about their vocal problems, over 65% reported they were not satisfied with how they were reacting to their recovery. Based on the results from this study, group fitness instructors could have their quality of life impacted when having a vocal disorder and this population is at risk of developing vocal problems that warrant medical management. It was suggested this population needs to be educated regarding vocal health and to have information for the fitness industry for their management of such problems.

Self-Perception of Sound Levels and Vocal Effort

Zoe (2015) researched group exercise instructors' knowledge, attitudes, and behaviors regarding sound exposure and hearing protection strategies for two groups: those with intervention and those without intervention. Those who were in the intervention group received intervention via a program called Dangerous Decibels® which is described as

> a public health partnership with the goal of reducing the incidence of noise-induced hearing loss and related tinnitus (Martin, 2008; Martin et al., 2006). The program uses educational outreach, museum exhibits, and research to promote and study hearing health. Educational activities address the sources of dangerous sounds, the consequences of being exposed to dangerous sounds, and ways to be protected from dangerous sounds. (Martin et al., 2013, p. 1).

Zoe (2015) created a questionnaire and obtained dosimetry measurements of fitness classes that were administered/ collected in three separate circumstances. Both groups received the pre-intervention questionnaire; however, only the intervention group received a post-intervention and a seven-week follow-up to identify the changes, if any, among that group's attitudes, knowledge, and behaviors regarding sound exposure and hearing protective strategies. The results indicated the sound levels in the fitness classes could be exceeding NIOSH recommendations as the average sound level of the 24 classes fitness classes measured ranged from 90.0 to 101.3 dBA. For the intervention group, the Dangerous Decibels program was suggested to be a positive influence on fitness instructor's knowledge, attitudes, and behaviors about sound levels and hearing protection. There was an increase in the number of participants who answered questions correctly regarding knowledge about sound levels and hearing protection. With regard to their attitudes, results showed a higher number of participants were concerned regarding high sound levels and what that could do to their hearing. Some positive behavioral changes were seen after intervention as there was an increase in participants' willingness to give up certain activities that could potentially be harmful to their hearing. Zoe also concluded that although fitness instructors understood the value of having good hearing, they seemed to be lacking the intention to protect their hearing as they were not committed to giving up activities that could have sound levels loud enough to damage their ears. Zoe suggested a greater need for education for this population regarding the risk of being exposed to hazardous sound levels and the need to use appropriate methods to protect hearing. In addition, Zoe suggested that sound levels in group fitness classes needed to decrease to prevent the possibility of hearing damage. For specific noise levels from this study compared to other studies mentioned in the literature review, see Table 1.

Van Leer and van Mersbergen (2017) measured patient-perceived vocal effort pre and post voice therapy treatment in 36 subjects who had "phonotraumatic vocal disorders." The term *phonotraumatic hyperfunction* was utilized by these researchers and was referenced from another source who defined it as "associated with the formation of benign vocal fold lesions – such as nodules and polyps" (Mehta et al., 2015, para. 4). Van Leer and van Mersbergen had participants complete two elements: the Borg CR10 (Borg, 1982) scale, in order to observe treatment-related vocal effort reduction, and item 14 of the Voice Handicap Index (Jacobson et al., 1997) in order to compare it to the validity of the Borg CR10 before and after four sessions of voice therapy. The Voice Handicap Index employs a 5-point ordinal response format ranging from 0 (*never*) to 4 (*always*) to rate the frequency of occurrence of each scale item. For the present study, only item 14 was analyzed: "I feel as though I have to strain to produce voice"" (van Leer & van Mersbergen, 2017, p. 389). The Borg CR10 scale is a "category-ratio scale that asks users to rate their perception of physical effort or exertion in relation to a task" (van Leer & van Mersbergen, 2017, p. 389). The scale was adapted by van Leer and van Mersbergen to refer to vocal effort rather than vocal exertion. The scale is a 0-10 point scale of which participants were informed that a value of "10" described "the amount of vocal effort or strain you feel here (pointing to the larynx) when you have laryngitis and can barely get sound out, even with a lot of strain" (van Leer & van Mersbergen, 2017, p. 389), and the "0" value was described as "the absence of vocal effort you felt here (pointing to the larynx) when you practiced that (i.e., the resonant voice strategy) with your therapist" (van Leer & van Mersbergen, 2017, p. 389). Van Leer and van Mersbergen found that after subjects had finished the four voice therapy treatments, scores on the Borg CR10 and the Voice Handicap Index had decreased significantly. Data indicated that scores at session one with an average of 4.69 on the Borg CR10 scale had decreased to 1.99 after session four. The Voice Handicap Index item 14 scores decreased as well as the session one average was 2.28 and session four average was 1.11. Researchers concluded the Borg CR10 could be useful when determining vocal effort specifically before and after treatment to assess for change and the Voice Handicap Index item 14 could be utilized to assess how frequently increased vocal effort was perceived by subjects and therefore both could be utilized together when assessing a subject's vocal effort prior to vocal treatment and post vocal treatment.

Graneto and Damm (2013) conducted a study assessing 55 nurses' perception of ambient noise when working in the emergency department as well as collecting sound level measurements while they were taking the survey. In order to assess their perception of noise, a survey was created which asked questions relating noise level to the medical work environment, if the noise level is affects tasks, as well as if the noise level affects patients healing environment. In addition to the survey sound levels were collected, utilizing a multi-range SLM set to OSHA protocol, on the countertop while the nurses completed the survey. Results indicated that all sound level measurements collected were at or below 70 dBA. Results for the survey indicated that the majority of nurses reported the ambient noise level as low/not loud. When asked if noise levels were greater than they should be researchers found that nurses who have been working in the emergency department for less than one year perceived the noise levels to not be as loud as those who had been working in that department for longer periods of time. Nurses were asked about how the ambient noise affected their calculations, charting, and phone reports. Based on those three questions, 32% reported that they were never affected by the noise, 54% answered rarely or sometimes, and 14% reported frequently or always. When asked if they felt the noise levels affected the patients' healing environment 39% answered never or rarely, 37% answered sometimes, and 24% answered frequently or always. When the participants were asked if the noise level effects patient's healing environment, 39% of responses were never" or "rarely, 37% said sometimes, 24% responded frequently or always. Researchers did find that for those who did not report that the sound levels affected their work were completing the questionnaire with a measured sound level of less than 60 dBA. Although the perception of noise is perceived to be low and generally not interfering with tasks, researchers suggested that the perception of noise in emergency departments depends on the years of experience, specifically that those working for a lower number of years perceived the noise levels to be lower than those with more experience.

Based on the literature review, the exploration of fitness instructors' knowledge, attitudes, and behaviors regarding sound levels, the potential of hearing damage and vocal effort, and the potential of laryngeal damage will provide an increased knowledge about this vastly growing population and the potential associated risk factors.

CHAPTER III

METHODOLOGY

The current study was designed to investigate the participant's self-perception of sound levels and vocal effort when working as a fitness instructor using an electronic questionnaire. The University of Northern Colorado's Institutional Review Board reviewed this protocol and determined this project to be exempt (see Appendix B).

Participant Recruitment

Participants were recruited through this researcher's personal contacts, pages on social media relating to fitness classes and/or fitness class instruction, and fitness organizations by asking if they were a fitness instructor or if they knew of someone who was. Those who were interested in the study were sent the recruitment email (see Appendix C). The email contained a brief explanation of the research, inclusion criteria, incentive, and the link to the questionnaire. Participants also had the ability to forward the recruitment email to other fitness instructor contacts they knew.

To be included in this study, participants had to be over the age of 18 and were currently or had recently been employed part-time or full-time as a fitness instructor who taught fitness classes (such as spin, Zumba, group personal training, barre, yoga, etc.). In addition, if participants had a hearing impairment or vocal disorder diagnosed by a physician, speech language pathologist, or audiologist prior to their employment as a fitness instructor, they were not able to participate in this study. If they had had a hearing impairment or vocal disorder diagnosed by a physician, speech language pathologist, or audiologist while they were employed as a fitness instructor, then they could participate in this study. If participants did not or had not had any diagnosed vocal or hearing disorder or impairment by a physician, speech language pathologist, or audiologist, they could also participate in this study.

Procedures

Consent Form

Participants received a Qualtrics link via an email. The link that participants received on the recruitment email took them to a Qualtrics site displaying the consent form (see Appendix D). Participants read the consent form and then decided if they consented by selecting "yes I consent" or "no I do not consent" on the question displayed below the form. If participants agreed to the consent form, they were directed to the questionnaire. If they did not agree to the consent form, the survey terminated and they could not continue. The consent form included the amount of time it would take to complete the questionnaire, a description of the questionnaire, information about how to be included in the incentive that was offered, the inclusion criteria, and how their answers would be confidential and could not be linked to themselves or to their employer. In addition, it stated their participation in this research project was strictly voluntary and they could withdraw at any time by exiting the Qualtrics link. The questionnaire for this study was generated using Qualtrics software Version [May 2021] of Qualtrics (see Appendix E).

Questionnaires

Utilized/Adapted Questionnaires

Questions about knowledge, attitudes, and self-reported behaviors in regard to sound levels and the potential risk of hearing damage were utilized and adapted from a questionnaire by Zoe (2015) who studied the "Effectiveness of a Noise-Induced Hearing Loss Prevention Education Programme in Group Exercise Instructors." Questions utilized for this project are similar to Zoe's questionnaire because it was also created for fitness instructors: questions about participants' knowledge about sound levels and exposure limits and what part of the ear could be affected, attitudes toward hearing healthcare and concerns about high sound levels, and behaviors participants had with regard to volume setting of the music, if they utilize hearing protection, and if they have conversations about the sound levels with fellow patrons and their friends/colleagues. Many questions were kept the same but had a different format due to utilizing a different survey platform. In addition, questions from Zoe that asked about sound levels knowledge, attitudes, and vocal effort were adapted and utilized for the vocal section as well.

Questions about knowledge, attitudes, and self-reported behaviors with regard to vocal effort and potential of laryngeal damage were utilized and adapted from two research articles (Rumbach, 2013; van Leer & van Mersbergen 2017). A question and related scale from the van Leer and van Mersbergen (2017) questionnaire was asked: "Utilizing the graph below, how would you rate your vocal effort during the last fitness class you instructed?" (see Appendix E, Q17). The anchoring statement for 10 (maximum vocal effort) from this article was used; however, the 0-point anchor description was changed for the current study. The description of those two points to this current project were,

> To anchor the 0-point, think only of the amount of vocal effort when speaking quietly to someone sitting close to you in a quiet room. Think only of vocal effort and not the mental effort or concentration it took to produce effortless voice. To anchor the 10-point, think of it as the amount of vocal effort or strain you feel when you have laryngitis and can barely get sound out, even with a lot of strain.

In addition, other questions relating to this section were adapted from another study that was also created for fitness instructors. Rumbach (2013) studied "Voice Problems of Group

Fitness Instructors: Diagnosis, Treatment, Perceived and Experienced Attitudes and Expectations of the Industry" and only the questions specifically asking about any current vocal problems group fitness instructors could be experiencing or have had as well as self-reported behaviors were utilized and adapted for this project. Same as the sound level questions, many questions were kept the same but had a different format due to utilizing a different survey platform.

Study Questionnaire

If participants agreed to the consent form, they were directed to the study questionnaire (see Appendix E). The questions had forced responses before the participant could continue to the next question. There were 74 questions in the questionnaire that had seven sections (listed below). The first few questions of the questionnaire were specific to the inclusion criteria to ensure those who were taking the questionnaire fit the criteria (how old they are and if they were diagnosed with a hearing/vocal disorder prior to their employment as a fitness instructor). If they did not fit the criteria, the questionnaire terminated. If they fit the criteria, they could continue the questionnaire (see Appendix E, Qs: 1-4 and 6)

- .Inclusion Criteria
- Demographic and General Questions
- Fitness Industry Questions
- Vocal Self-Perception Questions
- Sound Level Self-Perception Questionnaire
- Hearing Health, Knowledge, and Beliefs about Hearing
- Hearing and Vocal Health Knowledge and Beliefs
- Amazon Drawing.

Table 2 contains demographic and general questions from the questionnaire.

Table 2

Demographic and General Questions from Questionnaire

Question Number	Question
1	How old are you?
2	Prior to your employment as a fitness instructor, have you ever been officially diagnosed with a hearing loss by an audiologist or physician?
3	Prior to your employment as a fitness instructor, have you ever been officially diagnosed as having a vocal disorder by a speech language pathologist or physician?
4	Have you ever been officially diagnosed with a hearing loss by an audiologist or physician while being employed as a fitness instructor?
6	Have you ever been officially diagnosed as having a vocal disorder by a speech language pathologist or physician while being employed as a fitness instructor?
8	To which gender do you most identify?
9	What type of fitness class(es) do you teach? Select all that apply.
10	What is the average duration of an individual class that you teach?
13	On average, how many classes do you teach per day?
14	On average, how many classes do you teach per week?
20	Does your area of employment provide a microphone for you to utilize when instructing?
21	Is utilizing a microphone mandatory for all instructors at your area of employment?
43	Does the studio or gym you work at provide hearing protection for employees?
68	How often do you receive feedback about the music volume in class being too loud?
74	Would you like to participate in the drawing to win one of two $50 Amazon Gift Cards?

Table 3 contains the categories of knowledge, attitudes, and behaviors relative to Research Question 1.

Table 3

Survey Questions Related to Research Question 1

Category	Question Number	Question
Knowledge relating to sound levels and potential of hearing damage	15	Have you ever been concerned about having your ears damaged due to loud sounds?
	53	Do you know where to obtain hearing protection and what type of hearing protection is best for fitness instructors?
	54	If you answered yes to the previous question, (Q53) please explain where you know to obtain hearing protection and what type of hearing protection is best for fitness instructors?
	55	Which of the following types of sounds are typically loud enough to damage your ears (please select all that apply)
	56	Sounds measuring _____ and over can cause hearing loss (please select the best answer)
	57	Which of the following are good ways to protect your ears when you are around loud sounds? (Please select all that apply)
	58	Hearing an extremely loud sound even one time can cause you to lose some hearing
	59	Which part of the ear is most commonly damaged by exposure to loud sounds? (Please select the best answer)
	60	How old do you have to be to get hearing loss from loud sounds? (Please select the best answer)

Table 3 continued

Category	Question Number	Question
Attitudes relating to sound levels and potential of hearing damage	5	If you answered yes to the previous question, (Q4) have you sought out help from a speech language pathologist, audiologist, or physician for your hearing loss?
	32	Do you believe the sound in the fitness area is louder than it should be?
	33	Do you believe the sound level during your instruction is
	34	Do you believe the sound level during your classes is too loud/very loud?
	35	Do you believe the volume setting of the music during instruction is:
	36	Do you feel that the sound level during your instruction interferes with tracking/guiding/directing the exercise routine?
	37	Do you feel the sound level interferes with your ability to communicate with patrons? (For example, having to repeat instructions to patrons who didn't hear/understand you over the music)
	38	Do you feel your choice of sound level(s) enhances patron enjoyment?
	39	Do you feel the choice of sound level communicates the exercise intensity/motivation needed for the class patrons?
	42	What factors influence your choice of the highest volume setting used:
	45	Do you consider the risk of potential hearing damage to you or your patrons when selecting your volume setting of music played in the fitness class?

Table 3 continued

Category	Question Number	Question
Attitudes relating to sound levels and potential of hearing damage	61	People who listen to loud music all the time do not seem to have hearing loss, so I do not have to worry about getting a hearing loss
	62	How important is it for you to have good hearing?
	64	Would you be willing to give up activities if you know that the sound levels are dangerously loud?
	69	Are you concerned about the effects of loud sounds on your hearing?
	71	Please rank the importance of the following factors (1 being the most important, 4 being the least important) when determining the music volume for the classes you teach. ______ Your personal preferences (1) ______ Class participants' preferences (2) ______ Direction from gym management (3) ______ Standards set by fellow instructors (4)
	72	Are you interested in learning more about the effects of noise on your hearing and how to best protect yourself from hearing damage from loud sounds?
Self-reported hearing behaviors relating to sound levels and potential of hearing damage	11	Do you play amplified music?
	12	If you answered yes to the previous question, (Q11) how loud is the music that you play?
	40	Do you wear hearing protection when you instruct a fitness class?
	41	Do you wear hearing protection when you are taking a fitness class?
	44	If you answered yes to the previous question, (Q43) is hearing protection offered to patrons every class?

Table 3 continued

Category	Question Number	Question
Self-reported hearing behaviors relating to sound levels and potential of hearing damage	46	If you answered yes to the previous question, (Q45) please explain how you consider the risk of potential hearing damage to you or your patrons when selecting your volume setting of the music played in the fitness class.
	49	How many hours do you typically listen to personal music devices (e.g., iPod) each day?
	50	How often do you talk to your friends/colleagues about the possibility of loud sounds damaging your ears?
	51	How often do you talk to your friends/colleagues about protecting your ears around loud sounds?
	52	During your next fitness class, will you try something to protect your ears when you are around loud sounds?
	63	Do you avoid spending time in places with loud sounds?
	66	How often do you take action to protect your ears if sound levels are very loud?
	67	How often do you ask class participants if the music volume is at a comfortable level?

Table 4 contains the categories of knowledge, attitudes, and behaviors relative to Research Question 2.

