Voices problems in the fitness industry: Factors associated with chronic hoarseness

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Abstract

Purpose: To determine factors associated with chronic hoarseness in Australian group fitness instructors (GFI).

Method: A total of 361 GFI (81 males, 280 females), aged between 18–67 years currently active in the Australian fitness industry, completed a 65-item self-completion questionnaire distributed via SurveyMonkey. Demographic, lifestyle and voice use variables thought to influence vocal health and voice production in the GFI population were examined using logistic regression analyses. GFI’s chronic hoarseness with response options “positive” and “negative” was considered as the outcome variable of interest.

Result: Approximately 39% of the study participants reported having chronic hoarseness. Multivariable logistic regression modelling revealed a set of statistically significant factors associated with chronic hoarseness. These include: younger age, partial voice loss while instructing, partial voice loss after instructing and using vocal volume louder than normal speaking voice whilst instructing.

Conclusion: This study has identified factors associated with the presentation of chronic hoarseness in the Australian GFI population. Prospective studies are required to validate the findings of this study in order to better understand predictive factors of chronic hoarseness among GFI.

Keywords: Voice, dysphonia, professional issues

Introduction

Research has confirmed that voice disorders within the group fitness industry are prevalent, with 44–70% of group fitness instructors (GFI) experiencing a degree of chronic voice difficulty at some point in their career (Long, Williford, Scharff Olson, & Wolfe, 1998; Newman & Kersner, 1998; Rumbach, 2013a). The most common complaint is increased hoarseness (42–77%), with tired voice, weak voice, strained voice, difficulties with high or low notes, low or high speaking voice, limited singing range, loudness decay and the experience of pitch breaks also being reported (Heidel & Torgerson, 1993; Long et al., 1998; Newman & Kersner, 1998; Rumbach, 2013a). These acoustic and sensory-perceptual symptoms have been shown to negatively influence work performance, work efficiency and personal identity (Long et al., 1998; Newman & Kersner, 1998; Rumbach, 2013b; Sapir, Atias, & Shahar, 1990; Sapir, Keidar, & Mathers-Schmidt, 1993).

Voice difficulties in the fitness industry are likely to be of multi-factorial origin, arising from a combination of physiological, psychological and environmental factors (Behlau, Zambon, & Madazio, 2014). This may not be surprising considering the loud work environment (Goel, Lin, Pearse, & Sockalingam, 2009; Yaremchuk & Kaczor, 1999), vocal demands and the degree of forceful glottic closure that occurs when speaking and vigorous exercise occur simultaneously (Koblick, 2004). Despite the industry placing a greater emphasis on the use of technology (i.e. amplification devices and sound systems; Hyde, 2002; IDEA Health and Fitness Association, 2001; Long et al., 1998; MacLellan, Grapes, & Elster, 1987) and building of spaces/facilities with the purpose of housing group fitness activities (Fitness First, 2014; Hyde, 2002), 78% of instructors report experiencing a degree of acute voice change during the course of teaching a 60-minute class (Rumbach, 2013a). Repeated episodes of acute vocal trauma, with or without sufficient time for recovery, can lead to the formation of habitual voicing patterns and contribute to the development of chronic voice difficulties.
Professional and occupational voice users work across a wide range of disciplines and genres, with each industry having specific professional demands that may contribute to both acute and chronic voice problems (Behlau et al., 2014). To date, there has been limited investigation of voice difficulties in the fitness industry; however, the scientific literature has explored voice use in professionals with similar workplace conditions and vocal demands to those of GFIs. A number of studies identify the increased likelihood of physical education teachers developing voice problems (Bermudez de Alvear, Baron, & Martinez-Arquero, 2010; Grillo & Fugowski, 2011; Sliwinska-Kowalska, Niebudek-Bogusz, Fiszer, Los-Spychalska, Kotylo, Szurowska-Przygocka, et al., 2006; Smith, Kirchner, Taylor, Hoffman, & Lemke, 1998), with common vocal activities in coaching such as shouting over distance for long durations without the use of amplification (Smith et al., 1998). Likewise, cheerleaders experience similar vocal demands leading to acute dysphonia, pitch breaks, sore throat and vocal fatigue (Reich, McHenry, & Keaton, 1986). Vocal behaviours, including straining to project the voice without adequate abdominal breath support, hard glottal attack and cheering at an inappropriate/high pitch in the presence of excessive neck and laryngeal tension, indicate a combination of risk factors that increase vocal load and, thus, the likelihood of developing acute and long-term voice problems (Andrews & Shank, 1983; Reich et al., 1986).

