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Vocal Problems in Sports and Fitness Instructors: A Study of Prevalence, Risk Factors, and Need for Prevention in France

***Lionel Fontan, †Marie Fraval, †Anne Michon, ‡Sébastien Déjean, and §Muriel Welby-Gieusse,** *†§‡*Toulouse, France*

Summary: Objectives. Sports and fitness instructors (SFIs) are known for being a high-risk population for voice difficulties (VD). However, past studies have encountered various methodological difficulties in determining prevalence and risk factors for VD in SFIs, such as limited population, gender and selection biases, or poor statistical power, because VD were studied as a binary variable. The present research work addresses these issues and aims at studying the prevalence of vocal problems and risk factors in French SFIs, a population in which no such study was conducted yet. Another objective is to survey the French SFIs' habits and expectations regarding vocal prevention and care.
Study design. This is a cross-sectional study.
Methods. Three hundred and twenty SFIs answered a questionnaire, whether in an online (n = 267) or a paper (n = 53) version. The questionnaire consisted of 31 items addressing self-reported vocal difficulties, supposed risk factors, and personal health-care history, followed by the Voice Handicap Index assessment.
Results. Prevalence of self-reported vocal difficulties is 55%. The Voice Handicap Index is significantly associated with gender, age, and variables related to work environment (noise and music) and habits (shouting, frequency of classes), as well as with daily sleeping time. Results also indicate that a minority of the SFIs (37%) received information on vocal difficulties, whereas a majority (80%) declares being interested in participating in prevention programs.
Conclusions. This work confirms that SFIs are a high-risk population for VD, underlines the need for specific information programs in France, and provides relevant data for driving such preventive actions.
Key Words: sports and fitness instructors–prevalence of vocal problems–risk factors–Voice Handicap Index–professional voice use.

INTRODUCTION

The demand for sports and fitness training has largely increased in western countries since the beginning of the 21st century. More than 260,000 instructors were reported by the United States Department of Labor in 2012. European countries have experienced the same trend: in France, 10,000 fitness centers were accounted for in 2013 by the Ministry of Youth Affairs and Sports.

Several studies suggested that sports and fitness instructors (SFIs) are more likely than the general population to experience voice difficulties (VD).[1–5] More specifically, it is hypothesized that these difficulties are caused by a complex conglomerate of physiological, psychological, and environmental factors.[5] The heavy vocal loading required to give instructions to class participants and to stimulate them lays on top of these factors. Nevertheless, in comparison with other professionals who also cope with a high level of vocal loading such as school teachers, SFIs may experience additional risk factors related to their work environment. SFIs often give instructions while performing exercises for demonstration purposes, and this combination of vocal and physical efforts can lead to forceful glottic closure.[6] Also, SFIs frequently deal with poor acoustic conditions by teaching in reverberating rooms or with the presence of loud music or other competing noises such as participants' voices and noise induced by fitness machines. This may increase their vocal effort, as explained by the Lombard effect.[7] Finally, other elements into SFIs' environment might increase their vocal risks, such as the use of air-conditioning or the presence of chlorine when working in aquatic environments.[8,9]

These numerous factors related to SFIs' professional practice need to be added to the list of other known variables influencing the occurrence of VD, such as demographic, health, and vocal hygiene factors. Given the number of variables at stake, the earliest studies about prevalence of VD in SFIs and associated professional risk factors dealt with rather limited populations, with up to 63 SFIs.[1–4] Moreover, these studies often showed a strong gender bias toward female participants, which is known to be an important risk factor for VD.[10]

To address these limitations, Rumbach conducted a study in 361 group fitness instructors and identified several risk factors directly linked to their profession.[5] However, as the author stated, because the study was done using a self-reporting questionnaire distributed through social networks, a selection bias might have occurred. Instructors with voice disorders may indeed be more likely to answer a questionnaire addressing this specific issue, which would lead to an overestimation of the prevalence of voice problems.

Also, to the best of our knowledge, no study has yet been conducted using a precise quantitative index such as the Voice Handicap Index (VHI[11]) to address voice problems in SFIs. On a statistical point of view, a continuous dependent variable such

as the VHI would allow for a more precise analysis of the effects of each risk factor.