Table 4

Survey Questions Related to Research Question 2

Category	Question Number	Question
Knowledge of vocal effort and potential of laryngeal damage	16	Have you ever been concerned about having your voice damaged by overuse?
	29	What factors do you think can affect/impact your vocal health when working as a fitness instructor?
	30	What are ways that you can preserve your voice after instruction?
	31	What are some symptoms of vocal problems? Check all that apply
Attitudes of vocal effort and potential of laryngeal damage	7	If you answered yes to the previous question, (Q6) have you sought out help from a speech language pathologist or physician?
	28	Have you experienced any voice problems that have affected your emotions and quality of life (eg, make you upset, concerned, unsatisfied with your job performance, unsatisfied with the job)?
	47	Do you consider the risk of potential vocal fatigue when selecting the volume setting of the music?
	65	Would you be willing to give up activities if you know that it could cause vocal damage?
	70	Are you concerned about over using your voice?
	73	Are you interested in learning more about vocal damage and how best to protect yourself from voice disorders?

Table 4 continued

Category	Question Number	Question
Self-Reported Vocal Behaviors of vocal effort and potential of laryngeal damage	17	Utilizing the graph below, how would you rate your vocal effort during the last fitness class you instructed?
	18	Do you have to raise your voice when instructing in order for patrons to hear you?
	19	Do you utilize a microphone when instructing a fitness class?
	27	Please select any that apply to your situation. I have had: ▢ Feelings of discomfort when speaking (1) ▢ Feelings of pain when speaking (2) ▢ A reduced ability to speak for long periods (3) ▢ Periods of complete voice loss (4) ▢ Difficulty being heard/getting my message across (frequent need to repeat statements) (5) ▢ Other (please specify) (6) ____________________ ▢ None of the above applies to me (7)
	48	If you answered yes to the previous question, (Q47)please explain how you consider your risk of potential vocal fatigue when selecting the volume setting.

Table 5 contains the categories of knowledge, attitudes, and behaviors relative to Research Question 3.

Table 5

Survey Questions Related to Research Question 3

Question Number	Question
22	After instructing your last class of the day, do you feel your voice is:
23	Have you ever experienced vocal problems (loss of voice, soreness in the throat, hoarseness, roughness, lower than normal voice pitch, tired/fatigued voice, etc.) after instructing your last class of the day?
24	If you answered yes to the previous question, (Q23) please select the words that describe your throat symptoms (if any):
25	If you answered yes to the previous question, (Q23) have you adjusted your teaching method due to your current or previous voice problems?
26	If you answered yes to the previous question, (Q25) please indicate the way you adjusted your method of teaching. Select those that are applicable

Incentive

Participants had the ability to enter their email for a drawing for a $50 Amazon gift card at the end of the questionnaire. Once the questionnaire was closed, only the emails from participants who chose to enter were placed in the drawing and two winners were selected randomly from all participants who chose to enter the drawing. The two winners were sent an Amazon E-Gift Card to their email address. There were no other interactions between the participants and the researcher unless the researcher was contacted directly regarding questions about the project and/or vocal and hearing health; however, the researcher was not contacted.

Data Analysis

Seventy-four questions were included in the questionnaire. The descriptive analysis for this paper was generated using Qualtrics software. The participants' responses were confidential. Participants were assigned a random number via Qualtrics software to keep responses confidential. No responses were directly linked to any participant or fitness studio. Data were stored on a password protected computer and a password protected Qualtrics account.

Several questions asked participants to explain their answer in the text box provided. The qualitative data obtained from these items were analyzed by performing an informal thematic process. The researcher read over the responses noting common themes. Once themes were identified on a general level, the qualitative data were reviewed once again by the researcher for confirmation of themes. Since the main focus of the study was not qualitative, a second coder was not utilized. For example, Q29 asked "What factors do you think can affect/impact your vocal health when working as a fitness instructor?" and a text box was provided for typed responses from the participants. Themes were identified by the researcher based on the responses (overusing voice, environment, music/patron sound level, microphone, and other), and then each response was assigned into one of the five categories of themes based on what the researcher determined was the best fit.

CHAPTER IV

RESULTS

Purpose

The purpose of this research project was to provide further understanding about fitness instructor's knowledge, attitudes, and self-reported behaviors relating to sound exposure and vocal effort while instructing. The participants' responses from the Qualtrics questionnaire were descriptively analyzed and are reported below. Many questions had answer choices/variable names such as "never, rarely, sometimes, frequently, always" and "low, not loud, moderate, loud, very loud." All of the variable names above were then coded as integer numeric data ranging from one to the maximum number of coded options. The integer numeric data were utilized to report mean, standard deviation, minimum, and maximum: 1 = *Never*, 2 = *Rarely*, 3 = *Sometimes*, 4 = *Frequently*, 5 = *Always*; 1= *Low*, 2 = *Not Loud*, 3 = *Moderate*, 4 = *Loud*, 5 = *Very Loud*.

Of the 26 participants who started the questionnaire, one participant did not meet the inclusion criteria, specifically question two (Q2): "Prior to your employment as a fitness instructor, have you ever been officially diagnosed with a hearing loss by an audiologist or physician?" One participant who was diagnosed with a hearing loss did not seek out help from a speech language pathologist, audiologist, or physician (Q6). Overall, 25 participants met the inclusion/exclusion criteria. One participant completed the questionnaire up to Q34 but did not answer any further questions. Partial data are included in the results section for this participant up to Q34. Therefore, data for Q35-Q74 were reported by 24 participants.

Participants

Participant's ages ranged from 18-64 years old (see Table 6.) Eighty percent of participants identified as female and 20% identified as male (Q8).

Table 6

Q1: Age of Participants

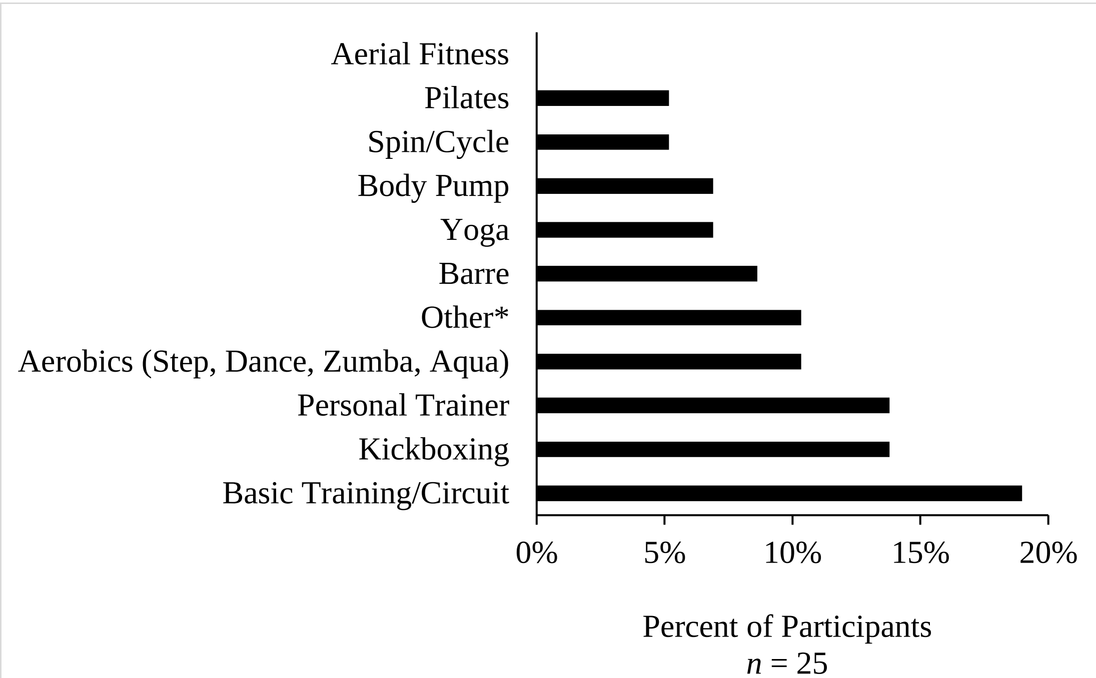
Age Category	Number of Participants	% of Participants
17 or Younger	0	0.0
18-24	6	23.1
25-34	13	50.0
35-44	5	19.3
45-54	1	3.9
55-64	1	3.9
65 or Older	0	0.0
Total	25*	100.0

*Included participant that only answered up to Q34

Figure 1 describes the type of fitness class(es) each participant taught.

Figure 1

Q9: What Type of Fitness Class(es) Do You Teach?



*Wrote in responses "Lagree"; "Crossfit"; "Bodybuiling, Contest Preparation, Body Transformation, Strength Training"; "Stretch and Core"; and "Foam Rolling/Mobility.".

The highest percentage of participants (19%) reported teaching basic training/circuit and the lowest percentage of participants (5.2%) reported teaching Pilates and spin/cycle. No participants reported teaching aerial fitness. Question 10 asked, "What is the average duration of an individual class that you teach"; 64% taught an individual class for a duration of 60 minutes, 32% taught for an average of 45 minutes, 4% taught for an average of 90 minutes or more, and no participant reported teaching an individual class for a duration of 30 minutes. The majority of participants taught an average of ≤ 1 class per week (see Table 7). The highest percentage reported for how many classes taught per week was three to four classes with three participants reporting teaching ≤ 10 classes per week (see Table 8).

Table 7

Q13: On Average, How Many Classes Do You Teach Per Day?

Average Number of Classes	Number of Participants	% of Participants
≤ 1	13	52
1-2	7	28
2-3	4	16
Total	24*	96

*****One person answered, *"See below"* and did not include a number.

Table 8

Q14: On Average, How Many Classes Do You Teach Per Week?

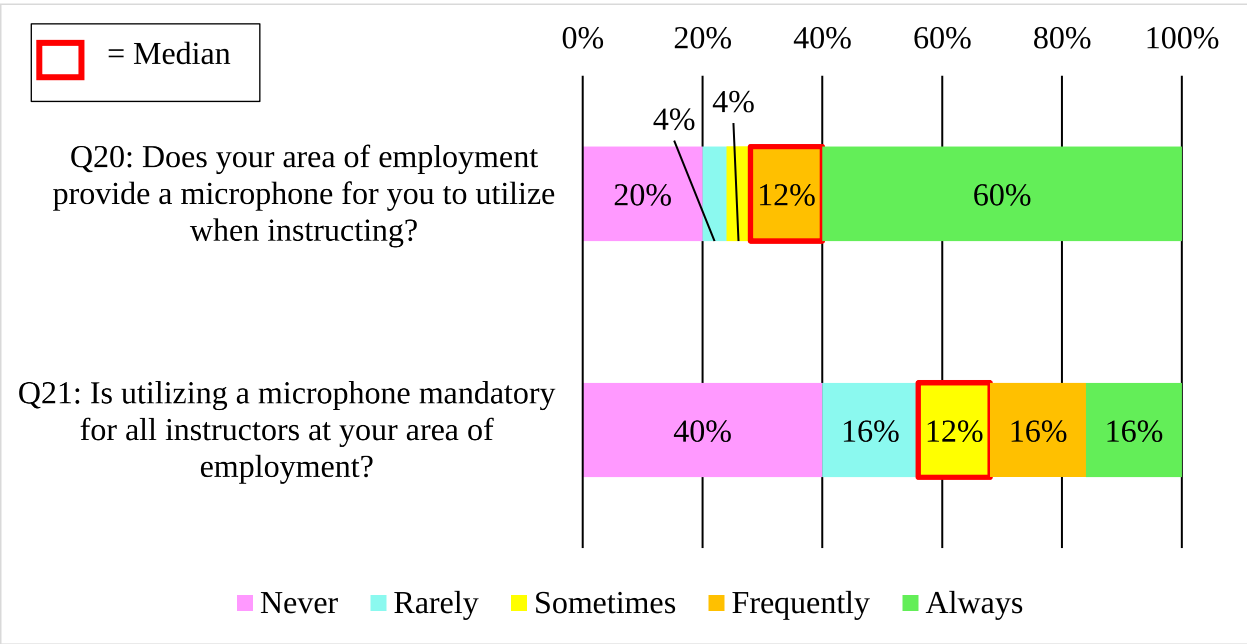
Average Number of Classes	Number of Participants	% of Participants
≤ 2	7	28
3-4	9	36
5-6	4	16
7-8	1	4
Write in: 5-10	1	4
Write in: 10+ ("10-16"; "12-15"; "15")	3	12
Total	25	100

*Included participant that only answered up to Q34.

Participants were asked if their area of employment provided a microphone when instructing (Q20); the majority (60%) reported *always* with an average (median) response of *frequently* and a standard deviation of 1.6. However, when asked if utilizing a microphone was mandatory for instructors (Q21), the highest percentage of participants reported *never* with an average (median) response of *sometimes* and a standard deviation of 1.5. Figure 2 provides further information for these two questions.

Figure 2

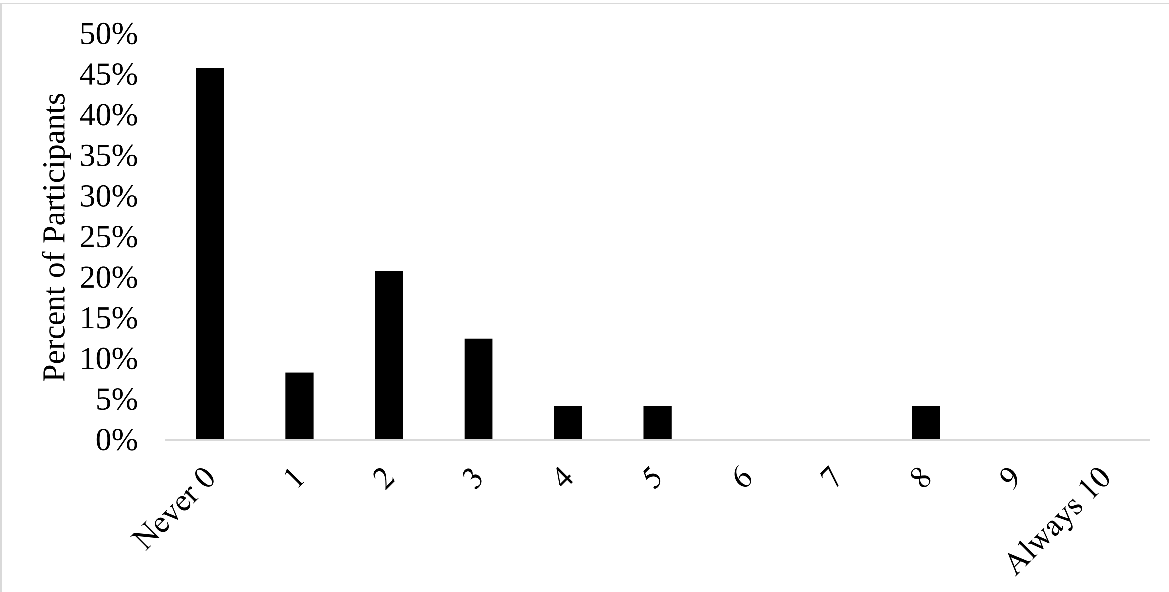
Microphones and Area of Employment



Question 43 asked if the studio or gym they worked at provided hearing protection for employees and 100% of participants reported no. Question 68 asked how often they received feedback about the music volume in class being too loud on a scale from 0-10 with 0 being never and 10 being always; the highest percentage of participants (45.8%) selecting 0 (see Figure 3).

Figure 3

Q68: How Often Do You Receive Feedback About the Music Volume in Class Being Too Loud?



Note. *M:* 1.6, *SD*: 2, Minimum: 0, Maximum: 8.

Sound Levels and Potential Risk of Hearing Damage

The first research question was related to describing the fitness instructors' knowledge, attitudes, and self-reported behaviors relating to sound levels and the potential risk of hearing damage while instructing. To answer each part of this question, the results were split into the three sections: knowledge, attitudes, and self-reported behaviors.

Knowledge Regarding Sound Exposure

Question 15 asked if they were concerned about having their ears damaged due to loud sounds and 52% of participants were not concerned and 48% were concerned. Question 53 asked if participants knew where to obtain hearing protection and what type was best for fitness instructors: 16.7% answered yes and 83.3% answered no. Question 54 was an extension to Q53 that asked participants to write in where they could obtain hearing protection and what type of hearing protection was best if they chose yes to Q53. Of the 16.7% who answered this question, zero participants reported on what type of hearing protection was best. Explanations of where to obtain hearing protection included the following: “I have access to ear plugs at home and other studios I attend,” “Amazon,” “We have a set for trainers in the office if we need them,” and “I only know of buying ear plugs from Walgreens.”

Table 9 reports responses to questions relating to knowledge about sound levels and the potential of hearing damage (Q55-Q60).

Table 9

Knowledge about Sound Levels and the Potential of Hearing Damage

Question	*N*	% of Responses
Q55: *Which of the following types of sounds are typically loud enough to damage your ears (please select all that apply*		
Concerts*	24	100.0
Gunfire*	23	95.8
Fireworks*	20	83.3
Sporting Events*	19	79.2
Personal Music Players*	17	70.8
Pubs*	6	25.0
Radio	6	25.0
Traffic Noise*	2	8.3
Dishwasher	1	4.2
Conversations with Friends	0	0.0
Q56: *Sounds measuring _____ and over can cause hearing loss (please select the best answer)*		
65 decibels (dBA)	2	8.3
70 decibels (dBA)	3	12.5
85 decibels (dBA)*	3	12.5
90 decibels (dBA)	0	0.0
Not Sure	16	66.7
Q57: *Which of the following are good ways to protect your ears when you are around loud sounds? (Please select all that apply)*		
Turn down the volume*	23	95.8
Use earplugs or earmuffs*	22	91.7
Move away from the sound*	19	79.2
Put cotton or tissue in your ears	4	16.7
Not sure	2	8.3
None of the above	0	0.0
Q58: *Hearing an extremely loud sound even one time can cause you to lose some hearing*		
True*	18	75.0
False	0	0.0
Not Sure	6	25.0
Q59: *Which part of the ear is most commonly damaged by exposure to loud sounds? (Please select the best answer)*		
Ear Drum	11	45.8
Not Sure	7	29.2
Hair cells in the inner ear*	4	16.7
Eustachian Tube	2	8.3

Table 9 continued

Question	Number	% of Responses
Q60: *How old do you have to be to get hearing loss from loud sounds? (Please select the best answer)*		
Over age 40	0	0.0
Over age 50	0	0.0
Over age 60	0	0.0
Any Age*	24	100.0

Note. *N* = 24. *Correct Reposes.