These findings provide insight into the potential factors associated with and likely outcomes for the report of vocal difficulties for instructors working within the group fitness industry. However, the inherently different professional demands and vocal loading between GFIs and other occupational voice disorder groups makes their respective voice-related problems fundamentally different. Currently, little is known regarding the impact of exercise on voice function in the short- and long-term and research is yet to systematically examine factors that are correlated with the presentation of chronic voice difficulties in the GFI population who have different physical and vocal demands to other populations previously studied. Therefore, the current study aims to begin remediating this knowledge deficit by determining a set of factors associated with self-report of chronic hoarseness, the most common voice complaint, in the group fitness industry. It is hoped that this information will allow instructors and the industry at large to become more cognisant of behaviours that may be associated with the report of chronic voice symptoms. The long-term objective would be to use the data from this study to inform a prospective investigation of chronic hoarseness that may aid in the establishment of an evidence-based screening or preventative model of voice care targeted to the demands of the industry.

Methods

Procedure

A link to an anonymous online self-report questionnaire (www.surveymonkey.com) was distributed electronically by industry gatekeepers, social media (e.g., Facebook, Twitter) and fitness blogs and remained accessible for 5 months (December 2011–May 2012). The 65-item questionnaire was developed based on previous research (Heidel & Torgerson, 1993; Long et al., 1998) and clinical experience and utilized a combination of dichotomous, multiple choice and open-ended response questions; additional open response fields were included to allow elaboration. Prior to the survey being disseminated, industry-based research was conducted using a small number (n = 10) of GFIs to seek feedback on structure, clarity and relevance of each question. Questions gathered information pertaining to instructor demographics and living habits; group fitness background and experience; teaching characteristics and voice use; and level of voice education. The questionnaire was estimated to take ∼15 minutes to complete. Question and page skip logic was used to create custom paths for each participant to avoid presentation of extraneous questions. Participants were required to provide consent prior to accessing the questionnaire and all data were collected in a de-identified manner so as to encourage participation. Ethical clearance for this study was obtained from The University of Queensland Behavioural and Social Science Ethics Committee (Project Number 2011001249).

Participants

A total of 361 GFIs were recruited from across Australia (81 males and 280 females; aged 18–67 years, mean = 37.3; SD = 1.4) to participate in this study. All participants were earning income from teaching one or more group fitness programs on a weekly basis and, by self-report, had no history of vocal injury prior to employment in the group fitness industry. A total of 412 respondents accessed the questionnaire; of this cohort, 361 respondents provided full biographical details and were, therefore, included in the study.

The total cohort (n = 361) reported working as part of the group fitness industry for an average of 8.5 years (SD = 8.2, range = 1–47), at an average frequency of 7.6 classes per week (SD = 4.9, range = 2–32). Approximately 51% (n = 185) of group fitness instructors reported teaching consecutive classes once per week and up to four consecutive classes 3–times per week, with each class lasting ~60 minutes (range = 30–90 minutes). For 35.2% (n = 127) of respondents, group fitness instruction was their primary occupation and source of income, whilst the remainder (64.8%; n = 234) were largely employed in occupations that also rely heavily on
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Data analysis

This article focuses on the factors associated with chronic hoarseness only, where “chronic” is defined as symptoms lasting in excess of 3 weeks. Respondents were required to indicate whether they believed chronic hoarseness was present or absent. Data presented in this article represent the responses to questions regarding demographics and living habits (questions 1, 2, 4–11), group fitness background (questions 12–16), facility and teaching characteristics and voice use (questions 26, 32, 33, 35–40, 50) (see Supplementary material to be found online at http://informahealthcare.com/doi/abs/10.3109/17549507.2014.987820). The data represented in this study has been included as part of a study of prevalence of self-reported voice symptoms in the GFI population and the original questionnaire in its entirety can be found there (Rumbach, 2013a). For the purposes of this study, only numerical open-ended responses were included in the analysis (questions 13 and 15 only [Supplementary material to be found online at http://informahealthcare.com/doi/abs/10.3109/17549507.2014.987820]; for all fixed response categories, each response was coded using the upper limit of each response category (e.g. for a response category 1–2 years the response was coded as “2” for the purposes of data analysis).