The present research work aims at studying the prevalence of voice problems—as reported by a questionnaire including the VHI assessment—and the influence of associated risk factors in French SFIs, a population in which no such study was conducted yet. The need for research in France is all the more important because to date there is not any French national health program designed to raise awareness of vocal risks among SFIs. To better understand what is at stake, a last objective of the present study is to survey the SFIs' habits and expectations regarding vocal prevention and care.

METHODS

Participants

Three hundred and twenty SFIs (140 men and 180 women) participated in this study. Their age ranged from 18 years old to 65 years old (mean = 31; SD = 7.7). All of them were working as SFI in France and benefited from 6 months up to 35 years of teaching experience.

Data collection

Two hundred and sixty-seven participants were recruited *via* social networks or *via* emails. As the number of SFIs who were contacted by these means is likely to be larger than the actual number of SFIs who answered the questionnaire, a selection bias could have occurred. To address this issue, 53 additional participants were directly recruited in sports and fitness centers; in this last case, all the SFIs working in the centers were asked to answer the questionnaire. Participants' recruitment took place during February and March 2015. The 267 participants contacted by electronic means filled in a questionnaire online, whereas the 53 additional participants completed a paper version of the same questionnaire.

The questionnaire consisted of 31 questions for which an English translation is given in the Appendix, followed by the 30 questions of the VHI in its French translation.[11,12] The first 31 questions were grouped in six different sections, among which five sections were related to the study of vocal risk factors, and the last one related to vocal health prevention and care history:

- demographics
- teaching experience and habits
- teaching environment
- vocal habits
- lifestyle and vocal hygiene
- history with vocal difficulties and related health care.

RESULTS

Preliminary analysis: Selection bias

The first analysis consisted in determining if there was a significant difference between VHI obtained by the SFIs contacted *via* electronic means and VHI obtained by SFIs who were directly contacted in sports and fitness centers.

To this end, a Mann-Whitney *U* test was conducted, with the selection group as the independent variable and VHI as the dependent variable. Results indicated that VHI was not significantly different between SFIs recruited by electronic means (*Mdn* = 158.6) and SFIs directly recruited in sports and fitness centers (Mdn = 170.1, $U = 6564$, $P = .405$). As a consequence, data for both groups were combined for subsequent statistical analyses (Figure 1).

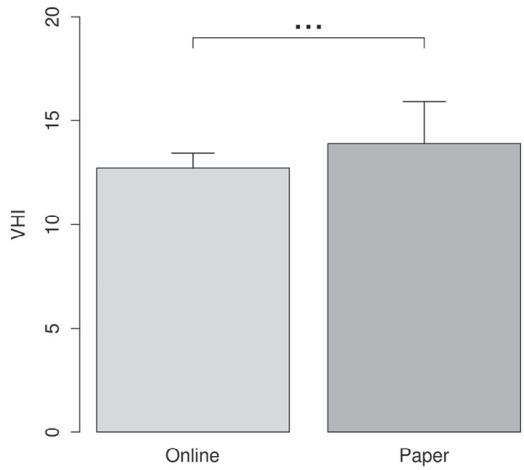

FIGURE 1. Mean VHI for SFIs who completed the questionnaire in its online or paper version. Error bars represent standard errors of the means. ··· means the difference is not significant.

Prevalence of VD in French SFI

One hundred and seventy-five SFIs (54.7%) reported experiencing VD such as sore throat or vocal losses without any connection to Ear, Nose and Throat (ENT) illnesses. Mean VHI for all SFIs was 12.9 (Min = 0; Max = 80; SD = 13.7). Mean VHI for male SFIs (mean = 10.3; SD = 11.9) was found to be lower than for female SFIs (mean = 14.9; SD = 14.7).

Survey of risk factors

As the present study involves a large number of variables, a principal component analysis (PCA)[13] was first performed to provide a global overview of the data. Then, the relationship between each potential risk factor and VHI was analyzed. In the PCA (Figure 2), VHI was considered as a supplementary variable. In such a graphical representation, the nature of the correlation between two variables can be visualized through the angles between two vectors: if the angle is sharp, the correlation is positive; if the angle is obtuse, the correlation is negative; and if the angle is right, the correlation is null.