Attitudes Regarding Sound Exposure

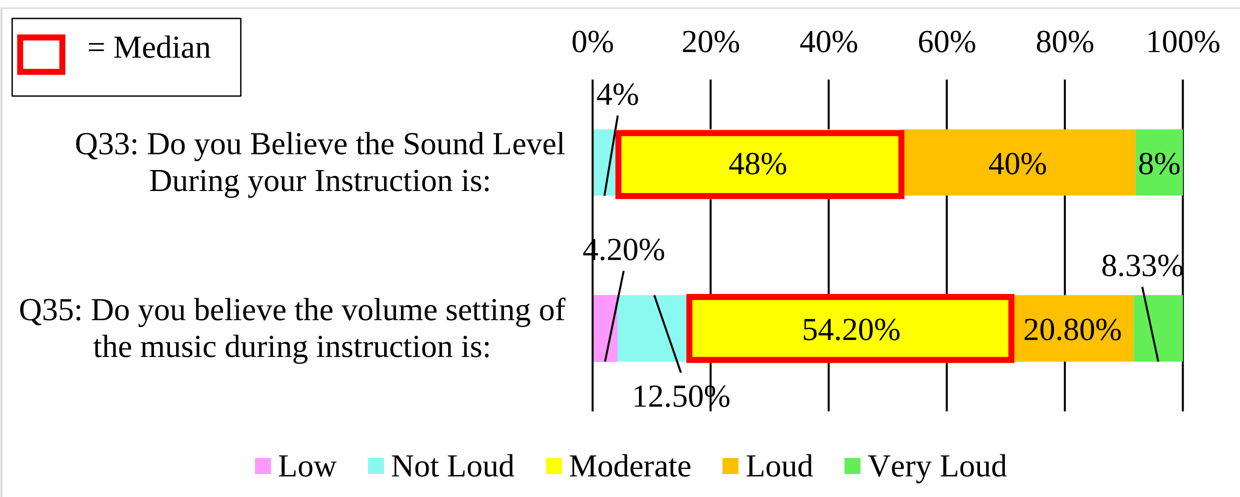
As stated in the previous section, zero participants reported that they have been diagnosed with a voice disorder (Q4). Therefore, the following question, which falls into the attitudes category, was not displayed for participants: *If you answered yes to the previous question, have you sought out help from a speech language pathologist, audiologist, or physician for your hearing loss? (Q5).*

For Q45, participants were asked if they considered the risk of potential hearing damage to themselves or their patrons when selecting the volume setting of music played in the fitness class and only 33.3% considered it and 66.7% selected they did not. Question 71 asked participants to rank the importance of the following factors: “Your personal preferences, direction from gym management, class participants preferences, and standards set by fellow instructors” with 1 being the most important and 4 being the least important, when determining the music volume for the classes they taught. The mean scores were 1.9 for Personal Preferences, 3 for Direction from Gym Management, 1.6 for Class Participants’ Preferences, and 3.5 for Standards Set by Fellow Instructors. The closer the mean was to 1 indicated the specific choice was more important for participants and the closer the average was to 4 indicated it was least important. The responses for this question suggested many had flexibility on volume setting as gym management and fellow instructor standards were not as important as their personal preferences or the class participants' preferences. Question 72 asked participants if they were interested in learning more about the effects of noise on their hearing and how to best protect themselves from hearing damage from loud sounds; 58.3% selected they were interested and 41.7% selected they are not interested.

Figure 4 illustrates responses for Q33 and Q35. For Q33, participants were asked their perception on the sound level during instruction and the average and Q35 asked their perception on the volume setting of the music during instruction. For both of these questions, the average response (median) was *moderate*.

Figure 4

Self-Perceptions of Volume Settings



Question 32 asked if they believed the fitness area was louder than it should be and the average (median) and majority of participants (60%) reported *sometimes*. Question 34 asked if they believed the sound level during their classes was too loud/very loud with the average (median) reporting *rarely*. Question 36 asked if the sound level interfered with their instruction during the exercise routine and the average response (median) was *rarely*. Question 37 asked if the sound level interfered with communication and the majority (58.3%) and average response (median) reported *sometimes.* Question 38 asked if they felt the sound level enhanced patron enjoyment and Q39 asked if the sound level communicated the exercise intensity/motivation needed for the class patrons. The average response (median) for both of these questions was *frequently* with the majority (54.7%) selecting *frequently* for Q38. For further results on these questions, see Figure 5.

Participants were asked what factors influenced their choice of the highest volume setting used and the responses were split into three themes: Intensity/Motivation of the Type of Class, Patrons, and Instructor Preference. Explicit responses to this question are summarized in Table 10.

Figure 5

Attitudes About Sound Levels and Potential of Hearing Damage

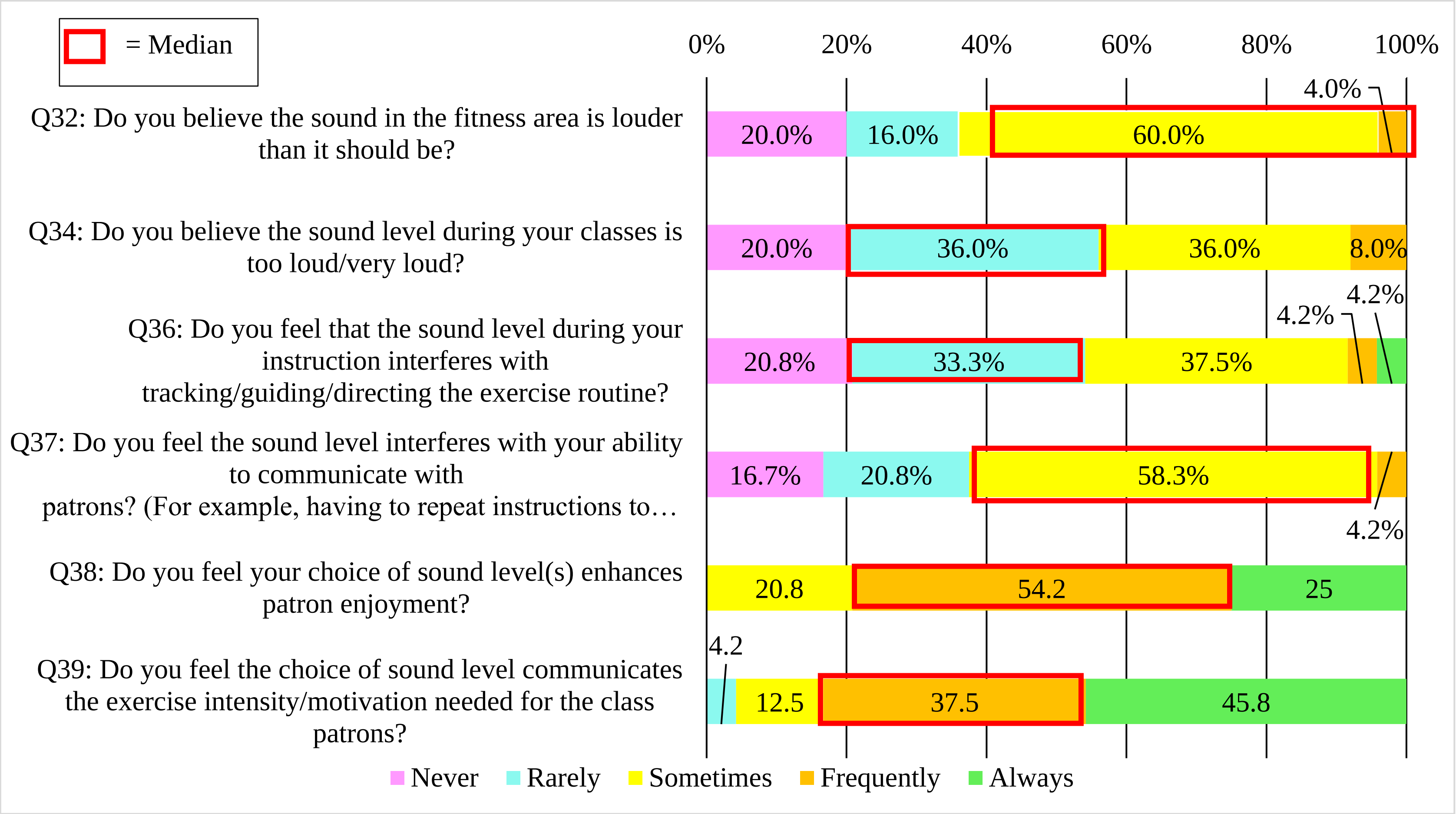


Table 10

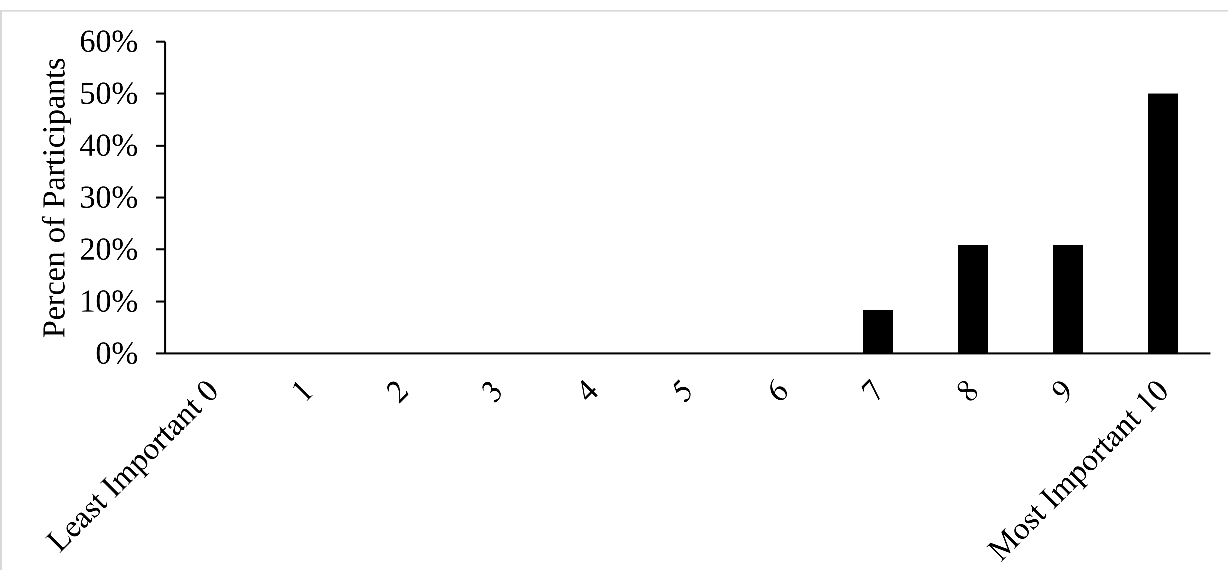
Q42: What Factors Influence Your Choice of the Highest Volume Setting Used?

Theme of Responses	Participants Responses
Intensity/Motivation of the Type of Class	Surrounding businesses, amount of people in class, intensity level of class
	If I am at a point in the exercise where I can stop talking and let the clients zone out through the music.
	Intensity. louder music motivates my clients to work harder and not focus so much on being tired.
	Amount of people taking my class at one time, type of music being played, needing to motivate my students!
	How the music influences the workout & how heavy the beat of the music is
	We are instructed to keep our music at a 'motivating' level
	Make sure the athletes can still hear me but it's loud enough to keep intensity levels up
	Intensity of workout or if a beat needs to be heard in order to follow along
	Workout of the day
	Type of client, type of class (advanced/beginner), difficulty of movement (often will turn music up for difficult portions)
	If the microphone can be heard over the music while also keeping it loud enough to be able to find the beat of the music
	Type of class: yoga is easier to play softer music than a spin class
	The class I am teaching. Zumba I have it pretty loud because I do non-verbal cues during the dances.
Patrons	Based on the energy the clients show early on.
	Amount of people in class
	Intensity, vibes from the class
Instructor Preference	If I can't hear my self talk then it's too loud.
	Being able to clearly communicate with client
	Being heard over it while still having the hype or intensity
	Ease of communication, type of client/workout.
	Music is used as a background. A volume that can be heard but that I can comfortably talk over is my typical choice.
	I just keep it at a moderate level. I don't like drowning participants with my music and I don't like screaming over songs. So I just keep it to where I can hear it but it's not necessarily influencing the workout
	Needing to be heard/create atmosphere over ambient noise (loud fans, other gym music, participant chatter outside room)

Question 61 asked participants to select *agree*, *disagree*, or *not sure* to the following statement: “People who listen to loud music all the time do not seem to have hearing loss, so I do not have to worry about getting a hearing loss” of which the correct answer was *disagree.* Results indicated 79.2% selected *disagree* and 20.8% selected *not sure*. For Q62, Q64, and Q69, participants were provided with a continuous scale of 0-10 with 0 being the least and 10 being the most. Question 62 asked how important it was for them to have good hearing and the majority (50%) reported 10 (see Figure 6). However, when asked if they would be willing to give up activities if they knew the sound levels were dangerously loud (Q64), the average response (mean) was 4.7 (see Figure 7). Similar responses were seen for Q69 which asked if they are concerned about the effects of loud sounds on their hearing and the average response (mean) was 4.3 as well (see Figure 8).

Figure 6

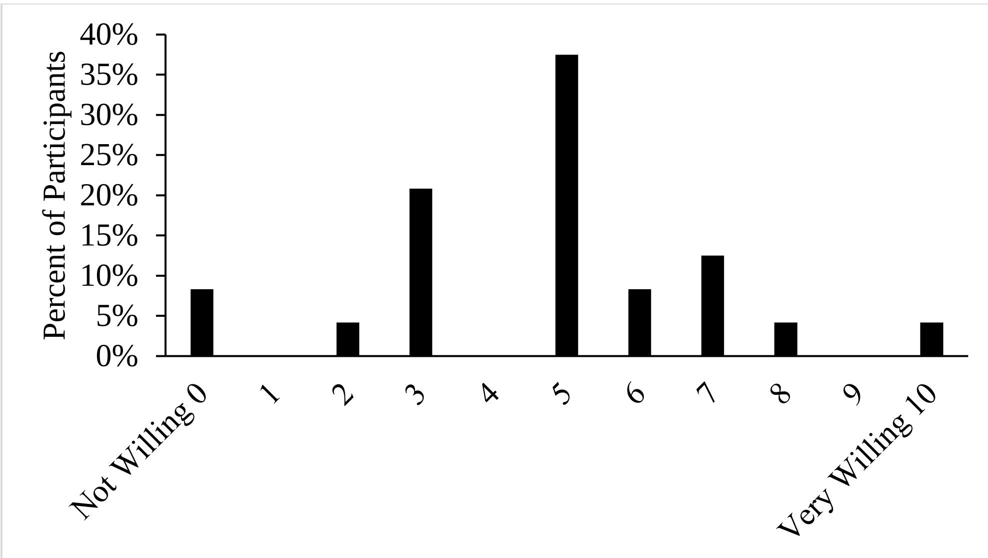
Q62: How Important Is It for You to Have Good Hearing?



Note. M: 9.1, *SD:* 1, Minimum: 7, Maximum: 10.

Figure 7

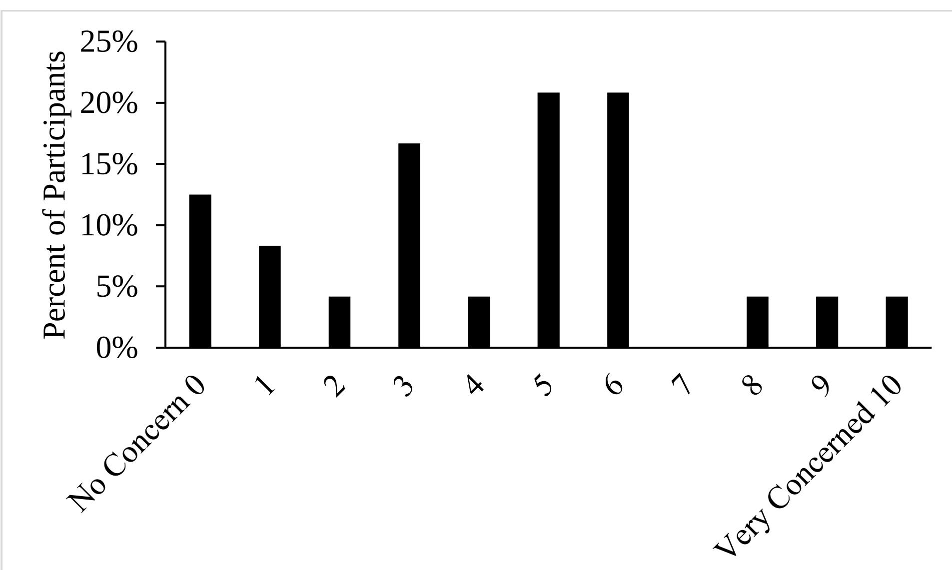
Q64: Would You Be Willing to Give Up Activities If You Know That the Sound Levels Are Dangerously Loud?



Note. M: 4.7, *SD:* 2.3, Minimum: 0, Maximum: 10.