At the completion of the online survey, all data were downloaded to a Microsoft Excel file, coded by the presence or absence of chronic hoarseness and analysed using descriptive statistics and logistic regression modelling with Stata software (version 10.0, 2007). Not all individuals completed each item in the questionnaire; therefore, percentage responses for each question were calculated relative to the total sample size, including the percentages of non-responses.

As the outcome variable (chronic hoarseness) had two response categories (positive [chronic hoarseness present] and negative [chronic hoarseness absent]), binary logistic regression analysis was carried out to examine whether hoarseness was associated with each of the demographic, teaching practice, vocal hygiene and lifestyle variables. Due to low responses, some response categories in questions 9, 10 and 32 (see Supplementary material to be found online at http://informahealthcare.com/doi/abs/10.3109/17549507.2014.987820) were merged for further analysis.

Before constructing the multivariable logistic regression model, collinearity of the explanatory variables was examined using Variance Inflation Factor (VIF) with an admissible value of < 2.0 (Alin, 2010). Variation inflation factors for all the explanatory variables with < 2 suggested suitability for all of them to be included in the multivariable regression model. Multivariable logistic regression analysis was conducted to determine factors independently associated with the presentation of chronic hoarseness. Explanatory variables considerably associated with the outcome variable at significance level $p < 0.1$ on bivariate analysis were included in the base multivariable logistic regression model (Lang, 2007). The sentence should read: A higher significance [$\alpha$] level [10%] was considered for initial variable selection, as a lower [$\alpha$] can often lead to the deletion of important confounders (Greenland, 2008). A backward elimination strategy was implemented to develop the final multivariable model. This process begins with a model containing all the explanatory variables of interest, significant at bivariate level. At each step, the variable with smallest $F$-statistic is deleted to improve the fitted model, with this process being repeated until no further improvement is possible. The final multivariable logistic regression model included only those explanatory variables that were significantly associated with the outcome of interest at the multivariable model. The final model was then adjusted to remove outliers (standardized residuals $> 2.0$). To evaluate the goodness-of-fit of the final multivariable logistic regression model to the data, the Hosmer–Lemeshow (H-L) goodness-of-fit and a receiver operator characteristic (ROC) curve were generated and evaluated.

Results

Chronic hoarseness was reported by 39.6% ($n = 143$) of the total cohort. Of those who reported a degree of chronic voice change ($n = 256$), hoarseness was the most commonly reported symptom at 55.9%.

Characteristics of the GFI population with and without chronic hoarseness

Demographic, lifestyle and voice use variables thought to influence vocal health and voice production in the GFI population were examined to help establish factors that may be associated with GFIs experiences of chronic hoarseness during their time in the industry. The initial list of variables was over-inclusive to ensure all possible variables had been considered. Results comparing the group of GFIs with chronic hoarseness ($n = 142$) and those without chronic hoarseness ($n = 219$) are reported in Tables I–III. Differences between groups were determined using bivariate logistic regression. Two demographic variables, age (years; $p = 0.001$) and years in the industry ($p = 0.046$) were found to be significantly and negatively associated with chronic hoarseness (see Table I); With each year increase in age, the odds of presenting with hoarseness are reduced by 4% (95% CI = 0.94–0.99) and the odds of presenting with hoarseness are reduced by 3% (95% CI = 0.95–0.99) with each additional year working as a GFI.

Further differences between groups were identified for variables relating to teaching practices.
Table I. Bivariate logistic regression of demographic characteristics for Group Fitness Instructor (GFI) who did and did not report experiencing chronic hoarseness.

| Population variable               | Chronic hoarseness (n = 142) | No chronic hoarseness (n = 219) | Unadjusted OR (95% CI) |
|----------------------------------|------------------------------|---------------------------------|------------------------|
|                                  | Mean ± SD  n   %             | Mean ± SD  n   %             | p*                     |
| Continuous data                  |                              |                                |                        |
| Age (years)                      | 34.7 ± 10.6  53  37.3        | 39.0 ± 11.4 74  33.8          | 0.001* 0.96 (0.94–0.99) |
| Classes taught per day           | 1.7 ± 0.8 89  62.7          | 1.6 ± 0.8 145 66.2           | 0.32* 1.14 (0.88–1.49)  |
| Classes taught per week          | 8.1 ± 5.4 31  21.8          | 7.3 ± 4.5 50  22.8           | 0.133* 1.03 (0.99–1.08) |
| Days per week teaching           | 4.4 ± 1.6 111 78.2         | 4.1 ± 1.6 169 77.2          | 0.142* 1.10 (0.97–1.26) |
| Number of programs taught        | 3.2 ± 1.8 53  37.3          | 3.0 ± 1.8 74  33.8           | 0.259* 1.07 (0.95–1.20) |
| Years in the industry            | 7.5 ± 7.2 89  62.7          | 9.3 ± 8.8 145 66.2          | 0.046* 0.97 (0.95–0.99) |
| Categorical data                 |                              |                                |                        |
| GFI primary occupation           | Yes 53 37.3                   | 74 33.8                       | 0.492** 1.17 (0.75–1.81) |
|                                  | No* 89 62.7                   | 145 66.2                      |                        |
| Gender                           | Male 31 21.8                  | 50 22.8                       | 0.824** 0.94 (0.57–1.57) |
|                                  | Female* 111 78.2              | 169 77.2                      |                        |