So, one can observe a rather obvious positive correlation between *Exp.* (years of teaching experience) and *Age*, and a negative correlation between *Spks_norm*. (Speaks normally*)* and *Shouts*. For a better readability, an interactive three-dimensional graphic representing the variable positions in the three first dimensions resulting from the PCA is available on the following website: https://www.irit.fr/recherches/SAMOVA/FONTAN/pca3D.html

The relationships between VHI (dependent variable) and the variables associated with supposed risk factors are assessed differently depending on the nature of each independent variable

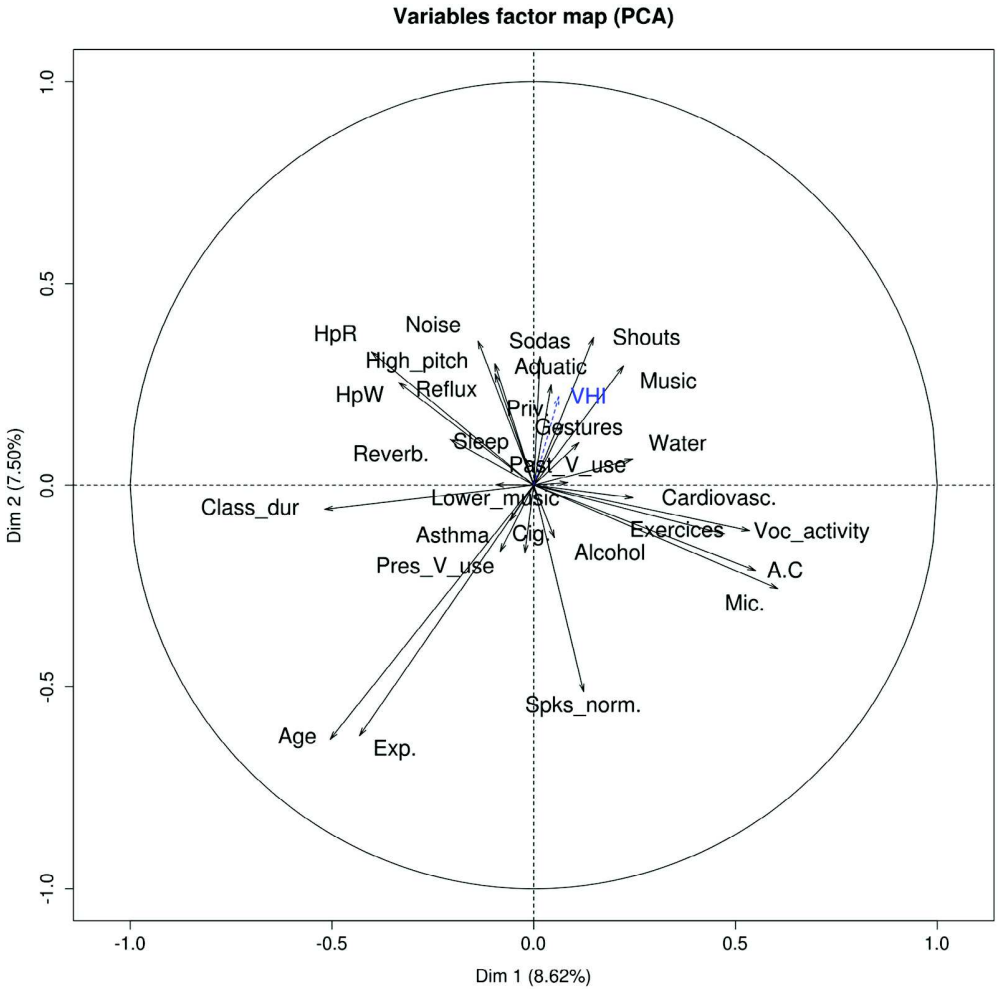

FIGURE 2. Variable representation from PCA performed on the whole data set. Active (resp. supplementary) variables are represented in black (resp. blue) arrows. The first two principal components (PCs) represent 16% of the variability. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Abbreviation	Extended description of variable	Abbreviation	Extended description of variable
A.C	Air-conditioning in teaching rooms	Mic.	Use of a microphone
Age	Age	Music	Music loudness
Alcohol	Alcohol consumption	Noise	Number of competing noise sources
Aquatic	Teaching in aquatic environments	Past_V_use	Past other vocal activities
Asthma	Asthma or allergies	Pres_V_use	Current other vocal activities
Cardiovasc.	Cardiovascular training classes	Priv.	Heavy vocal use in private situations
Cig.	Cigarette packs-years	Reflux	Gastric reflux
Class_dur	Classes duration	Reverb.	Teaching in reverberant rooms
Exercises	Performing exercises while teaching	Shouts	Shouting
Exp.	Work experience	Sleep	Sleep duration
Gestures	Performing gestures when teaching	Sodas	Sodas/juices consumption
High_pitch	Speaking with a higher pitch	Spks_norm.	Speaking normally
HpR	Max. teaching hours in a row	Voc_activity	Frequency of vocal activities
HpW	Hours per week	Water	Water consumption
Lower_music	Lowering the music when speaking		