Figure 8

Q69: Are You Concerned About the Effects of Loud Sounds on Your Hearing?



Note. M: 4.3, *SD:* 2.7, Minimum: 0, Maximum: 10.

Self-Reported Behaviors Regarding Sound Exposure

Participants were asked if they played amplified music during the class (Q11); 96% selected that they did play amplified music and 4% selected they did not. For the 96% who selected they did play amplified music, zero participants selected that their music was quiet, 11 selected their music loudness was moderate, and 13 selected it was loud (Q12). When asked if they wore hearing protection when instructing a fitness class (Q40) or taking a fitness class (Q41) 100% of participants selected they never wore hearing protection for either situation. Because zero participants answered yes to Q43, which asked if the studio or gym they work at provided hearing protection for employees, Q44, which asked if hearing protection was offered to patrons every class, was not displayed for any participant.

Of the eight participants who answered yes to Q45, which asked if they considered the risk of potential hearing damage to themselves or their patrons when selecting the volume setting of the music played in the fitness class, Q46 asked them to explain in their own words how they considered the risk; participants provided the following write-in answers

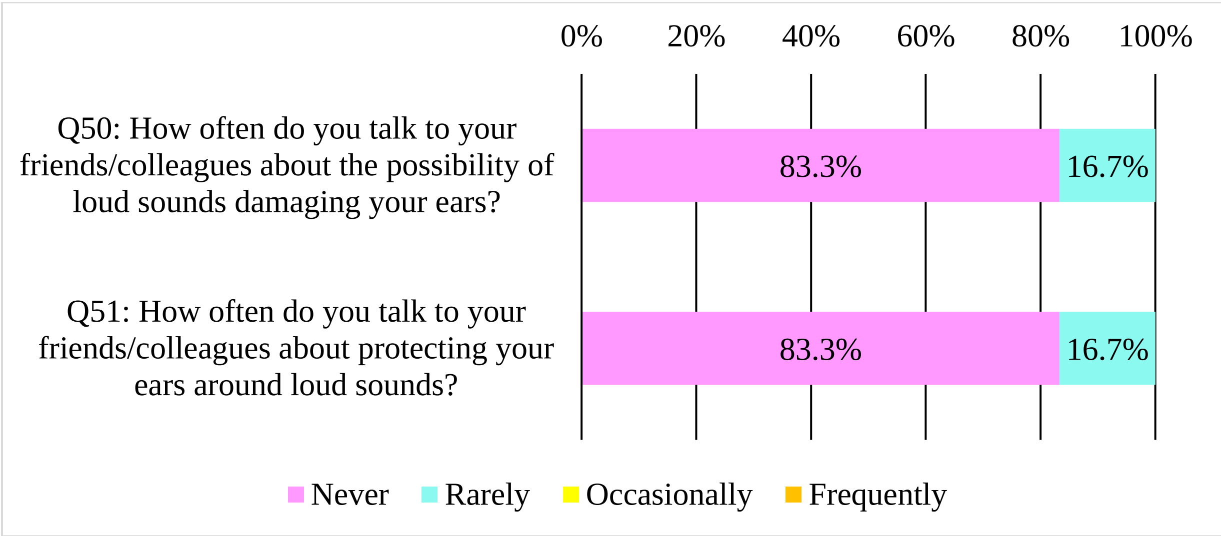
- I stand under the speakers and make sure it’s not too loud to interfere with instruction or comfort level.
- Making sure that the level is not interfering with my instruction and that everyone can hear me vs. just hearing the music
- Age
- If volume of music is not carefully monitored
- I make sure it’s not too loud and ask them for their opinion

- It may be too loud for some participants and I have not realized that until this survey. I should be more considerate.
- I don’t want to set the volume to a point where sound is painful or overwhelming
- I just don’t put it loud to avoid any potential hazards. Better safe than sorry.

Question 49 asked participants how many hours they listened to personal music devices each day and the average response (mean) reported was one to two hours with a standard deviation of 1, a minimum of 0 to 1 hour, and a maximum of >5 hours. Questions 50 and 51 asked how often participants talked to their friends/colleagues about two things: the possibility of loud sounds damaging their ears and protecting their ears when around loud sounds. The majority of participants (83.3%) selected never for both questions (see Figure 9).

Figure 9

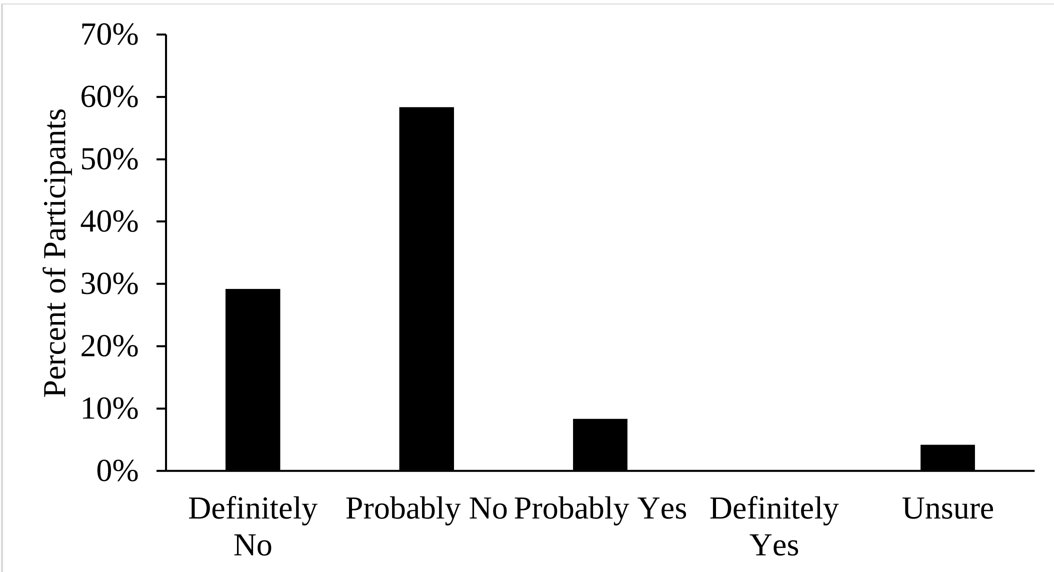
Self-Reported Behaviors About Sound Levels and Potential of Hearing Damage



Question 52 asked participants if they would try something to protect their ears when around loud sounds during their next fitness class and the average (median) and majority (58.3%) reported probably no (see Figure 10 for further detail).

Figure 10

Q52: During Your Next Fitness Class, Will You Try Something to Protect Your Ears When You Are Around Loud Sounds?

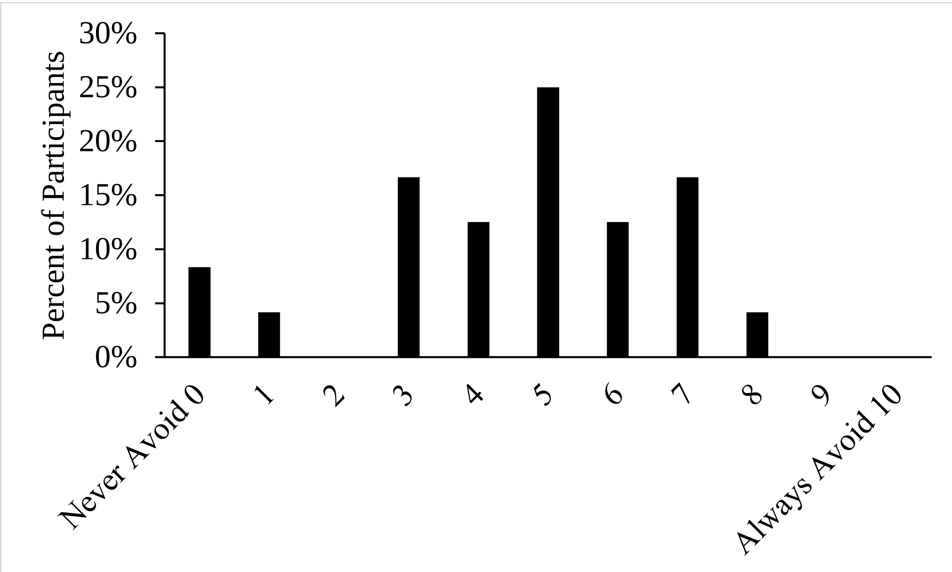


Note. Median: Probably No (2); *M:* 1.9; *SD: 0.7.*

For Q63, Q66, and Q67, participants were provided with a continuous scale of 0-10, with 0 being the least and 10 being the most. For Q63, participants were asked if they avoided spending time in places with loud sounds. The average response (mean) was 4.5 with the highest percentage (25%) reporting *5* (see Figure 11).

Figure 11

Q63: Do You Avoid Spending Time in Places With Loud Sounds?

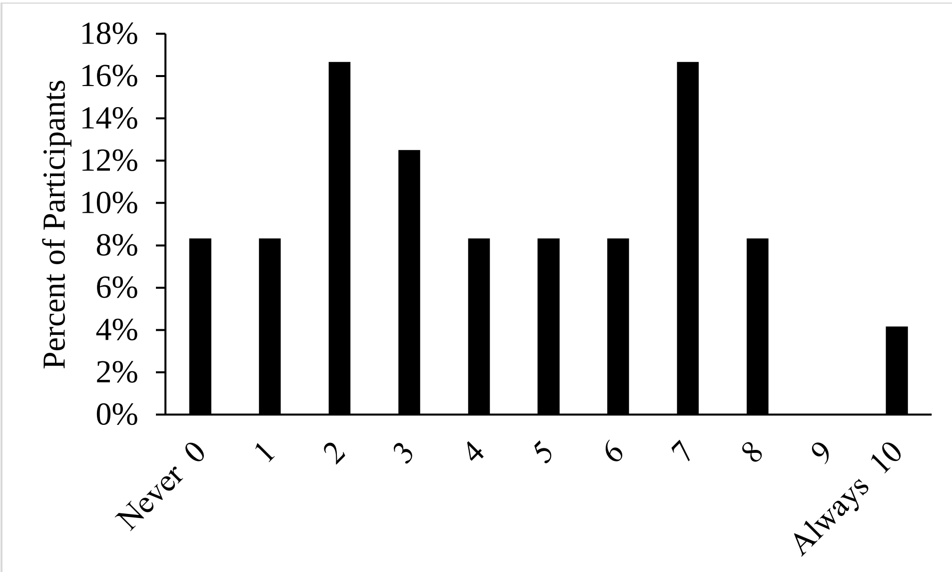


Note. *M:* 4.5, *SD*: 2.1, Minimum: 0, Maximum: 8.

For Q66, participants were asked how often they took action to protect their ears if sound levels were very loud and the average response (mean) was 4.3 with the highest percentage (16.7%) reporting 2 and 7 (see Figure 12).

Figure 12

Q66: How Often Do You Take Action to Protect Your Ears If Sound Levels Are Very Loud?

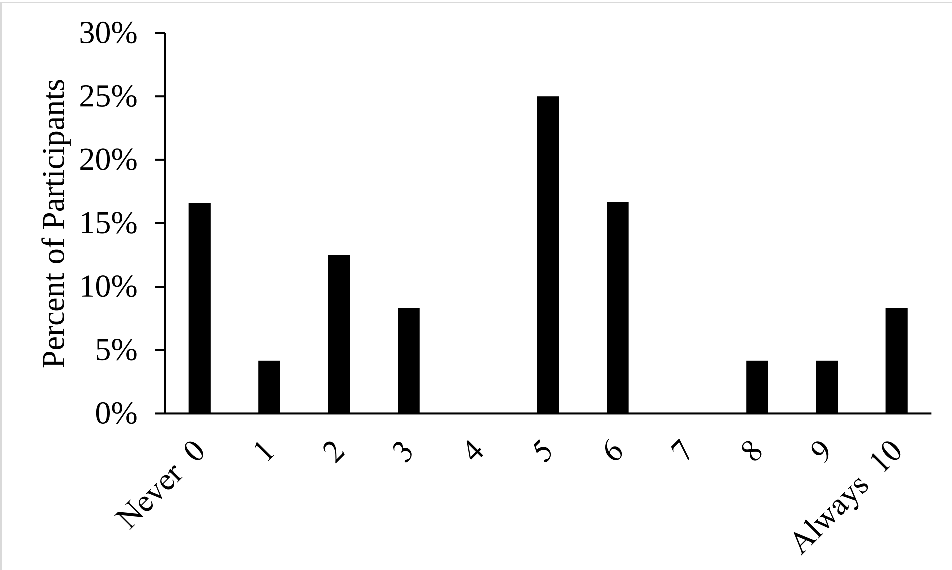


Note. M: 4.3, *SD*: 2.8, Minimum: 0, Maximum: 10.

For Q67, participants were asked how often they asked class participants if the music volume was at a comfortable level and the average response (mean) was 4.3 with the highest percentage (25%) reporting 5 (see Figure 13).

Figure 13

Q67: How Often Do You Ask Class Participants If the Music Volume Is at a Comfortable Level?



Note. M: 4.3, *SD*: 3, Minimum: 0, Maximum: 10.

Vocal Effort and Potential of Laryngeal Damage

The second research question was related to knowledge, attitudes, and self-reported behaviors relating to vocal effort and potential risk of laryngeal damage. To answer each part of this question, the results were split into the three categories: knowledge, attitudes, and behaviors.

Knowledge About Vocal Effort and Potential of Laryngeal Damage

Participants were asked if they had ever been concerned about having their voice damaged by overuse (Q16) and 64% selected no and 36% selected yes. For Q29, participants were asked what factors could affect/impact their vocal health when working as a fitness instructor. The write-in responses were placed in five different categories/themes: overusing voice, environment, music/patron sound level, microphone, and other (see Table 11 for results).

Table 11

Q29: What Factors Do You Think Can Affect/Impact Your Vocal Health When Working as a Fitness Instructor?

Theme	Participants Responses
Overusing voice	Talking with energy consistently for longs amount of time or multiple times a day
	Long days of teaching, not understand how to utilize your voice and utilize diaphragm and not vocal chords (sic)
	Incorrect strain levels
	Teaching multiple classes in a row or getting dehydrated tend to make my voice go in and out or lead to voice loss
	When I teach dance without a mircophone (sic) I am yelling often. Yelling most definitely impacts my vocal health.
	Raising my voice over loud music. Not drinking enough water.
	Loudly talking into the speaker while doing the workout with participants. I am winded sometimes and still have to yell.
	Vocal health can be impacted by needing to raise my voice in order to be heard by my participants.
Environment	Facilities, for example, at [studio location] campus rec we had great facilities and support, and resources, but not all gyms have appropriate studio space, or resources, some dont even have mics.
	If the room is not well insulated.
	Dryness of air in the room, dust/dirt particles in the air, volume of music or athletes voices
Music/Patron Sound Level	Size of class, music volume
	Talking over loud music
	When my voice isn't amplified and the music is loud I strain my voice much more to teach.
	If particular gym has music volume too loud
	Large class size, loud music, amount of water intake
	I like to play my music loud to pump up my students and keep them motivated during a workout class. Due to this, I am talking VERY loudly in order to be heard in between sentences/instructions.
	Music volume; chatty clients; dry air/cold weather; microphone use
	Audio balance of music/microphone, ambient noise, improper hydration, lack of rest
Microphone	Not using a mic but I do almost every class
	Hydration; microphone quality
	No mic
Other	NA
	Water
	Dehydrated

For Q30, participants were asked the ways they could preserve their voice after instruction and the write-in responses were placed in four different categories: hydration, vocal rest, monitoring vocal use, and other (see Table 12 for results). For Q31, participants were asked “What are symptoms of vocal problems?” and were instructed to select all that apply; 72% selected raspy voice, 68% selected hoarse voice, 24% selected breathy voice, 20% selected trouble swallowing, and 52% selected coughing (note that all were correct answers).

Table 12

Q30: What Are Ways That You Can Preserve Your Voice After Instruction?