OR, Odds Ratio.

Note: For logistic regression: 0 = no hoarseness, 1 = hoarseness.

* p-values are based on chi-square with appropriate degrees of freedom.

** p-values are based on t-test with appropriate degrees of freedom.

* reference category.

(see Table II). Vocal volume whilst instructing was significantly and positively associated with reports of chronic hoarseness. Using a louder than normal speaking voice increased the odds of presenting with hoarseness by 2.9-times ($p = 0.003; 95\% \text{ CI} = 1.4–5.8$) and those using a vocal volume reported to be much louder than their normal speaking voice increased the odds of presenting by chronic hoarseness by 7.6-times ($p < 0.001; 95\% \text{ CI} = 3.3–17.7$). Consistent microphone use ($p = 0.033$) was also found to be significantly and positively associated with whether an instructor reported chronic hoarseness, with those who consistently used a microphone having 1.9-times higher odds of reporting a degree of chronic hoarseness compared with their counterparts who failed to consistently utilize voice amplification ($\text{OR} = 1.9; 95\% \text{ CI} = 1.1–3.3$). It is also important to note that vocal volume used by instructors during periods of exercise instruction was found to be independent of GFIs’ microphone use, as determined by a chi-square test ($p = 0.532$).

Health factors were also found to be statistically significant indicators of whether GFIs would experience chronic hoarseness. GFIs who reported experiencing colds and flu often had 1.9-times ($p = 0.008; \text{OR} = 1.9; 95\% \text{ CI} = 1.2–3.3$) higher the odds of reporting chronic hoarseness than their counterparts, who reported they were healthy. Furthermore, having a sore throat often and teaching with a sore throat were significantly and positively associated with reports of chronic hoarseness. Instructors who reported having a sore throat often and teaching with a sore throat had 3.3 ($p < 0.001; 95\% \text{ CI} = 2.1–5.4$) and 1.6 ($p = 0.6; 95\% \text{ CI} = 0.98–2.7$) times higher odds of reporting chronic hoarseness, respectively. Teaching whilst sick was prevalent (84.5%; $n = 120$), with this behaviour leading to odds 2-times higher of experiencing chronic hoarseness when compared to individuals who rested when ill ($p = 0.015; 95\% \text{ CI} = 1.1–3.5$). Partial voice loss during ($p < 0.001$) and after instruction ($p < 0.001$) also increased the odds of instructors reporting chronic hoarseness by 6.8 ($95\% \text{ CI} = 4.0–11.5$) and 4.9 ($95\% \text{ CI} = 3.1–7.9$) times, respectively, when compared to those who did not report any voice change during or after teaching. Despite these findings, there were no significant differences between groups for all general lifestyle variables examined (see Table III).

Factors associated with chronic hoarseness in the GFI population

Of the 23 variables considered for initial logistic regression analysis, 10 variables were found to be significantly associated with the dependent variable (at $p \leq 0.10$) and were included in the base multivariable logistic regression model. Backward elimination established six variables that did not achieve significance in the final multivariate model (i.e. teaching when sick, teaching with a sore throat, sore throat often, experiencing cold/flu often, consistent microphone use and years in the industry). Therefore, the four variables included in the final multivariate regression model were: age; partial voice loss while instructing; partial voice loss after instructing; and vocal volume whilst instructing. Table IV summarizes the following findings:

(a) Age is significantly and negatively associated with reporting chronic hoarseness. With each year increase in age, the odds of presenting with hoarseness are reduced by 4%;
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(b) Partial voice loss during exercise instruction is significantly and positively associated with reporting chronic hoarseness. GFI who experience partial voice loss while instructing have 7.3-times higher odds of reporting chronic hoarseness than their counterparts who experience no voice change during fitness instruction;

c) Partial voice loss after exercise instruction is significantly and positively associated with reporting chronic hoarseness. For instructors experiencing partial voice loss after teaching a class, the odds of chronic hoarseness are 7.2-times higher than that of their counterparts who experience no voice change after fitness instruction; and

d) Perceived vocal volume whilst instructing is significantly and positively associated with reporting chronic hoarseness. Instructors who use a voice louder than normal whilst instructing have odds 10.3-times higher for reporting chronic hoarseness than those who use a normal speaking voice. Instructors who use a voice much louder than normal whilst instructing have odds 12-times higher for reporting chronic hoarseness than those who use a normal speaking volume.

A non-significant H-L statistic ($p = 0.16$) suggests that the estimated model fits the data well. The area under the ROC curve (AUC) was 0.9, indicating the model's goodness-of-fit was highly accurate (Greiner, Pfeiffer, & Smith, 2000).

Discussion

This study was the first to systematically examine factors associated with self-report of chronic hoarse-
ness in the Australian GFI population. Ten factors relating to lifestyle, teaching practice and voice behaviour and vocal hygiene that were significantly associated with the report of chronic hoarseness have been identified. These include, with the consideration of younger age and less years in the industry: partial voice loss while instructing, increased vocal volume above normal speaking level whilst instructing, teaching when sick, teaching with a sore throat, having a sore throat mal speaking level whilst instructing, teaching when instructing, increased vocal volume above normal voice or softer.

Using a microphone. Although many of the factors investigated align with those commonly hypothesized to increase the risk of developing voice problems in GFI's (Heidel & Torgerson, 1993; Long et al., 1998; Newman & Kersner, 1998), the current study highlights some new considerations and provides validation of the association between the self-report of chronic hoarseness with previously postulated related factors. Such information may raise awareness regarding the relationship between behavioural and environmental factors and their potential influence on vocal health. This data also contributes to the limited evidence-base that may influence voice education tailored to the GFI population.

Instructor age was found to be related to the report of chronic hoarseness. Surprisingly, this was a statistically significant and negative relationship, indicating that, with each year increase in age, the odds of presenting with hoarseness is reduced by 4%. This is a novel finding as (1) this is the first research in the GFI population that has found age to be a factor statistically related to voice problems, (2) it suggests that the normal effects of increasing age on voice are not impacting vocal health in this current population and (3) it raises the question of why younger individuals in this occupational group are reporting more chronic voice difficulties that their older counterparts. Physical changes that accompany normal ageing may cause a weakening of strength and elasticity of the laryngeal musculature and respiratory and phonatory function (Decoster & Debruyne, 2000; Hollien, 1987; Sataloff, Caputo Rosen, Hawkshaw, & Spiegel, 1997; Newman & Kersner, 1998; Verdonck-de Leeuw & Mahieu, 2003). These effects may not be evident in the

Table III. Between-groups comparison, using bivariate logistic regression, of lifestyle variables for Group Fitness Instructor (GFI) who did and did not report experiencing chronic hoarseness.

| Population variable       | Chronic hoarseness (n = 142), n (%) | No chronic hoarseness (n = 219), n (%) | p* | Unadjusted OR (95% CI) |
|---------------------------|-------------------------------------|---------------------------------------|----|-----------------------|
| Smoking                   |                                      |                                       |    |                       |
| Yes                       | 2 (1.4)                             | 3 (1.4)                               | 0.976 | 1.03 (0.17–6.23) |
| No*                      | 140 (98.6)                          | 216 (98.6)                            |    |                       |
| Regular medications      |                                      |                                       |    |                       |
| Yes                      | 29 (20.4)                           | 53 (24.2)                             | 0.403 | 0.80 (0.48–1.34) |
| No*                      | 113 (79.6)                          | 166 (75.8)                            |    |                       |
| Allergies                 |                                      |                                       |    |                       |
| Yes                      | 34 (23.9)                           | 47 (21.5)                             | 0.581 | 1.15 (0.7–1.9)  |
| No*                      | 108 (76.1)                          | 172 (78.5)                            |    |                       |
| Drink alcohol regularly  |                                      |                                       |    |                       |
| Yes                      | 50 (35.2)                           | 91 (41.5)                             | 0.228 | 0.74 (0.49–1.18) |
| No*                      | 92 (64.8)                           | 128 (58.5)                            |    |                       |
| Drink caffeine regularly |                                      |                                       |    |                       |
| Yes                      | 115 (81.0)                          | 176 (80.4)                            | 0.884 | 1.04 (0.61–1.78) |
| No*                      | 27 (19.0)                           | 43 (19.6)                             |    |                       |
| Hours sleep per night    |                                      |                                       |    |                       |
| <5 hours*                | 9 (6.3)                             | 13 (5.9)                              | 0.645 | 1.21 (0.54–2.71) |
| 6–8 hours                | 127 (89.4)                          | 203 (92.7)                            | 0.256 | 3.83 (0.38–38.74) |
| >9 hours                 | 6 (4.2)                             | 3 (1.4)                               |    |                       |