at stake. The link with a quantitative variable (such as *Age*) is assessed using the Pearson correlation coefficient. This coefficient is between −1 and 1; these limits indicate respectively perfect negative and positive relationships. A statistical test is systematically performed to evaluate the significance of the value: the lower the P value, the stronger the conclusion for a nonzero correlation between the two variables. When studying the link between VHI and a categorical variable (such as *Gender*), we

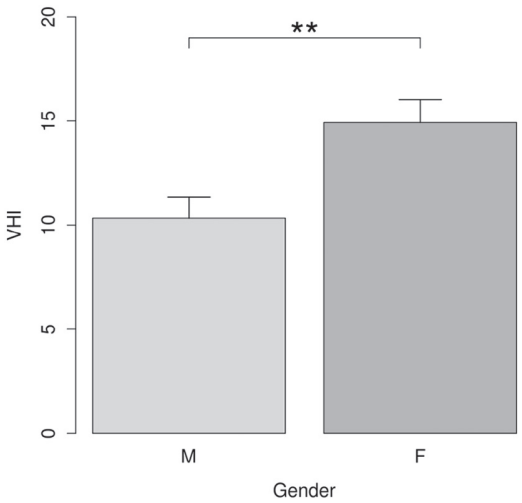

FIGURE 3. Mean VHI for male *versus* for female SFIs. Error bars represent standard errors of the means. ** mean that the differences are significant at the .01 level.

performed a Mann-Whitney *U* test to compare the mean VHI between the subgroups defined by the categories. In this case, the lower the *P* value, the stronger the difference in VHI for the subgroups. In the following subsections, we present only the results for variables showing a significant link with VHI (ie, *P* value lower than .05).

Demographic variables

Regarding demographic variables, *Age* and *Gender* show a significant relationship with VHI (Figure 3). The Pearson correlation coefficient between *Age* and VHI is −.115, which is slightly significant ($P = .039$). This negative value indicates that the older SFIs have a lower VHI.

The Mann-Whitney *U* test provides a rather strong conclusion for the difference between men and women ($P = .005$); women obtain greater VHIs than men. Mean VHIs for men and women are respectively 10.3 (SD = 11.9) and 14.9 (SD = 14.7).

Teaching experience and habits

In this part, only the number of teaching hours per week is positively correlated to the VHI. The Pearson correlation coefficient is .115, which is slightly significant ($P = .04$). The positive value of the correlation indicates that VHI increases with the number of hours per week performed by the instructor.

Teaching environment

Two variables related to the teaching environment appear to be significantly related to VHI: music loudness and the number of noise sources. Both exhibit a positive correlation ($r = .15$, $P = .009$ for *Music_Loudness* and $r = .12$, $P = .04$ for *Nb_Noise_sources*).