Theme	Participants Responses
Hydration	Drinking water abs resting your vocal cords
	Water, hot tea, and rest
	Honey, tea, water, no talking/take a brak (sic)
	Drink water, talk from the diaphragm not the throat.
	Drinking lots of water and staying hydrated during and after instructing a class
	Fluids! Water. I live alone so when I go home I am resting my voice for the remainder of the evening.
	Drink water; warm tea with honey
	Rest, hot drinks
	Staying hydrated
	Drink enough water, rest voice
	Water / tea
	Drink tea and not talk
	Drink plenty of fluids and rest.
	Gargle, throat coat tea
	Drink water and talk lower.
	Rest, water, tea.
	Drink plenty of water and warm fluids.
Vocal Rest	Rest it!
	Avoid teaching more than 2 classes per day and stay hydrated
	Avoid yelling, loud talking, tea, hydration
Monitoring Vocal Use	Monitor music played during session so client can clearly hear your command
	Using a microphone
	Microphone
Other	?
	NA

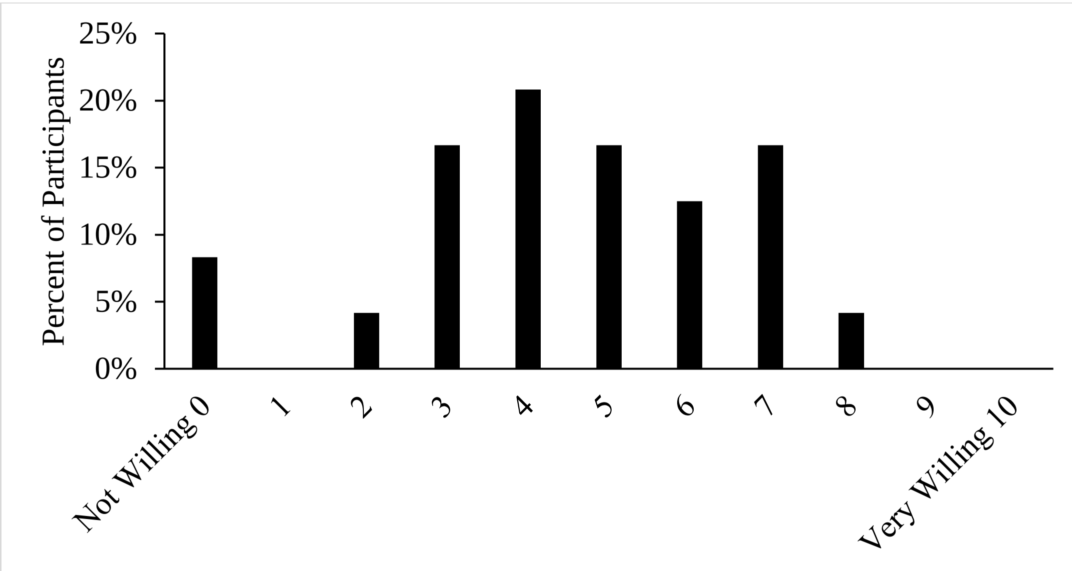
Attitudes About Vocal Effort and Potential of Laryngeal Damage

For Q7: “If you answered yes to the previous question, (Q6) have you sought out help from a speech language pathologist of physician?”, zero participants had ever been officially diagnosed as having a vocal disorder by a speech language pathologist or physician while being employed as a fitness instructor. Therefore, this question was not displayed for any participant. For Q28, participants were asked if they had experienced any voice problems that had affected their emotions and quality of life and 4% of participants (one person) selected yes and 96% selected no. The one participant who selected yes was asked to specify,and they wrote in “Sometimes feel anxious about how I sound to participants if my voice is scratchy & not soothing.” For Q47, participants were asked if they considered the risk of potential vocal fatigue when selecting the volume setting of the musicand 33.3% selected yes and 66.7% selected no.

For Q65 and Q70, participants were provided with a continuous scale of 0-10,with 0 being the least, and 10 being the most. Question 65 asked if participants would be willing to give up activities if they knew it could cause vocal damage and the average response (mean) was 4.5 with a standard deviation of 2.1. The highest percentage of participants (20.8%) selected 4 (see Figure 14).

Figure 14

Q65: Would You Be Willing to Give Up Activities If You Know That It Could Cause Vocal Damage?

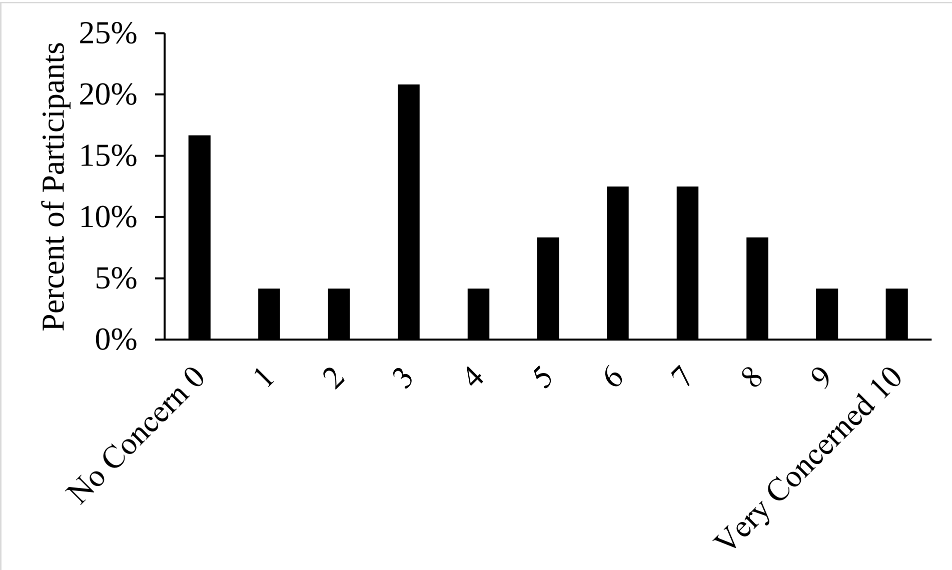


Note. *M*: 4.5, *SD*: 2.1, Minimum: 0.00, Maximum: 8.00.

Question 70 asked participants if they were concerned about over-using their voice and the average response (mean) was 4.4 with a standard deviation of 3. The highest percentage of participants (20.8%) selected 3 (see Figure 15). For Q73, participants were asked if they were interested in learning more about vocal damage and how best to protect themselves from voice disorders; 58.3% reported yes and 41.7% reported no.

Figure 15

Q70: Are You Concerned About Over-Using Your Voice?



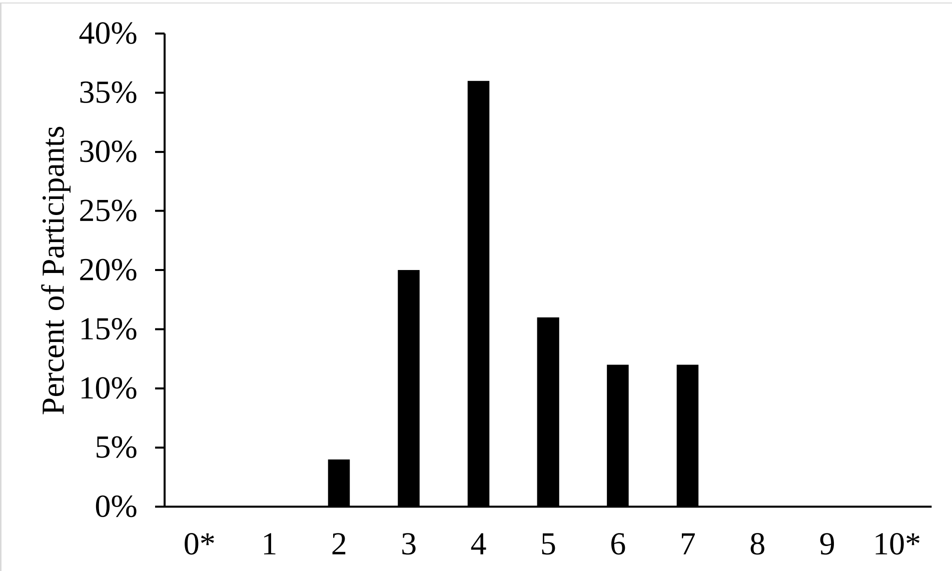
Note. M: 4.4, *SD*: 3, Minimum: 0, Maximum: 10.

Self-Reported Behaviors About Vocal Effort and Potential of Laryngeal Damage

For Q17, participants were provided with a continuous scale of 0-10 with 0 being the least, and 10 being the most. The average response (mean) was 4.5 with a standard deviation of 1.4. The data point with the highest percentage of participants (36%) was 4 (see Figure 16).

Figure 16

Q17: Utilizing the Graph Below, How Would You Rate Your Vocal Effort During the Last Fitness Class You Instructed?

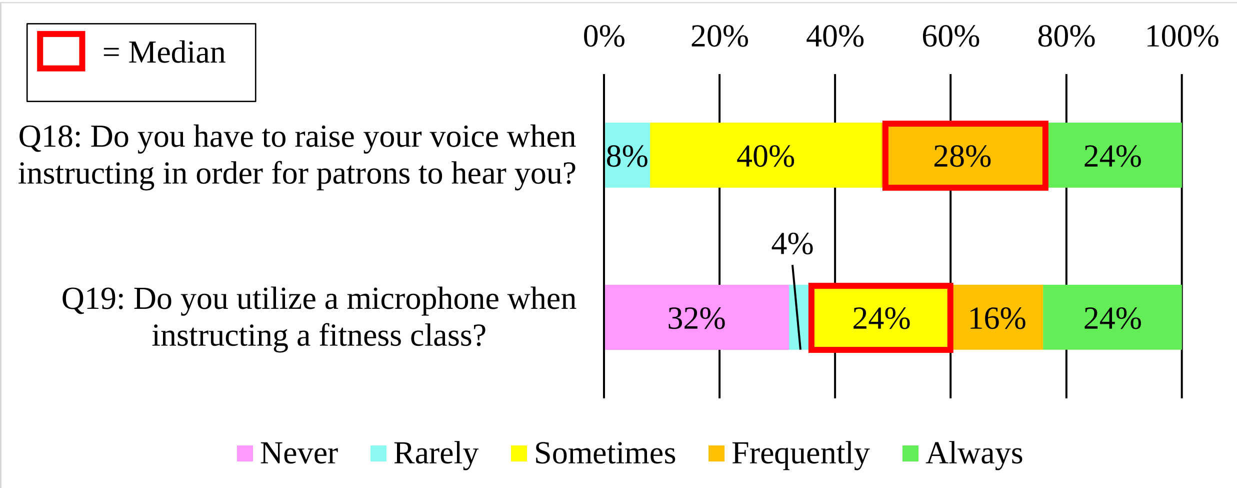


***** 0-point: only of the amount of vocal effort when speaking quietly to someone sitting close in a quiet room. Think only of vocal effort and not the mental effort or concentration it took to produce effortless voice. *10-point: the amount of vocal effort or strain felt when having laryngitis and can barely get sound out, even with a lot of strain.
Note. *M:* 4.5, *SD*: 1.4, Minimum: 2, Maximum: 7.

Question 18 asked if they had to raise their voice when instructing in order for patrons to hear them and the average response (median) was *frequently*. For Q19, participants were asked if they utilized a microphone and the average response (median) was *sometimes* (see Figure 17).

Figure 17

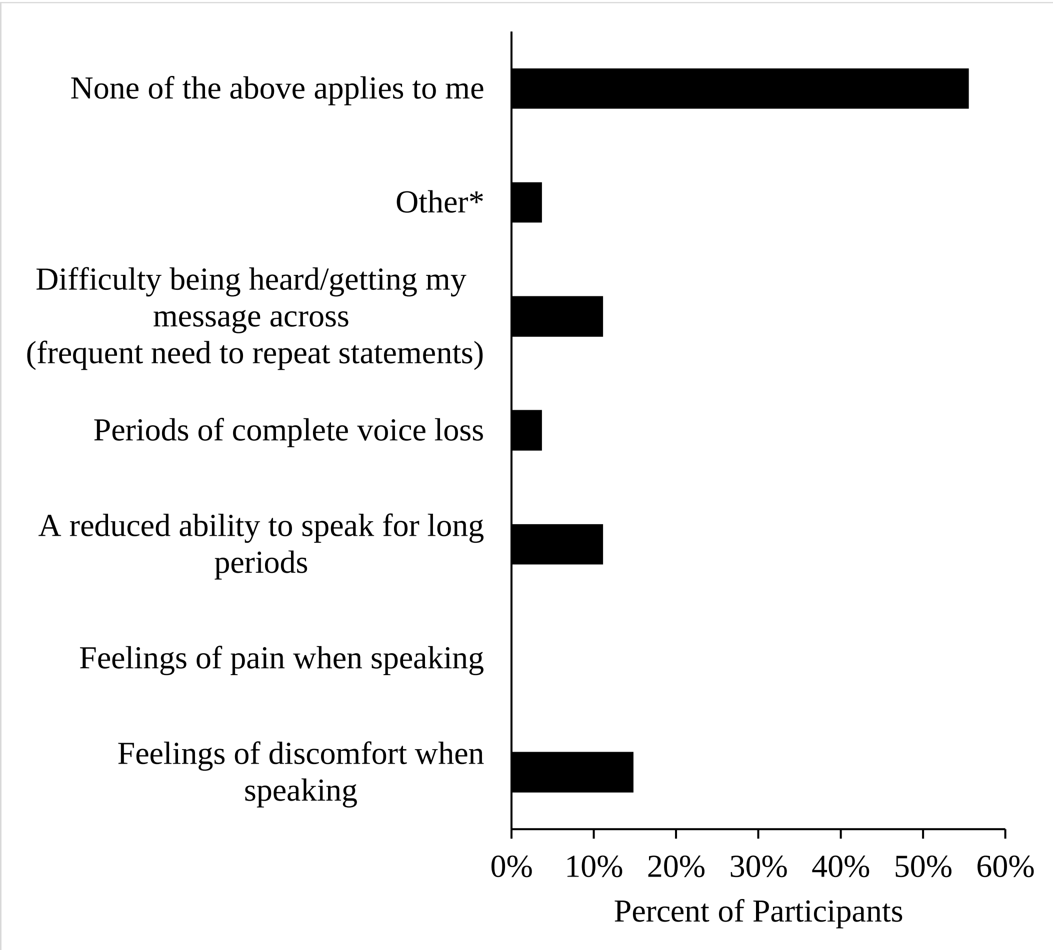
Self-Reported Behaviors About Vocal Effort and Potential of Laryngeal Damage



For Q27, participants were asked to select if they had had vocal symptoms. The majority (55.7%) reported not experiencing any vocal symptoms; however, 44.4% selected various symptoms. *Feelings of discomfort when speaking* was chosen most by participants with 14.81% choosing this symptom. Three participants selected *a reduced ability to speak for long periods* and one participant selected *periods of complete voice loss* (see Figure 18).

Figure 18

Q27: Please Select Any That Apply to Your Situation. I Have Had:



*Write in response: "Dry Throat."

Question 48 asked participants to explain how they considered their risk of potential vocal fatigue when selecting the volume setting. This question was an extension of Q47 that asked participants if they considered the risk of potential vocal fatigue when selecting the volume setting and only eight answered yes and therefore only eight answered Q48. The following were participants' write in responses.

- I know that I have to do this everyday, multiple timess (sic) a day, and I do not want my personal life to be inhinged (sic) by teaching. I also love it and want to do it for a long time so I take care of myself
- How much I will have to yell over the system
- Now i dont use loud music and I lower it when talking anyway
- I can tell when I am straining, especially if I am not mic-ed in a small class so I will turn the volume down so I don't have to yell over the music.
- If you must yell in order for your client to comprehend
- I need to be able to sustain voice level for the whole hour without extreme exertion
- I want to be able to comfortably talk over the music.
- Trying to balance mic & song audio so that mic audio comes across louder/clearer to participants.

Vocal Damage Symptoms Immediately Following Instruction

Question 22 asked participants how they felt their voice was after instructing the last class of the day from selecting one of the following: *poor, fair, good, very good*, and *excellent*. The average response (median) was *good* with 0% of participants selecting *poor* and 24% selecting *excellent*.

Note that for the following section, participants who answered yes to Q23 were then asked Q24-Q26. Question 23 asked if participants had ever experienced vocal problems (loss of voice, soreness in the throat, hoarseness, roughness, lower than normal voice pitch, tired/fatigued voice, etc.) after instructing their last class of the day; 56% selected they had experienced it and 44% selected that they had not. The 56% of participants were then asked to select what words describe their feeling (Q24). The largest number of participants (12) selected *dry*. The same 56% (14 participants) who answered yes to Q23 were then asked if they had adjusted their teaching method due to their current or previous vocal problems (Q25). Of the 14 participants, five participants answered *yes*, and 9 participants answered *no*. Question 26 was then displayed for the five participants and they were asked to indicate the way they adjusted their teaching. One participant selected reduced teaching hours, two participants selected *talk less in class, that is, increase nonverbal cueing*, two participants selected *improve voice care/vocal hygiene*, one participant selected *other* and was asked to specify and wrote-in “Utilized microphone during classes I previously did not (yoga).” Note that zero participants selected *alter work program, that is, change the programs that you teach.*

CHAPTER V

DISCUSSON/CONCLUSION

For the current study, the majority of participants (54.2%) taught ≤ 1 class per day and the largest proportion of participants (36%) taught three to four classes per week. The data from the current study were similar to that of other studies such as Dallaston and Rumbach (2016) whose participants taught an average of 4.75 classes per day and 2-10 classes per week and Rumbach (2013) whose participants on average taught nine classes per week. On average, fitness instructors taught 60-minute classes for the current study, which was similar to Beach and Nie's (2014) study where the average duration was 51.5 minutes (1997-1998 data set) and 52.8 minutes (2009-2011 data set) and to Rumbach where 89.5% of classes measured were approximately 60 minutes as well. Overall, the current study's data on participant demographics, number of classes taught, and duration of classes were similar to other studies that involved fitness instructors.

Hearing Health

Hearing Health Knowledge

Questions 55-60 were utilized and adapted from Zoe (2015); the data comparing the two studies are displayed in Table 13. When asked what types of sounds were typically loud enough to cause damage to their ears, the current study had a higher percent of participants select the correct answers (concerts, sporting events, personal music players, and gunfire) than in Zoe's study. Less than 25% of participants selected 85 dBA and above could cause hearing loss and that hair cells in the inner ear were commonly damaged by exposure to loud sounds for both studies, suggesting a lack of knowledge for these areas. The current study had a higher percentage of participants who selected correct answers on how to protect their ears when around loud sounds when compared to the Zoe study for all three of the correct answers; however, the majority for both studies selected the correct answers. In addition, the majority knew that at any age one could get hearing loss from loud sounds with 100% of the current study's participants selecting the correct answer as compared to 81% for the Zoe study.

Questions 15, 53, and 54 included in the current study were not utilized or adapted from another study and therefore could not be compared to other literature. Over half of participants reported not being concerned with having loud sounds damaging their ears; however, 48% selected they were concerned. Fitness instructors seemed to lack knowledge about hearing protection as only four participants reported knowing where to obtain hearing protection and no participants reported knowledge of what types of hearing protection devices were best for their occupation.