(p* -values are based on chi-square with appropriate degrees of freedom.
*reference category)

Table IV. Logistic regression estimates of factors associated Group Fitness Instructor (GFI) experience of chronic hoarseness of final multivariable logistic regression model.

| Variable                        | OR (adjusted) | p   | 95% CI     |
|---------------------------------|---------------|-----|-----------|
| Age                             | 0.95          | 0.005 | 0.92–0.99 |
| Partial voice loss while        | 7.35          | <0.001 | 3.33–16.21 |
| instructing                     |               |     |           |
| Partial voice loss after        | 7.16          | <0.001 | 3.63–14.13 |
| instructing                     |               |     |           |
| Vocal volume whilst             |               |     |           |
| instructing*                    | 10.24         | <0.001 | 2.68–39.19 |
| Louder than normal voice        |               |     |           |
| Much louder than normal voice   | 12.04         | <0.001 | 2.69–53.84 |

OR, Odds Ratio.
*reference category = normal speaking voice or softer.

Variables included in the base model but could not achieve significance in the final multivariable logistic regression include: teaching when sick, teaching with a sore throat, sore throat often, experience cold/flu often, consistent microphone use and years in the industry.
practicing GFI population, as overall body health in these individuals is paramount to occupational success. Maintenance of peak physical fitness may be helping the voice to stay healthy in those who do not have any pre-morbid voice difficulties. Another consideration is that GFIs above the age of 40 are minimally represented in this data. This is in accordance with previous studies, who have failed to elucidate any effect of age on the prevalence of voice problems in the GFI population (Heidel & Torgerson, 1993; Newman & Kersner, 1998). The voice, once matured in early adulthood (∼ 20 years), generally remains unchanged until ∼ 60 years if the individual is healthy. However, the group reporting chronic hoarseness in this study was an average of 52 months younger than those reporting no voice difficulty. Clinically, this is a minimal difference. A number of factors such as smoking, alcohol consumption, personality factors and recreational and social lifestyle behaviour, all of which are commonly implicated in the presentation and exacerbation of voice disorders in younger adults may be contributing factors to voice symptomatology (Murphy & Doyle, 1987; Roy, Bless, & Heisey, 2000; Roy, Merrill, Gray, & Smith, 2005; Sorensen & Horii, 1982). The competitive nature of individuals upon entry to the profession, overall lack of voice education and withdrawal from the industry when voice difficulties are encountered (Rumbach, 2013a, b) may also be compounding the age effect found.

Interestingly, the chronically hoarse group was also found to have less years in the industry. This finding is unlike those reported by earlier studies of voice difficulties in aerobics instructors which indicated that those who had been teaching for more than 6–7.8 years were more likely to report a history of voice problems than those who had taught for shorter periods (Long et al., 1998; Newman & Kersner, 1998). Although significantly different, the groups in this study were separated by ∼ 21 months; again, a minimal clinical difference. It can be hypothesized that those individuals who may be more susceptible to voice difficulties experience these earlier on in their GFI careers and then leave the industry, resulting in a group of GFIs with more experience who are vocally healthier than their counterparts who have been in the industry less time. Therefore, it may be inferred that, despite level of experience, instructors are likely to report voice problems attributable to voice misuse at some point in their career. Lack of education surrounding voice care and workplace pressure to instruct whilst vocally compromised (Rumbach 2013a, b) may also contribute to instructors with less experience reporting a higher rate of chronic hoarseness.