Vocal habits

In this section, we focus on the variable *Shouts*. Before studying its link with VHI, we analyze the relationships with other variables. First, shouting is highly related to the music loudness. The Mann-Whitney *U* test highlights a significant difference

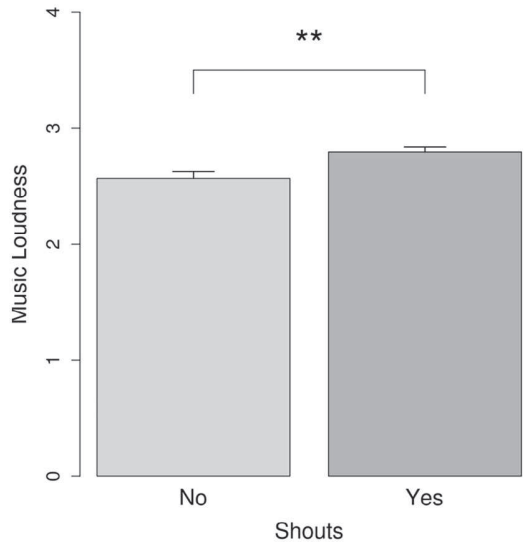

FIGURE 4. Music loudness for SFIs who tend to shout *versus* those who do not tend to shout. Error bars represent standard errors of the means. ** mean that the differences are significant at the .01 level.

for the music loudness depending on the shouting habit of the instructor ($P = .0004$): the music is significantly louder in the group of shouting instructors (Figure 4).

Furthermore, *Shouting* is, rather logically, negatively linked to *Speaks_Normally*. This was assessed using a chi-square test evaluating the link between two categorical variables (*P* value about 10^{-6}). Instructors who shout speak less often normally (Figure 5).

Finally, the relationship between the shouting habit and VHI appears to be highly significant. The *P* value of the Mann-Whitney *U* test is about 10^{-7} and mean values are 8.3 for nonshouting instructors (SD = 9.7) and 15.8 for those not shouting (SD = 15).

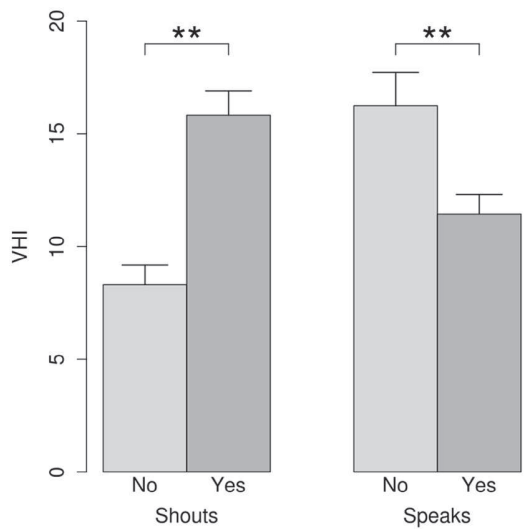

FIGURE 5. Mean VHI for SFIs who tend to shout or not (*left*) and for SFIs who tend to speak normally or not (*right*). Error bars represent standard errors of the means. ** mean that the differences are significant at the .01 level.

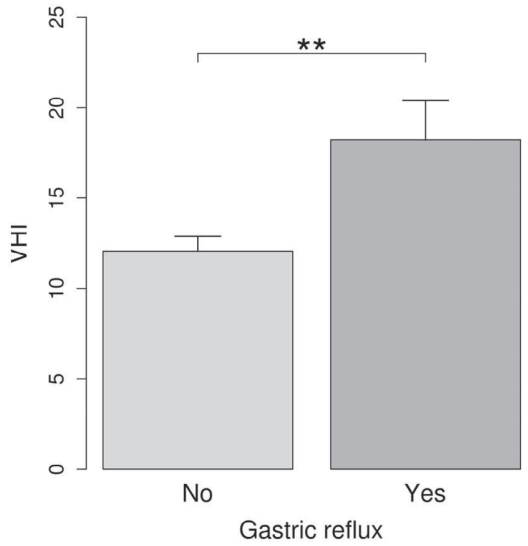

FIGURE 6. Mean VHI for SFIs who experience gastric reflux *versus* SFIs who do not. Error bars represent standard errors of the means. ** mean that the differences are significant at the .01 level.