The incorrect answers for these questions could have been due to participants' lack of knowledge about sound levels and the potential of hearing damage. Even though many participants selected the correct answers of how to protect their ears, some might not have been able to recognize when they were in situations that might potentially be hazardous to hearing health and, if recognized, they might not have been able to use the proper methods or find proper hearing protection. The lack of knowledge in this area was seen in other literature such as Nelson et al. (2005) who stressed that the lack of hearing prevention could be the largest factor of NIHL and stressed that the use of hearing protection devices and overall education about prevention could reduce hearing problems in occupational settings.

Table 13

Comparison of Correct Responses to Knowledge Questions

Question	Current Study % of Responses (*N* = 24)	Zoe (2015) % of Responses (*N* = 21)
Q55: Which of the following types of sounds are typically loud enough to damage your ears (please select all that apply		
Concerts	100.0	61.9
Gunfire	95.8	90.5
Fireworks	83.3	9.5
Sporting Events	79.2	19.0
Personal Music Players	70.8	47.6
Pubs	25.0	52.4
Traffic Noise	8.3	19.0
Q56: Sounds measuring _____ and over can cause hearing loss (please select the best answer)		
85 decibels (dBA)	12.5	23.8
Q57: Which of the following are good ways to protect your ears when you are around loud sounds? (Please select all that apply)		
Turn down the volume	95.8	85.7
Use earplugs or earmuffs	91.7	66.7
Move away from the sound	79.2	71.4
Q58: Hearing an extremely loud sound even one time can cause you to lose some hearing		
True	75.0	61.9
Q59: Which part of the ear is most commonly damaged by exposure to loud sounds? (Please select the best answer)		
Hair cells in the inner ear	16.7	0.0
Q60: How old do you have to be to get hearing loss from loud sounds? (Please select the best answer)		
Any Age	100.0	81.0

Hearing Health Attitudes

The results from the current study suggested participants recognized the importance of having good hearing similar to the results from Zoe (2015). Participants appeared to have concerns regarding their hearing; however, when compared to Zoe (2015), the current study indicated more participants were not as concerned with loud sounds affecting their ears. Fitness instructors reported more often that the preference of class participants was most important (on a scale from 1-4) when selecting the music volume during their instruction. Whereas gym management mandate and standards set by fellow instructors were ranked third and fourth, respectively. As this question was utilized from Zoe, results were compared and the results from that study were the same as the current study, suggesting fitness instructors had flexibility when selecting the volume setting of their music and gym management did not seem to be as important. When asked if they would be willing to give up activities if sound levels were dangerously loud on a scale from 0-10, the average answer selected was 5 and selections ranged from 0 to 10, which was consistent with the Zoe study. This suggested that participants were not as willing to give up activities if they knew sound levels were dangerously loud. However, if preservation of hearing health was prioritized, utilizing methods of hearing protection might alleviate the potential for giving up activities. The statement "people who listen to loud music all the time do not seem to have hearing loss, so I do not have to worry about getting a hearing loss" was utilized from the Zoe study. The average (median) response was *disagree* based on Zoe's data and the average (median) response to the current study was *disagree* as well, suggesting the two studies had similar results.

The survey asked a series of questions about fitness instructors' perceptions of the music in the fitness area. Fitness instructors, on average, found the sound level and music level during their instruction were at a moderate level. However, when asked if the fitness area was louder than it should be, the average response was *sometimes* and when asked if the sound level in their classes was too loud, the average response was *rarely*. These data suggested fitness instructors felt the sound level was related to enhancing patron enjoyment. This suggestion was seen in other studies who found that patrons of fitness classes did report the music level influenced their enjoyment of the class (Torre & Howell, 2008; Wilson & Herbstein (2003). Data from the current study also suggested the fitness instructors felt the choice of sound level communicated the intensity/motivation needed for patrons, which was consistent with the results obtained by Beach and Nie (2014). From the patrons' point of view, results from Torre and Howell (2008) and Beach and Nie (2014) found patrons felt the music level communicated motivation as well. The current study further explored how sound level enhanced patron enjoyment and motivation. Out of all the write-in answers for this question, the majority of answers suggested the intensity and motivation of the type of class was the main reason for choosing the highest volume setting used.

Although this study along with the other studies listed above indicated the sound level increased patron enjoyment and motivation, fitness instructors from this study reported the sound level could sometimes have a negative effect. Specifically, fitness instructors reported the sound level in the fitness area was sometimes louder than it should be, the sound level during instruction sometimes interfered with tracking/guiding/directing the exercise routine, and also interfered with their ability to communicate with patrons. Another study that investigated the possible negative effects of sound levels in fitness classes found a portion of patrons taking the fitness class reported that increased volume could have a stressful effect on them (Beach & Nie, 2014). The results from these questions indicated that although fitness instructors perceived the sound level had a positive effect on patrons' motivation and enjoyment of the class, it also suggested there could be negative effects such as having increased difficulty communicating with the patrons as well as difficulty tracking/guiding/directing the routine.

Overall, there were many reasons to why fitness instructors chose a specific sound level such as increasing patron enjoyment, motivation, and intensity. However, there could be potential negative effects to the sound level like having difficulty communicating with patrons or directing the exercise routine. Based on this study, the majority of participants reported not considering the risk of hearing damage to themselves or their patrons when selecting the volume setting of music played in the fitness class.

Hearing Health Self-Reported Behaviors

The majority of participants reported playing music at a loud level during their instruction. When surveyed if they asked their patrons if the volume was at a comfortable level, the results suggested the fitness instructors occasionally asked patrons with the average leaning toward not asking often, which was consistent with the results from the Zoe (2015) study. When asked if they would try something to protect their ears when around loud sounds during their next class, the majority of fitness instructors in the current study responded they probably would not do anything. Zoe asked a similar question; however, the query was related to behaviors that might occur any time during the month following their last fitness class and not specifically during fitness classes. Zoe's data suggested that fitness instructors would be willing to try something to protect their ears. The difference in responses between the two studies might have been due to asking about willingness to protect their ears specifically relating to teaching their fitness class (the current study) versus general activities (Zoe study).

For the current study, the majority of participants reported never having conversations about protecting their ears or the possibility of loud sounds damaging their ears. Zoe (2015) asked the same question and found similar responses that fitness instructors were rarely having conversations about protecting their ears; however, the researcher found the participants were occasionally having conversations about the possibility of loud sounds damaging their ears. Although there was a difference in the amount of fitness instructors who were discussing the possibility of loud sounds damaging their ears, there were no responses from either study that indicated fitness instructors were frequently having these discussions. The majority of participants reported not considering the risk of potential hearing damage to themselves or their patrons when selecting your volume setting of the music. However, there were eight participants who did consider it whose main reasons were related to having the music not interfere with the instruction or to make sure the volume was not causing an inconvenience for the patrons. Participants were asked if hearing protection was provided for employees and 100% of participants reported it was never provided and when asked if they utilized hearing protection while instructing or taking a fitness class, 100% also reported never utilizing protection.

The results from the hearing health questions suggested the fitness instructors had some knowledge when it came to sound levels and the potential of hearing damage. However, knowledge was lacking in their ability to identify exactly what sound levels were hazardous. No participants reported utilizing hearing protection when instructing a fitness class and the average response was that most did not take action to protect their ears when sound levels were very loud outside of instructing. Overall, it seemed many fitness instructors had an adequate baseline knowledge about sound levels and hearing damage but did not feel the necessity to develop behaviors to protect their hearing. Based on results from this section, it suggests that because there was a lack of discussion about the possibility of loud sounds damaging their ears or protecting their ears when around loud sounds, no methods were in place for protecting their hearing when instructing. Perhaps if more discussion was had regarding sound levels and hearing protection, more fitness instructors would be concerned with the risk of potential hearing damage with the goal of implementing safe and appropriate methods to protect the hearing of those in the fitness classes.

Vocal Health

Vocal Health Knowledge

Of the five symptoms listed, the highest proportion of participants selected a raspy voice, followed by hoarse voice, was a symptom of vocal damage and over half of participants selected that coughing was also a symptom. However, breathy voice (24%) and trouble swallowing (20%) was not selected by the majority. Although the majority of participants were not concerned with having their voice damaged due to overuse, their write-in responses suggested they knew of factors that could affect/impact their vocal health and were aware of methods they could use to preserve their voice after instruction. The main themes explained by fitness instructors as ways that could affect/impact vocal health were overusing voice, the environment where they taught, the music and patron sound levels, and the use and quality of the microphone. The main themes reported by fitness instructors on ways to preserve their voice after instruction were hydration, vocal rest, and monitoring vocal use. All but three responses to these two questions were appropriate responses on ways one could preserve their voice and what factors could affect/impact their voice. In addition, based on their write in responses and their answers on selecting symptoms of vocal problems, fitness instructors seemed to have adequate knowledge about vocal effort and potential of laryngeal damage. However, they appeared to lack knowledge on other symptoms of vocal problems and could benefit from further knowledge on vocal health.

Vocal Health Attitudes

All but one participant reported they had not had voice problems that had affected their emotions and quality of life with the one participant who reported having voice problems explaining, “Sometimes feel anxious about how I sound to participants if my voice is scratchy & not soothing.” Similar results were seen in the study by Rumbach (2013) who had fitness instructors answer the same question and results indicated fitness instructors’ voice problems affected their quality of life and emotions (frustration, sadness, and concern with regard to the longevity of their teaching career were of concern). The results from the current study along with the Rumbach study suggested voice problems could affect fitness instructors’ emotions and quality of life. Participants were asked about the risk of potential vocal fatigue when selecting the volume setting of the music and the majority selected that they did not consider the risk. On average the participants in the current study were not willing to give up activities they knew had the potential to cause vocal damage and most were not concerned about overusing their voice. Although there seemed to be a lack of concern regarding their vocal use, over half of participants were interested in learning more about vocal damage and how best to protect themselves from vocal disorders.

Participants’ attitudes about vocal effort and the potential of laryngeal damage suggested most were not concerned about overusing their voice or protecting their voice even if they knew they would be in a position that could cause vocal damage.

Vocal Health Self-Reported Behaviors

Participants utilized a vocal effort scale to rate their vocal effort on a scale from 0-10 (low to high effort) during the last fitness class they instructed. The average rating was 4.5 with the highest report being 7 (12% of participants) and the lowest being 2 (4% of participants), suggesting some fitness instructors were not utilizing a high amount of vocal effort but a few appeared to be utilizing a high amount of vocal effort when instructing. Specifically, the data suggested that on average, some fitness instructors frequently needed to raise their voice when instructing so patrons could hear them. Although some needed to raise their voice when talking during a fitness session, on average, participants reported they *sometimes* utilized a microphone with the largest percentage of respondents (32%) reporting they never utilized one.

Similar to the question from Rumbach (2013), participants were asked to select vocal symptoms that have applied to their situation. The difference for the current study was the inclusion of the option to select that none of the situations listed applied to them due to the fact that to be included in the Rumbach study, participants were required to have a diagnosed vocal disorder while in the current study they did not have this requirement. Over half of participants from the current study reported that none of the listed vocal symptoms applied to them. For those participants who did report vocal issues, symptoms were reported as *feelings of discomfort when speaking, a reduced ability to speak for long periods,* and *difficulty being heard*. However, participants in the Rumbach study reported vocal symptoms including *periods of complete voce loss* and *difficulties being heard* most often. For the eight participants in the current study who reported considering the risk of potential vocal fatigue when selecting the music volume, all but one reported they took into consideration the potential level of vocal effort utilized when instructing so they did not have to increase their effort over the music.

Data from the vocal effort scale indicated that although 15 participants reported utilizing a moderate amount of vocal effort during fitness class instruction (values of 4 or lower), 10 participants selected a higher value on the scale (values of 5-7), suggesting some fitness instructors used a high amount of vocal effort when instructing. It is likely high levels of vocal effort contributed to the vocal symptoms experienced by many of the participants.

The results from the vocal health section suggested fitness instructors had adequate knowledge about vocal effort and the potential of vocal damage. Specifically, participants reported knowledge on what circumstances could cause potential damage to their voice and the majority seemed to know various methods they could use to preserve their voice after instructing for the day. However, the majority of participants were not concerned about overusing their voice or had the intention to protect their voice if in a circumstance that might cause vocal damage. With regard to their behaviors, the majority of participants reported not considering the risk of potential vocal fatigue when selecting the volume setting of the music while the majority of participants reported they had to raise their voice when instructing even when utilizing a microphone. As for the auditory system, fitness instructors appeared to have knowledge about vocal effort and the potential of vocal damage but they did not seem to want to make positive changes to protect their vocal health.

Post-Instruction Vocal Symptoms

As stated previously in the results section, there was an oversight when importing the questions to Qualtrics such that the questions relating to symptoms of hearing damage were not included. Due to the oversight, the results for Research Question 3 only pertained to vocal damage fitness instructors had experienced immediately following fitness class instruction.

Two questions from this section (Q24-Q26) were adapted from Rumbach (2013). Of 56% of current participants who reported experiencing vocal problems after instructing their last class of the day, only five reported adjusting their teaching methods in response and zero participants selected altering their work program, i.e., changing the programs they taught. Rumbach (2013) asked the same questions to group fitness instructors and found 81.58% of their participants (31 instructors) reported adjusting their patterns of vocal use during teaching. Adjusting their vocal use patterns included altering their work program by no longer teaching classes that required higher levels of vocal effort, reducing overall class hours, improving general vocal hygiene, and increasing nonverbal cueing. Altering work programs by no longer teaching classes that required higher levels of vocal effort was the least selected adjustment method by participants from that study. When comparing the two studies, they were similar in the fact the instructors did not appear to alter their work program by changing the programs they taught due to voice problems.

Based on the fitness instructor responses for this section, some fitness instructors in the current study reported experiencing vocal problems after instructing their last fitness class of the day. Although the majority said their voice felt “good, very good, or excellent” after instructing, over half of participants had experienced vocal problems after teaching; yet most did not adjust their teaching methods due to their vocal problems. Results indicated 66.8% of fitness instructors did not consider the risk of potential vocal fatigue when selecting the volume setting of the music. Given those data, there could be a potential connection between the sound levels chosen during instruction and the amount of vocal effort required to instruct for the duration of the class. A study conducted by Stowe and Golob (2013) suggested ambient noise containing speech-similar frequencies could cause significant parameter changes in a person’s speech output such as intensity and duration. If fitness instructors are playing music with speech-similar frequencies, they then could be increasing their vocal effort to get their instruction across to participants. Based on previous literature, vocal effort was defined as the perceived exertion of a vocalist's response to a perceived communication scenario (Hunter et al., 2020). The fact that 54.2% of participants from the current study reported playing amplified music *loud* and reported difficulty communicating with patrons due to the sound level, it is suggested the amount of vocal effort needed to instruct during the whole class period could lead to potential vocal problems, especially if teaching multiple times a day.

Strengths and Weaknesses of the Study

Strengths

A strength of this study included having participants from a wide range of ages. In addition, another strength was including fitness instructors who taught a variety of fitness classes.

Weaknesses

There was researcher oversight when importing the survey to the online Qualtrics platform as the questions relating to symptoms of hearing damage were not included. Due to this oversight, participants only answered questions relating to vocal damage they had experienced immediately following their fitness class instruction while not reporting on symptoms of hearing damage. Another weakness was the researcher was not able to directly measure sound levels or vocal effort of fitness instructors during their instruction. Such objective data would be useful in determining real risk to the auditory or vocal systems.

Future studies might benefit by asking why fitness instructors did not utilize hearing protection or utilize a microphone when instructing.

Potential Benefits for Fitness Instructors

Fitness instructors could benefit from greater education with regard to vocal and hearing health. For this study, over half of participants reported they would be interested in learning more about vocal damage, how best to protect themselves from voice disorders, the effects of noise on their hearing, and how to best protect themselves from hearing damage from loud sounds.

No participants reported utilizing hearing protection even when teaching with high sound levels of music. Fitness instructors could benefit from greater education on how to care for their hearing, i.e., having more information on hearing protection devices, specifically types of hearing protection devices that could be worn without affecting their performance as a fitness instructor as very few knew where to obtain hearing protection and no participants reported on what *type* would be best for their occupation. The type of hearing protection that would be best for fitness instructors would be flat attenuation ear plugs Niquette (2007) defined as an equal reduction in sound across frequency. This type of hearing protection would not affect their ability to convey instructions to patrons and would not alter the clarity and perceived enjoyment of the music as the music would only sound quieter. Having the availability of ear plugs at the fitness studios might provide hearing health benefits for instructors as well as patrons. In addition, further education about the hazards of high sound levels could create increased discussion between friends/colleagues/patrons about the risk of damage to the auditory system and therefore could create positive changes within the studios that focus on protecting themselves and their patrons from hearing damage.

Furthermore, over half of participants reported experiencing vocal problems after instructing their last class of the day with some having the symptom of a reduced ability to speak for long periods and one participant reporting periods of complete voice loss. Participants would benefit from greater knowledge about vocal effort and associated vocal fatigue as well as information regarding alternative methods of teaching such as having a microphone system at their studio.

Conclusions

Fitness instructors took part in a questionnaire regarding their knowledge, attitudes, and behaviors for two different instances: (a) perceived sound levels and potential of hearing damage and (b) perceived vocal effort and potential of laryngeal damage. In addition, participants were asked to answer questions regarding instances of vocal symptoms suggestive of potential vocal damage immediately following their fitness class instruction.

Although most of the fitness instructors in this study showed knowledge on how to care for their voice and some had knowledge on how to protect their hearing, some did not feel the necessity to develop behaviors or change their attitudes to protect their hearing and vocal health. In addition, for those who had experienced vocal problems after instructing, most reported they did not adjust their teaching methods due to their vocal problems. Based on this study, fitness instructors could benefit from education about sound levels and vocal health to change their attitudes and adopt safer behaviors.