Previous research investigating vocal behaviours of aerobics instructors and cheerleaders has interpreted long-term patterns of vocal misuse as a contributor to the formation of habitual voicing patterns and the development of hoarseness (Koblick, 2004; Newman & Kersner, 1998). Experiencing frequent illness and teaching when ill were found in this study to be significantly related to the report of chronic hoarseness. Laryngeal inflammation present during illness may result in temporary changes to pitch, loudness and vocal quality, requiring greater vocal effort for the speaker to counteract such changes which, in turn, may result in less efficient vocal technique and the development of poor vocal behaviours (Cazden, 2012; Murray & Rosen, 2000). Professional voice users, including GFIs, are thus advised to avoid strenuous voice use when sick, particularly when experiencing upper respiratory infections or other respiratory-related disorders, in order to reduce excess strain, vocal load and potential for vocal injury (Murray & Rosen, 2000).

Episodes of acute vocal trauma that manifest as partial voice loss, during or after teaching a class, if repeated, can lead to significant changes in voice function; GFIs who experience partial voice loss during and after instructing increased the odds of reporting chronic hoarseness by 6.8- and 4.9-times, respectively. Previous studies have documented the prevalence of acute episodes of partial or complete voice loss to be high (58–72%; Heidel & Torgerson, 1993; Rumbach, 2013a) during or immediately following periods of exercise instruction. Acute changes in vocal clarity within or immediately after a class may make tasks requiring vocal loading (e.g. exercising whilst vocalizing) more difficult to sustain, again increasing the likelihood of developing long-term voice problems.

Also found to be significantly associated with reports of chronic hoarseness was increased vocal volume whilst instructing, with a considerable number of GFIs with chronic hoarseness reporting use of a “louder than normal speaking voice” (64.8%) or “much louder than normal speaking voice” (26.1%) whilst instructing a class. Odds of reporting chronic hoarseness increased for each loudness category above normal vocal volume. Similar correlations have been found in classroom teachers, with increased vocal volume more likely to be used by those who report voice disorders (Chen, Chiang, Chung, Hsiao, & Hsiao, 2010; Smith et al., 1998). It has been proposed that the louder voice is used as a compensatory measure to maintain speech intelligibility and teaching efficiency whilst combatting environmental noise (Anderson, 2004). It is possible that use of this loud voice increases impact stress during glottal closure, leading to further vocal deterioration for the instructor (Chen et al., 2010; Hess, Verdolini, Bierhals, Mansmann, & Gross, 1998; Jiang & Titze, 1994; Peterson, Verdolini-Marston, Barkmeier, & Hoffman, 1994).

Previous studies examining voice problems in aerobics instructors found increased vocal volume to be positively associated with vocal fatigue, lack of amplification and general voice problems (Heidel & Torgerson, 1993; Wolfe, Long, Youngblood, Willford, & Olson, 2002). Koblick (2004) identified a significant reduction in vocal loudness when
instructors taught using amplification ($M = 96.8$ dB; $SD = 3.8$ dB) vs no amplification ($M = 103.1$ dB; $SD = 4.1$ dB), suggesting correlations between use of amplification and decreased vocal volume. While previous studies cite amplification as a means of reducing vocal load and consequent voice problems (Boone, McFarlane, Von Berg, & Zraick, 2010; Koblick, 2004; Mathieson, 2001; McCormick & Roy, 2002; Roy, Weinrich, Gray, Tanner, Walker Toledo, Dove, et al., 2002), findings from this study indicate that GFIs developed chronic hoarseness despite consistent microphone use. Such results may suggest GFIs lack the knowledge of how to best use the microphones and sound equipment made available and are, therefore, continuing to demonstrate poor vocal habits whilst instructing, despite using amplification devices. As such, formalized training on how to utilize microphones correctly while exercising should be incorporated into any future voice education packages that may be developed for the fitness industry.

**Professional and clinical implications**

It is important to acknowledge, at both an instructor and industry level, that any degree of perceptual voice change places limitations on vocal clarity and intensity. This may restrict an instructor’s ability to cue participants to perform physical exercises safely, potentially placing gym members at greater risk for injury. Chronic hoarseness also has the potential to impact on overall work performance and efficiency (Sapir et al., 1990, 1993). A study by Rumbach (2013b) reported that 89.5% of GFIs were unable to fulfil vocational tasks due to chronic voice difficulties, resulting in long periods of absenteeism, altering work programs/reduced hours, withdrawal from employment for the duration of treatment for their voice problems or ceasing work altogether. Limitations of job performance have been found to lead to considerable financial strain and personal burden, with impacts on social and emotional wellbeing (Smith, Gray, Dove, Kirchner, & Heras, 1997; Williams & Carding, 2005), which sees some GFIs leave the profession in pursuit of less vocally-demanding careers (Rumbach, 2013b).