Lifestyle and vocal hygiene

Regarding lifestyle variables, it appears that gastric reflux is significantly associated with VHI ($P = .004$) (Figure 6), whereas smoking is not ($P = .09$). Concerning quantitative variables, sleep duration has a negative correlation ($r = -.19$, $P = .0005$) with VHI; the shorter the sleeping duration, the higher the VHI.

Health-care habits and prevention needs

Among the 175 SFIs who experienced vocal problems only, 77 (44.0%) declared to have consulted a doctor or a speech therapist. The SFIs who underwent this process declared having solved their VD in most cases (63.6%), against 40.8% for the SFIs who did not consult.

If a minority of the 320 SFIs (36.6%) received information on vocal difficulties, a majority (79.7%) declared being interested in participating in such prevention programs. It also appears that the vocal difficulties encountered by the SFIs have, for a significant part (26.9%), had direct consequences on their professional life.

Discussion and conclusion

Results of this study clearly indicate that French SFIs are a high-risk population for vocal troubles. Indeed, 55% of the population reported experiencing VD, which is considerably higher than what is generally reported for the general population, that is, a prevalence approximating 30%.[14,15]

The VD prevalence reported here is however inferior to those reported in the studies of Heidel and Torgerson, and Rumbach (84% and 71%, respectively).[1,5] An explanation may be that in these previous studies the populations were constituted of a much larger part of female teachers (resp. 100% and 77.6%) than those recruited in the present study (56.3%), which is a risk factor well known[10] and confirmed by the present data. Also, to check if a selection bias occurred in this study, we compared the results obtained through the online questionnaire with the results obtained by SFIs who were directly contacted in sports and fitness centers. There was no significant difference between the two groups; the mean VHI is even slightly higher in the population who filled the paper version of the questionnaire.

The study of VHIs obtained by SFIs revealed an important interindividual variability. The multivariate analysis and pairwise comparisons underlined several risk factors contributing to this variability. On the one hand, two nonprofessional risk factors were found to be decisive: gastric reflux and sleep duration. On the other hand, this study revealed that some factors directly linked to the SFIs' professional activity were determinant for the appearance of VD. The main factor was the shouting behavior, strongly associated with VHI. The shouting behavior was itself directly linked to work environment variables such as the music loudness and the number of noise sources competing with voice. This can be explained by the Lombard effect, according to which the speaker adapts his or her voice intensity and pitch to cope with adverse noises during communication. It may therefore be reasonably hypothesized that noisy work conditions increase the risk of vocal forcing for SFIs. Another interesting fact that tends to confirm this hypothesis is that older SFIs (and therefore the more experienced) shout less often. Accordingly, VHI was found to be lower in the older population than in younger SFIs.

Other variables linked to SFIs' work environment (use of air-conditioning, working in presence of chlorine, working in reverberant rooms) and to their professional habits (performing exercises when speaking, teaching specific classes such as cardiovascular training) did not show a significant effect on VHI. However, the effects of these variables may have been masked by the complex relationships tying all variables. Given the large number of variables at stake, this study could be complemented by including more SFIs to confirm the nonsignificance of these factors.

On a societal point of view, the results underline the need for prevention programs designed to inform French SFIs about vocal risks. The data collected in the present survey indicate which part of the SFI population is more at risk (eg, young, female SFIs) and thus which classes could be designed as a priority for prevention programs (eg, aerobics classes, during which loud music levels are often used). The analysis of the vocal risk factors also provide important information for giving priority advice to SFIs regarding their teaching environment (music and noise intensity control), teaching and vocal habits (controlling the frequency of classes, avoiding shouting), and their lifestyle (importance of sleeping time). As our statistics indicate, only a minority of French SFIs received information on vocal difficulties, whereas a large majority (80%) would be interested in getting advice in vocal domain. Eventually, the data reported here show that VD have direct consequences on the SFIs' professional life in 27% of the cases, which is far from being negligible. It would therefore be interesting to go further and investigate about the amount of time missed from work because of vocal problems.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found online at at doi:10.1016/j.jvoice.2016.04.014.

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