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APPENDIX A

GLOSSARY

A Weighting: ‘A’ Weighting is a standard weighting of the audible frequencies designed to reflect the response of the human ear to noise. The ‘A’ Frequency Weighting network is the most widely used and is used to represent the response of the human ear to loudness. Measurements made with this frequency weighting will typically be displayed as dB(A) or dBA. For example, as LAeq, LAFmax, LAE etc where the A shows the use of ‘A’ Weighting (Cirrus Research plc, 2015).

Action Level (AL): An 8-hour time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently, a dose of fifty percent (OSHA)

Comfortable Vocal Dynamic Range (CVDR): Participant generates a low-intensity vocal production of /a/ to a high-intensity vocal production of /a/ without screaming or singing. This will represent the participants’ CVDR.

Comfortable Vocal Dynamic Range Max (CVDRMax): Measuring the lowest consistent voicing amplitude level (scaled to 0% of dynamic range) as well as the maximum vocal amplitude (100% of dynamic range, or comfortable vocal dynamic range maximum (CVDRMax)) during the calibration task.

C Weighting: ‘C’ weighting gives much more emphasis to low frequency sounds than the ‘A’ weighting response and is essentially flat or linear between 31,5Hz and 8kHz, the two -3dB or ‘half power’ points. In addition, Peak Sound Pressure measurements are made using the ‘C’ Frequency Weighting. Measurements made with this frequency weighting will typically be displayed as dB(C) or dBC. For example, as LCeq, LCPeak, LCE etc where the C shows the use of ‘C’ Weighting (Cirrus Research plc, 2015).

Decibel, A-Weighted (dBA): Unit representing the sound level measured with the A-weighting network on a sound level meter (NIOSH, 1988)

Decibel (dB): Unit of level when the base of the logarithm is the 10th root of 10 and the quantities concerned are proportional to power (ANSI S1.1-1994: decibel) (NIOSH, 1988)

Dose: The amount of actual exposure relative to the amount of allowable exposure, and for which 100% and above represents exposures that are hazardous (NIOSH, 1988)

Equivalent Continuous Sound Level (Leq): Leq is the equivalent continuous sound level and represents the total sound exposure for the period of interest or an energy average noise level for the period of interest. Leq is often described as the "average" noise level during a noise measurement which although not technically correct, is often the easiest way to think of Leq. If the noise is varying quickly, the average energy over a period of time is a useful measurement parameter and it is for this reason Leq is often called the Equivalent continuous level. Leq values should be written with a Frequency Weighting, such as dB(A) and also the measurement duration (Cirrus Research plc, 2015).

Estimated Dose or Est Dose %: The % dose projected forwards over an 8-hour period. (Cirrus Research plc, 2015).

Exchange Rate: An increment of decibels that requires the halving of exposure time, or a decrement of decibels that requires the doubling of exposure time. For example, a 3-dB exchange rate requires that noise exposure time be halved for each 3-dB increase in noise level; likewise, a 5-dB exchange rate requires that exposure time be halved for each 5-dB increase (NIOSH, 1988)

Frequency: For a function periodic in time, the reciprocal of the period. Unit, hertz (Hz) (ANSI S1.1-1994: frequency). (NIOSH, 1988)

Hertz (Hz): Unit of measurement of frequency, numerically equal to cycles per second (OSHA)

LAFmax: The maximum Sound Level with ‘A’ Frequency weighting and Fast Time weighting during the measurement period (Cirrus Research plc, 2015).

LAFmin: The minimum Sound Level measured with ‘A’ frequency weighting and Fast Time weighting during the measurement period (Cirrus Research plc, 2015).

LAVG: The Time Averaged Sound Level with an exchange rate other than 3dB (Cirrus Research plc, 2015).

Lmax: Maximum Sound Level (Cirrus Research plc, 2015).

Lmin: Minimum Sound Level (Cirrus Research plc, 2015).

Lombard Effect: Researchers have more recently defined the Lombard effect as the tendency for speakers to increase pitch, intensity, and duration in the presence of noise (Patel & Schell, 2008)

Maximum Sound Level (Lmax): Maximum Sound Level. The maximum noise level during a measurement period or a noise event (Cirrus Research plc, 2015).

Minimum sound level (Lmin): Minimum Sound Level. The minimum noise level during a measurement period or a noise event (Cirrus Research plc, 2015).

Muscle Fatigue: Cause increased tension in the vocal folds which is due to depletion or accumulation of biochemical substances in the muscle fibers (Bottalico, 2016)

National Institute of Occupational Safety and Health (NIOSH): Is charged with recommending occupational safety and health standards and describing exposure concentrations that are safe for various periods of employment—including but not limited to concentrations at which no worker will suffer diminished health, functional capacity, or life expectancy as a result of his or her work experience. By means of criteria documents, NIOSH communicates these recommended standards to regulatory agencies (including the Occupational Safety and Health Administration [OSHA]) and to others in the occupational safety and health community. Recommend nose exposure limit for workers is 85 dBA (8-hour time weighted average, equaling 100% dose) (NIOSH, 1988)

Noise: (1) Undesired sound. By extension, noise is any unwarranted disturbance within a useful frequency band, such as undesired electric waves in a transmission channel or device. (2) Erratic, intermittent, or statistically random oscillation (ANSI S1.1-1994: noise). (NISOH, 1988)

Occupational Safety and Health Administration (OSHA): In the Occupational Safety and Health Act of 1970 (Public Law 91-596), Congress declared that its purpose was to assure, so far as possible, safe and healthful working conditions for every working man and woman and to preserve our human resources (NIOSH, 1988)

Occupational Voice Users: "Those who depend on a consistent, special, or appealing voice quality as a primary tool of trade, and those who, if afflicted with dysphonia or aphonia, would generally be discouraged in their jobs and seek alternative employment" (Titze et al, 1997, p. 254)

Peak Sound Pressure: This function is often confused with the maximum Sound Level. Whereas the maximum is the highest sound level, the Peak level is the actual peak level of the pressure wave. The reason for this is that the maximum sound level is the RMS level with a time constant (F,S or I) applied, whereas the Peak is the highest point of the pressure wave before any time constant is applied (Cirrus Research plc, 2015).

Permissible Exposure Limit (PEL): The A-weighted sound level at which exposure for a criterion time, typically 8 hours, accumulates a 100# noise dose. Only sounds 90 dBA and higher are integrated into the PEL (i.e., the threshold level is 90 dBA). (OSHA, 1983)

Sound: 1) Oscillation in pressure, stress, particle displacement, particle velocity, etc. in a medium with internal forces (e.g., elastic, or viscous), or the superposition of such propagated oscillations. 2) Auditory sensation evoked by the oscillation described above (ANSI S1.1-1994: sound) (NIOSH, 1988)

Sound Intensity: Average rate of sound energy transmitted in a specified direction at a point through a unit area normal to this direction at the point considered. Unit, watt per square meter (W/m2); symbol, I (ANSI S1.1-1994: sound intensity; sound-energy flux density; sound power density) ((NIOSH, 1988)

Sound Intensity Level: Ten times the logarithm to the base ten of the ratio of the intensity of a given sound in a stated direction to the reference sound intensity of 1 picoWatt per square meter (pW/m2).Unit, dB; symbol, L (ANSI S1.1-1994: sound intensity level) (NIOSH, 1988)

Sound Pressure: Root-mean-square instantaneous sound pressure at a point during a given time interval. Unit, Pascal (Pa) (ANSI Sl.1-1994: sound pressure; effective sound pressure). (NIOSH, 1988)

Sound Pressure Level (SPL): Expressed in decibels, is a measure of the amplitude of the pressure change that produces sound. This amplitude is perceived by the listener as loudness (NIOSH, 1988)

Time-Weighted Average (TWA): The averaging of different exposure levels during an exposure period (NIOSH, 1988)

Tissue Fatigue: Takes place in the non-muscular tissue layers and is caused by changes in the molecular structure that results from mechanical loading and unloading (Bottalico, 2016)

Vocal Demand (Vocal Load): "“Vocal demand” is the vocal requirement for a given communication scenario, and it is independent of the vocalist’s physiology, production technique, or perception of the scenario. The “vocal demand” can be defined in terms of the description of the scenario (e.g., communicative purpose, complexity of material, listeners, environment, social/emotional situation) as well as in terms of the vocal content (propagating vocal acoustic signal) required to satisfy a communicative scenario (e.g., dB SPL, spectral content, accumulation and modulation over time of several voice parameters)” (Hunter et al., 2020 p. 515)

Vocal Demand Response (Vocal Loading): “Vocal demand response” is the way voicing is produced by an individual in an attempt to respond to a perceived “vocal demand” within a communication scenario. “Vocal demand response” is defined to include the process and product of phonation as determined by individual factors (e.g., physiological and psychological capacity of phonation). “Vocal demand response” would be described in terms of subjective and objective qualities, such as the sense of exertion and effort combined with physiological phonation in the context of a “vocal demand.” “Vocal demand response” would be dependent on individual attributes such as vocal health status, vocal capacity and training (baseline vocal aptitude), perceived communicative intent, communicative complexity, social/emotional state, self-auditory perception/feedback, and perceived room acoustics. Its individualized nature may result in one person experiencing a higher physiological demand (mechanical load, potentially overload) on the vocal system, thereby partially explaining a disparity of vocal injury between vocalists given similar “vocal demand.”” (Hunter et al., 2020 p. 516)

Voice disorder: A voice disorder exists when quality, pitch, loudness, or flexibility differs from the voices of others of similar, age, sex, and cultural group" (Aronson, 1985, p.6).

Vocal Effort: "Vocal effort" is the perceived exertion of a vocalist's response ("vocal demand response") to a perceived communication scenario ("vocal demand"). By defining "vocal effort" as the vocalists' perception of exertion and work associated with voice production, it is by definition measured via self-report." (Hunter et al., 2020 p. 517)

Vocal Fatigue: "Vocal fatigue" is the perceived measurable symptom that influences vocal task performance and is individual specific; it is a multifaceted concept integrating self-perceived vocal symptoms and/or physiologic deficit, which may be a result of high "vocal demand response," high "vocal effort," or neuromuscular deficit." (Hunter et al., 2020 p. 518)

Z Weighting: This has replaced Linear or Flat, and is defined as being a flat frequency response of 8Hz to 20kHz ±1.5dB. Measurements made with this frequency weighting will typically be displayed as dB(Z) or dBZ. For example, as LZeq, LZFmax, LZE etc where the Z shows the use of 'Z' Weighting (Cirrus Research plc, 2015).

APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

Date:	02/28/2021
Principal Investigator:	Ashley Bautista
Committee Action:	**IRB EXEMPT DETERMINATION – New Protocol**
Action Date:	02/28/2021
Protocol Number:	2011017166
Protocol Title:	Relationships between ambient noise levels and vocal effort when working as a fitness instructor
Expiration Date:	

The University of Northern Colorado Institutional Review Board has reviewed your protocol and determined your project to be exempt under 45 CFR 46.104(d)(702) for research involving

Category 2 (2018): EDUCATIONAL TESTS, SURVEYS, INTERVIEWS, OR OBSERVATIONS OF PUBLIC BEHAVIOR. Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met: (i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects; (ii) Any disclosure of the human subjects' responses outside the research would not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, educational advancement, or reputation; or (iii) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects can readily be ascertained, directly or through identifiers linked to the subjects, and an IRB conducts a limited IRB review to make the determination required by 45 CFR 46.111(a)(7).

You may begin conducting your research as outlined in your protocol. Your study does not require further review from the IRB, unless changes need to be made to your approved protocol.

As the Principal Investigator (PI), you are still responsible for contacting the UNC IRB office if and when:

UNIVERSITY OF
NORTHERN COLORADO

Institutional Review Board

- You wish to deviate from the described protocol and would like to formally submit a modification request. Prior IRB approval must be obtained before any changes can be implemented (except to eliminate an immediate hazard to research participants).
- You make changes to the research personnel working on this study (add or drop research staff on this protocol).
- At the end of the study or before you leave The University of Northern Colorado and are no longer a student or employee, to request your protocol be closed. *You cannot continue to reference UNC on any documents (including the informed consent form) or conduct the study under the auspices of UNC if you are no longer a student/employee of this university.
- You have received or have been made aware of any complaints, problems, or adverse events that are related or possibly related to participation in the research.

If you have any questions, please contact the Research Compliance Manager, Nicole Morse, at 970-351-1910 or via e-mail at nicole.morse@unco.edu. Additional information concerning the requirements for the protection of human subjects may be found at the Office of Human Research Protection website - http://hhs.gov/ohrp/ and https://www.unco.edu/research/research-integrity-and-compliance/institutional-review-board/.

Sincerely,

Nicole Morse
Research Compliance Manager

University of Northern Colorado: FWA00000784

APPENDIX C

RECRUITMENT LETTER

Hello,
My name is Ashley Bautista and I am a graduate student in the Doctor of Audiology program at the University of Northern Colorado. I am currently conducting a research project on fitness instructors and their hearing and vocal health. The goal of this project is to gain more information about music levels and vocal use relating to fitness classes. I have created a questionnaire that takes about 20 minutes to complete (see link below).
If you complete the questionnaire, you could be entered to win one of two **$50 Amazon gift cards!** Two $50 Amazon gift cards will be a part of this giveaway. After the questionnaire has been completed, you will be asked if you would like to enter your email for the randomized drawing. Your email will have no direct link to the questionnaire. The Amazon gift card drawing is optional, and you are not required to participate if you do not want to.
Inclusion Criteria:

- If you are 18 years old or older
- Are currently (or recently have been) employed as a fitness instructor (teaching classes such as spin, Zumba, barre, yoga, etc.)
- Do not have a preexisting hearing or voice (laryngeal) impairment or injury that was diagnosed prior to your employment as a fitness instructor diagnosed by a physician, speech-language pathologist, or audiologist.
  - If you currently have a hearing/voice impairment or injury that has not been diagnosed or has been diagnosed during your employment as a fitness instructor by a physician, speech-language pathologist, or audiologist you *are eligible* to participate in this study.
  - If you have had a hearing/vocal impairment or injury that was diagnosed prior to your employment as a fitness instructor by a physician, speech-language pathologist, or audiologist you are *not eligible* to participate in this study.
  - If you do not have any hearing/vocal impairment or injury you *are eligible* to participate in this study.

We take confidentiality very seriously, so all answers and responses will be anonymous.
In addition, if you could share this email/link to other fitness instructors that might be willing to participate, it would be greatly appreciated!
Here is the link for the questionnaire:
https://unco.co1.qualtrics.com/jfe/form/SV_d3WMDNMYuk2VI8e

Please feel free to contact me if you have further questions,
Ashley Bautista
Doctor of Audiology Graduate Student, University of Northern Colorado
baut1953@bears.unco.edu

APPENDIX D

INFORMED CONSENT FORM

UNIVERSITY OF
NORTHERN COLORADO
Institutional Review Board

INFORMED CONSENT FORM FOR PARTICIPANTS IN RESEARCH STUDY

Project Title: Relationships Between Ambient Noise Levels and Vocal Effort When Working as a Fitness Instructor

Graduate Student Researcher: Ashley Bautista
Phone: (719) 229-8529
Email: baut1953@bears.unco.edu

Research Advisor: Donald Finan, Ph.D.
Phone: (970) 351-1897
Email: Donald.Finan@unco.edu

We would like to ask you to participate in this research study that is being conducted through the University of Northern Colorado. The survey will take approximately 20 minutes to complete. There are several categories that ask questions based on: general information, your self-perception of sound levels and vocal effort, and your knowledge of hearing and hearing health.

We take confidentiality very seriously, so responses will be anonymous and kept confidential. There are no questions pertaining to your place of employment, personal information, or geographical area of which you live.

If you complete the questionnaire, you could be entered to win one of two **$50 Amazon gift cards!** Two $50 Amazon gift cards will be a part of this giveaway. After the questionnaire has been completed, you will be asked if you would like to enter your email for the randomized drawing. Your email will have no direct link to the questionnaire. The Amazon gift card drawing is optional, and you are not required to participate if you do not want to.

This research study is voluntary, so we thank you for being willing to participate. You may decide not to participate in this study and if you begin participation you may still decide to stop and withdraw at any time. Your decision will be respected and will not result in loss of benefits to which you are otherwise entitled. Your decision will not affect the status or conditions of your employment.

Inclusion Criteria:

- If you are 18 years old or older
- Are currently (or recently have been) employed as a fitness instructor (teaching classes such as spin, Zumba, barre, yoga, etc.)
- Do not have a preexisting hearing or voice (laryngeal) impairment or injury prior to your employment as a fitness instructor diagnosed by a physician, speech-language pathologist, or audiologist.
  - If you currently have a hearing/voice impairment or injury that has not been diagnosed or has been diagnosed during your employment as a fitness instructor by a physician, speech-language pathologist, or audiologist you *are eligible* to participate in this study.
  - If you have had a hearing/vocal impairment or injury that was diagnosed prior to your employment as a fitness instructor by a physician, speech-language pathologist, or audiologist you are *not eligible* to participate in this study.
  - If you do not have any hearing/vocal impairment or injury you *are eligible* to participate in this study.

If you have further questions about this research project, please feel free to contact Ashley Bautista using the contact information at the top of this consent form.

If you have any concerns about your selection or treatment as a research participant, please contact Nicole Morse, Research Compliance Manager, University of Northern Colorado at nicole.morse@unco.edu or 970-351-1910.