Management approaches for voice disorders typically involve client education of vocal hygiene as well as behavioural modifications according to the individual’s reported and presenting symptoms. Recent literature has suggested that, while behavioural therapy directed towards incorrect vocal behaviours can serve to improve voice quality and reduce the risk of further vocal damage, behavioural approaches are not guaranteed to facilitate the complete resolution of vocal fold pathology (Leonard, 2009). The findings of this research highlight that voice disorders in this population may be related to modifiable biological, environmental and teaching practices. Therefore, education and treatment should encompass all determinants of vocal health status, not simply focus on the reduction of the occupational vocal load. This evidence emphasizes the need for either a (1) screening and intervention approach or (2) universal voice education approach to help prevent the development of long-term voice problems. This further supports the aims of this study in identifying factors associated with the presentation of chronic hoarseness. Early identification and treatment of voice disorders may greatly reduce the activity limitations (i.e. performance limitations of having a hoarse voice) and participation restrictions (i.e. reduced work efficiency due to voice problems) which have been found to result from voice problems in GFIs (Rumbach, 2013b; World Health Organization, 2001).

**Limitations and future directions**

Whilst this research has identified factors associated with GFIs complaints of chronic hoarseness, these now require further prospective investigation with a second cohort of GFIs. The current findings support the hypothesis that voice difficulties in this population are likely to have multifactorial origins. Despite the findings adding to the existing knowledge base, a number of limitations around the design and distribution of the survey are apparent. Advertisement and distribution of the survey through industry gatekeepers and social media enabled nationwide participation of GFIs. However, the sample cannot be considered representative of the profession at large due to the potential sample bias that may be present due to the non-representative nature of the sampling. The high prevalence of chronic hoarseness reported may have been created by a bias toward GFIs with voice concerns to have a greater interest in completing the survey. Furthermore, instead of relying on snowball sampling, more widespread recruitment may have been achieved through direct contact with fitness facilities nationwide or if reminder emails had been sent via industry gatekeepers during the time the survey was available online.

Another inherent limitation of the study design was the collection of responses via an exclusively online method. Although data collection online is an efficient, convenient, accessible and relatively inexpensive process for respondents and researchers, this study relied on the accurate self-report of voice symptoms, which is inherent in survey research. However, the number of people surveyed ($n = 361$) contribute to the validity of the findings. Future studies should incorporate face-to-face acoustic, laryngoscopic, physiological and perceptual evaluations of voice quality and function, conducted and analysed by speech-language pathologists experienced in voice. Interview and focus group methodology would also ensure that all questions and responses are unambiguous (especially in relation to definitions of specific voice symptoms) and final data were complete.
Further prospective research using a new cohort of GFI is required to investigate whether factors associated with chronic hoarseness cause the development of chronic voice symptoms. Furthermore, studies that track long-term changes in vocal performance over time in groups of instructors entering the industry are required.

Once this research base has been expanded, formal voice education packages tailored to the group fitness industry should be developed, implemented and evaluated to determine their scope in preventing chronic voice difficulties, including hoarseness. Research should also examine the physiological effects of exercise on the vocal mechanism before, during and after group fitness instruction to better understand how the variable nature of fitness instruction impacts on vocal anatomy and voice production within this population.

Conclusion

This cross-sectional survey of voice problems in GFIs has identified a number of behavioural and environmental factors that are associated with the self-report of chronic hoarseness. These include younger age and less years in the industry, partial voice loss while instructing, partial voice loss after instructing, increased vocal volume above normal speaking level whilst instructing, teaching when sick, teaching with a sore throat, having a sore throat often, experiencing cold/flu often and consistently using a microphone.

Knowledge of the characteristics of and factors that related to the report of chronic hoarseness will provide industry educators, workplace management and instructors with an increased awareness of the behavioural, environmental and teaching practices associated with voice that may be modified to make the occupational voice load safer. In turn, it is hoped that this increased awareness will help facilitate greater vocal wellbeing and contribute to longevity of individual GFI employment in the industry. Whilst the current study has identified these factors as being associated with chronic hoarseness, the variability of conditions in which instructors teach classes as well as diverse personal characteristics makes these results difficult to generalize to the entire GFI population.

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**Supplementary material available online**

Supplementary material.