APPENDIX E

QUESTIONNAIRE

Consent
Q1 Do you agree to the consent form? By selecting yes, you have agreed that you have read the consent form and agree to continue to the questionnaire.

○ Yes, I consent (1)

○ No, I do not consent (2)

Questionnaire
Start of Block: Inclusion Criteria
Q1 How old are you?

○ 17 or Younger (1)

○ 18-24 (2)

○ 25-34 (3)

○ 35-44 (4)

○ 45-54 (5)

○ 55-64 (6)

○ 65 or Older (7)

Q2 **Prior** to your employment as a fitness instructor, have you ever been officially diagnosed with a hearing loss by an audiologist or physician?

○ Yes (1)

○ No (2)

Q3 **Prior** to your employment as a fitness instructor, have you ever been officially diagnosed as having a vocal disorder by a speech language pathologist or physician?

○ Yes (1)

○ No (2)

End of Block: Inclusion Criteria
Start of Block: General Questions

Q4 Have you ever been officially diagnosed with a hearing loss by an audiologist or physician **while being employed as a fitness instructor?**

- ◯ Yes (1)
- ◯ No (2)

Display This Question:
If Have you ever been officially diagnosed with a hearing loss by an audiologist or physician while... = Yes

Q5 If you answered yes to the previous question, have you sought out help from a speech language pathologist, audiologist, or physician for your hearing loss?

- ◯ Yes (1)
- ◯ No (2)

Q6 Have you ever been officially diagnosed as having a vocal disorder by a speech language pathologist or physician **while being employed as a fitness instructor**?

- ◯ Yes (1)
- ◯ No (2)

Display This Question:
If Have you ever been officially diagnosed as having a vocal disorder by a speech language pathologi... = Yes

Q7 If you answered yes to the previous question, have you sought out help from a speech language pathologist or physician?

- ◯ Yes (1)
- ◯ No (2)

Q8 To which gender do you most identify?

- ◯ Male (1)

○ Female (2)

○ Other (3) ____

○ Prefer not to say (4)

End of Block: General Questions

Start of Block: General Questions

Q9 What type of fitness class(es) do you teach? **Select all that apply.**

▢ Aerobics (Step, Dance, Zumba, Aqua) (1)

▢ Spin/Cycle (2)

▢ Yoga (3)

▢ Aerial Fitness (4)

▢ Kickboxing (5)

▢ Body Pump (6)

▢ Pilates (7)

▢ Basic Training/Circuit (8)

▢ Barre (9)

▢ Personal Trainer (10)

▢ Other (please specify) (11)
____

Q10 What is the average duration of an individual class that you teach?

- ◯ 30 Minutes (1)
- ◯ 45 Minutes (2)
- ◯ 60 Minutes (3)
- ◯ 90 Minutes or More (4)

Q11 Do you play amplified music?

- ◯ Yes (1)
- ◯ No (2)

Display This Question:
If Do you play amplified music? = Yes

Q12 If you answered yes to the previous question, how loud is the music that you play?

- ◯ Quiet (1)
- ◯ Moderate (2)
- ◯ Loud (3)

Q13 On average, how many classes do you teach per day?

____

Q14 On average, how many classes do you teach per week?

____

Q15 Have you ever been concerned about having your ears damaged due to loud sounds?

- ◯ Yes (1)
- ◯ No (2)

Q16 Have you ever been concerned about having your voice damaged by overuse?

- ◯ Yes (1)
- ◯ No (2)

End of Block: General Questions

Start of Block: Vocal Self-Perception Questions

Q17
Utilizing the graph below, how would you rate your vocal effort during the last fitness class you instructed?
To anchor the 0-point, think only of the amount of vocal effort when speaking quietly to someone sitting close to you in a quiet room. Think only of *vocal effort* and not the *mental effort* or concentration it took to produce effortless voice.
To anchor the 10-point, think of it as the amount of vocal effort or strain you feel when you have laryngitis and can barely get sound out, even with a lot of strain.

Maximum Vocal Effort 10
Very Very Severe Vocal Effort (Almost Maximum) 9
Very Severe Vocal Effort 8 7 6
Severe Vocal Effort 5
Somewhat Severe Vocal Effort 4
Moderate Vocal Effort 3
Slight Vocal Effort 2
Very Slight Vocal Effort 1
Very Very Slight Vocal Effort (Just Noticeable) .5 0

- ◯ 0 (2)
- ◯ 1 (3)
- ◯ 2 (4)
- ◯ 3 (5)

- 4 (6)
- 5 (7)
- 6 (8)
- 7 (9)
- 8 (10)
- 9 (11)
- 10 (12)

Q18 Do you have to raise your voice when instructing in order for patrons to hear you?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Frequently (4)
- Always (5)

Q19 Do you utilize a microphone when instructing a fitness class?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Frequently (4)
- Always (5)

Q20 Does your area of employment provide a microphone for you to utilize when instructing?

- ◯ Never (1)
- ◯ Rarely (2)
- ◯ Sometimes (3)
- ◯ Frequently (4)
- ◯ Always (5)

Q21 Is utilizing a microphone mandatory for all instructors at your area of employment?

- ◯ Never (1)
- ◯ Rarely (2)
- ◯ Sometimes (3)
- ◯ Frequently (4)
- ◯ Always (5)

Q22 After instructing your last class of the day, do you feel your voice is:

- ◯ Poor (1)
- ◯ Fair (2)
- ◯ Good (3)
- ◯ Very Good (4)
- ◯ Excellent (5)

Q23 Have you ever experienced vocal problems (loss of voice, soreness in the throat, hoarseness, roughness, lower than normal voice pitch, tired/fatigued voice, etc.) after instructing your last class of the day?

- Yes (1)
- No (2)

Display This Question:
If Have you ever experienced vocal problems (loss of voice, soreness in the throat, hoarseness, roug... = Yes

Q24 If you answered yes to the previous question, please select the words that describe your throat symptoms (if any):

- Burning (1)
- Aching (2)
- Tickling (3)
- Dry (4)
- Tight (5)
- Irritable (6)
- Sore (7)
- Lump in the throat (8)
- Other (9) ____
- None (10)

Display This Question:
If Have you ever experienced vocal problems (loss of voice, soreness in the throat, hoarseness, roug... = Yes

Q25 If you answered yes to the previous question, have you adjusted your teaching method due to your current or previous voice problems?

○ Yes (1)

○ No (2)

Display This Question:
If If you answered yes to the previous question, have you adjusted your teaching method due to your... = Yes

Q26 If you answered yes to the previous question, please indicate the way you adjusted your method of teaching. Select those that are applicable:

▢ Reduce teaching hours (1)

▢ Talk less in class, that is, increase nonverbal cueing (2)

▢ Alter work program, that is, change the programs that you teach (3)

▢ Improve voice care/vocal hygiene (4)

▢ Other (please specify) (5) ____

Q27 Please select any that apply to your situation.

I have had:

▢ Feelings of discomfort when speaking (1)

▢ Feelings of pain when speaking (2)

▢ A reduced ability to speak for long periods (3)

▢ Periods of complete voice loss (4)

▢ Difficulty being heard/getting my message across (frequent need to repeat statements) (5)

☐ Other (please specify) (6) ____

☐ None of the above applies to me (7)

Q28 Have you experienced any voice problems that have affected your emotions and quality of life (eg, make you upset, concerned, unsatisfied with your job performance, unsatisfied with the job)?

○ Yes (please specify) (1) ____

○ No (2)

Q29 What factors do you think can affect/impact your vocal health when working as a fitness instructor?

____

Q30 What are ways that you can preserve your voice after instruction?

____

Q31 What are some symptoms of vocal problems? Check all that apply

☐ Raspy Voice (1)

☐ Hoarse Voice (2)

☐ Breathy Voice (3)

☐ Trouble Swallowing (4)

☐ Coughing (5)

End of Block: Vocal Self-Perception Questions

Start of Block: Sound Level Self-Perception Questionnaire

Q32 Do you believe the sound in the fitness area is louder than it should be?

- ◯ Never (1)
- ◯ Rarely (2)
- ◯ Sometimes (3)
- ◯ Frequently (4)
- ◯ Always (5)

Q33 Do you believe the sound level during your instruction is

- ◯ Low (1)
- ◯ Not Loud (2)
- ◯ Moderate (3)
- ◯ Loud (4)
- ◯ Very Loud (5)

Q34 Do you believe the sound level during your classes is too loud/very loud?

- ◯ Never (1)
- ◯ Rarely (2)
- ◯ Sometimes (3)
- ◯ Frequently (4)
- ◯ Always (5)

Q35 Do you believe the volume setting of the music during instruction is:

- ◯ Low (1)

◯ Not Loud (2)

◯ Moderate (3)

◯ Loud (4)

◯ Very Loud (5)

Q36 Do you feel that the sound level during your instruction interferes with tracking/guiding/directing the exercise routine?

◯ Never (1)

◯ Rarely (2)

◯ Sometimes (3)

◯ Frequently (4)

◯ Always (5)

Q37 Do you feel the sound level interferes with your ability to communicate with patrons? (For example, having to repeat instructions to patrons who didn't hear/understand you over the music)

◯ Never (1)

◯ Rarely (2)

◯ Sometimes (3)

◯ Frequently (4)

◯ Always (5)

Q38 Do you feel your choice of sound level(s) enhances patron enjoyment?

◯ Never (1)

◯ Rarely (2)

◯ Sometimes (3)

◯ Frequently (4)

◯ Always (5)

Q39 Do you feel the choice of sound level communicates the exercise intensity/motivation needed for the class patrons?

◯ Never (1)

◯ Rarely (2)

◯ Sometimes (3)

◯ Frequently (4)

◯ Always (5)

Q40 Do you wear hearing protection when you instruct a fitness class?

◯ Never (1)

◯ Rarely (2)

◯ Sometimes (3)

◯ Frequently (4)

◯ Always (5)

Q41 Do you wear hearing protection when you are taking a fitness class?

◯ Never (1)

◯ Rarely (2)

◯ Sometimes (3)

◯ Frequently (4)

◯ Always (5)

Q42 What factors influence your choice of the highest volume setting used:

____

Q43 Does the studio or gym you work at provide hearing protection for employees?

○ Yes (1)

○ No (2)

Display This Question:
If Does the studio or gym you work at provide hearing protection for employees? = Yes

Q44 If you answered yes to the previous question, is hearing protection offered to patrons every class?

○ Yes (1)

○ No (2)

Q45 Do you consider the risk of potential hearing damage to you or your patrons when selecting your volume setting of music played in the fitness class?

○ Yes (1)

○ No (2)

Display This Question:
If Do you consider the risk of potential hearing damage to you or your patrons when selecting your v... = Yes

Q46 If you answered yes to the previous question, please explain how you consider the risk of potential hearing damage to you or your patrons when selecting your volume setting of the music played in the fitness class.

____

Q47 Do you consider the risk of potential vocal fatigue when selecting the volume setting of the music?

- ◯ Yes (1)
- ◯ No (2)

Display This Question:
If Do you consider the risk of potential vocal fatigue when selecting the volume setting of the music? = Yes

Q48 If you answered yes to the previous question, please explain how you consider your risk of potential vocal fatigue when selecting the volume setting.

____

End of Block: Sound Level Self-Perception Questionnaire

Start of Block: Hearing Health, Knowledge, and Beliefs about Hearing

Q49 How many hours do you typically listen to personal music devices (e.g. iPod) each day?

- ◯ 0-1 Hour (1)
- ◯ 1-2 Hours (2)
- ◯ 2-3 Hours (3)
- ◯ 3-4 Hours (4)
- ◯ >5 Hours (5)

Q50 How often do you talk to your friends/colleagues about the possibility of loud sounds damaging your ears?

- ◯ Never (1)
- ◯ Rarely (2)
- ◯ Occasionally (3)
- ◯ Frequently (4)

Q51 How often do you talk to your friends/colleagues about protecting your ears around loud sounds?

- ◯ Never (1)
- ◯ Rarely (2)
- ◯ Occasionally (3)
- ◯ Frequently (4)

Q52 During your next fitness class, will you try something to protect your ears when you are around loud sounds?

- ◯ Definitely no (1)
- ◯ Probably no (2)
- ◯ Probably yes (3)
- ◯ Definitely yes (4)
- ◯ Unsure (5)

Q53 Do you know where to obtain hearing protection and what type of hearing protection is best for fitness instructors?

- ◯ Yes (1)
- ◯ No (2)

Display This Question:
If Do you know where to obtain hearing protection and what type of hearing protection is best for fi... = Yes

Q54 If you answered yes to the previous question, please explain where you know to obtain hearing protection and what type of hearing protection is best for fitness instructors?

____

End of Block: Hearing Health, Knowledge, and Beliefs about Hearing

Start of Block: Hearing Health, Knowledge, and Beliefs about Hearing

Q55 Which of the following types of sounds are typically loud enough to damage your ears (please select all that apply)

- ▢ Gunfire (1)
- ▢ Personal music players (2)
- ▢ Dishwasher (3)
- ▢ Pubs (4)
- ▢ Concerts (5)
- ▢ Fireworks (6)
- ▢ Sporting events (7)
- ▢ Radio (8)
- ▢ Traffic noise (9)
- ▢ Conversations with friends (10)

Q56 Sounds measuring _____ and over can cause hearing loss (please select the best answer)

- ○ 65 decibels dBA (1)
- ○ 70 decibels dBA (2)
- ○ 85 decibels dBA (3)
- ○ 90 decibels dBA (4)
- ○ Not sure (5)

Q57 Which of the following are good ways to protect your ears when you are around loud sounds? (Please select all that apply)

- ☐ Move away from the sound (1)
- ☐ Turn down the volume (2)
- ☐ Put cotton or tissue in your ears (3)
- ☐ Use earplugs or earmuffs (4)
- ☐ None of the above (5)
- ☐ Not sure (6)

Q58 Hearing an extremely loud sound even one time can cause you to lose some hearing

- ○ True (1)
- ○ False (2)
- ○ Not Sure (3)

Q59 Which part of the ear is most commonly damaged by exposure to loud sounds? (Please select the best answer)

- ○ Ear drum (1)
- ○ Eustachian tube (2)
- ○ Hair cells in the inner ear (3)
- ○ Not sure (4)

Q60 How old do you have to be to get hearing loss from loud sounds? (Please select the best answer)

- ○ Over age 40 (1)
- ○ Over age 50 (2)
- ○ Over age 60 (3)

○ Any age (4)

Q61 People who listen to loud music all the time do not seem to have hearing loss, so I do not have to worry about getting a hearing loss.

○ Agree (1)

○ Disagree (2)

○ Not Sure (3)

End of Block: Hearing Health, Knowledge, and Beliefs about Hearing

Start of Block: Hearing and Vocal Health, Knowledge, and Beliefs

Q62 How important is it for you to have good hearing?

○ 0 (0)

○ 1 (1)

○ 2 (2)

○ 3 (3)

○ 4 (4)

○ 5 (5)

○ 6 (6)

○ 7 (7)

○ 8 (8)

○ 9 (9)

○ 10 (10)

Q63 Do you avoid spending time in places with loud sounds?

○ 0 (0)

- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)
- 8 (8)
- 9 (9)
- 10 (10)

Q64 Would you be willing to give up activities if you know that the sound levels are dangerously loud?

- 0 (0)
- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)
- 8 (8)
- 9 (9)
- 10 (10)

Q65 Would you be willing to give up activities if you know that it could cause vocal damage?

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Q66 How often do you take action to protect your ears if sound levels are very loud?

- ○ 0 (0)
- ○ 1 (1)
- ○ 2 (2)
- ○ 3 (3)
- ○ 4 (4)
- ○ 5 (5)
- ○ 6 (6)
- ○ 7 (7)
- ○ 8 (8)
- ○ 9 (9)
- ○ 10 (10)

Q67 How often do you ask class participants if the music volume is at a comfortable level?

- 0 (0)
- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)
- 8 (8)
- 9 (9)
- 10 (10)

Q68 How often do you receive feedback about the music volume in class being too loud?

- 0 (0)
- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)
- 8 (8)

- 9 (9)
- 10 (10)

Q69 Are you concerned about the effects of loud sounds on your hearing?

- 0 (0)
- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)
- 7 (7)
- 8 (8)
- 9 (9)
- 10 (10)

Q70 Are you concerned about over using your voice?

- 0 (0)
- 1 (1)
- 2 (2)
- 3 (3)
- 4 (4)
- 5 (5)
- 6 (6)

- 7 (7)
- 8 (8)
- 9 (9)
- 10 (10)

Q71 Please rank the importance of the following factors (1 being the most important, 4 being the least important) when determining the music volume for the classes you teach.
______ Your personal preferences (1)
______ Class participants' preferences (2)
______ Direction from gym management (3)
______ Standards set by fellow instructors (4)

Q72 Are you interested in learning more about the effects of noise on your hearing and how to best protect yourself from hearing damage from loud sounds?

- Yes (1)
- No (2)

Q73 Are you interested in learning more about vocal damage and how best to protect yourself from voice disorders?

- Yes (1)
- No (2)

End of Block: Hearing and Vocal Health, Knowledge, and Beliefs

Start of Block: Amazon Drawing

Q74 Would you like to participate in the drawing to win one of two $50 Amazon Gift Cards?

- Yes (1)
- No (2)

End of Block: Amazon Drawing

Amazon Gift Card Drawing

Q1 Would you like to be entered in the drawing to have the chance to win one of two $50 Amazon giftcards?

- ◯ Yes (1)
- ◯ No (2)

End of Block: Default Question Block

Start of Block: Email

Q2 You selected that you would like to participate in the drawing. Please enter your email in the box provided to be entered.

____

End of Block: Email