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Risk Factors for Voice Disorders among *Fado* Singers: A Cross-Sectional Study

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Abstract: *Fado* is an urban Portuguese musical style rooted in popular culture. Previously found data suggests that *Fado* singers may have an increased risk of developing voice disorders. (1) Aim: To determine the risk factors for the development of voice disorders among *Fado* singers. (2) Methods: A cross-sectional study was conducted through the administration of a questionnaire containing questions related to voice disorders in singers. The relationship between personal and social data, musical background, performance demands and habits, vocal health and wellbeing, and strategies to overcome voice problems are reported. Beyond a comprehensive characterization, odds ratios (ORs) and their 95% confidence intervals (CIs) for the association with voice disorders were calculated through univariate and multivariate logistic regression analyses. (3) Results: The significant risk factors for voice disorders were as follows in decreasing order: nose-related disorders; decongestants or antihistamines; oral contraceptives or hormone replacement therapy; previous smoking habits; and vocal fatigue after performances. (4) Conclusion: These activities significantly increased the risk of developing voice disorders. The evidence from this study and the relative low prevalence of self-reported voice disorders suggest that these singers may develop a kind of protective combination of factors beyond the scope of this research.

Keywords: voice disorders; risk factors; singing; epidemiology; *Fado*; self-report

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1. Introduction

1.1. Singing and Risk

Singing is known to be a professional occupation that increases the risk of voice disorders; however, the scientific evidence on this is sometimes conflicting. Indeed, a positive relationship between singing and laryngeal pathologies was found [1,2], and an association with vocal misuse and overuse is clear. Earlier, in 1996, occupational disorders related to voice were considered underdeveloped and poorly studied compared to other fields. This was a major impediment for professionals in need of clinical guidance. Vocal load, background noise, room acoustics, and relative humidity in the air were assigned and, hence, studied as possible risk factors [3]. Even nowadays, as perceived during the research, the amount of literature that clearly addresses risk factors for voice disorders in singers is still limited. It was expected to be higher since this occupation is more commonly associated with voice disorders than many other activities, as claimed in the professional and academic communities. The research on this subject is indeed scant [4], which makes it difficult to

compare results. Based on a meta-analysis approach, the risk of laryngeal pathologies and associated symptoms among professional singers was calculated [1]. Professional singers are more likely to reveal hoarseness (OR = 2.00; 95% CI: 1.61–2.49), gastroesophageal reflux disease (OR = 1.45; 95% CI: 1.19–1.77), Reinke's edema (OR = 2.15; 95% CI: 1.08–4.30), and vocal fold polyps (OR = 2.10; 95% CI: 1.06–4.14). The risk factors for developing voice disorders were quite similar during a comparison between singing teachers and a control group [5]. However, the first group was much more likely to report past or present voice disorders (OR = 3.67; 95% CI: 1.82–7.38). A current voice problem was three times more likely to be reported if the subjects were taking medications that contribute to dehydration (OR = 3.30; 95% CI: 1.50–7.24). The subjects who had reported past voice problems were five times more likely to refer to a present voice problem (OR = 4.73; 95% CI: 1.86–12.01). Additionally, in this study, the female subjects were two times more likely to report past voice problems than the male subjects (male subjects OR = 0.49; 95% CI: 0.26–0.93). The younger subjects showed a slightly lower probability of reporting than the older ones (OR = 0.97; 95% CI: 0.94–0.99).

Lately, reflux has been increasingly associated with voice disorders among singers, whether it is related to macroscopic and microscopic changes in the mucosa of the vocal folds [6,7] or to the singers' enhanced sensitivity to it [8].

The risk factors for voice disorders among Carnatic singers were as follows: clenching of teeth; frequent colds; difficulty hearing; stress related to the profession; and regular intake of medications [9]. Among Yakshagana performers, a form of folk theater in India, only frequent throat clearing (OR 6.2 [95% CI 1.6; 23.7]) was found to be a significant risk factor associated with a higher prevalence of self-reported voice problems [10].

In a more recent study involving professional actors and singers, the significant risk factors for voice disorders in singers were loud speech (p = 0.029) and the presence of allergies or asthma (p = 0.048) [11].

1.2. Fado and Its Voices

Fado is a form of urban and folk Portuguese music with a lyrical expression. The socio-historical literature about this singing style is abundant, though not relevant in the context of this paper. Culturally, formal training or singing lessons are not expected [12]. There were already some characteristics that could be considered hints for an increased risk for voice disorders, such as vocal health thresholds near pathological levels combined with unhealthy lifestyles and performing under poor acoustic conditions [13–17]. In a previous study, a prevalence of 39.6% of self-reported voice disorders was found among *Fado* singers [18]. The kind of laryngeal alterations reported are compatible with the consequences of a hyperfunctional pattern of voice production as well as a hypothetical vocal overload. The combination of all these aspects results in an apparently unruly setting that may constitute a hazard to the voices of singers.

Hence, the purpose of this study is to determine the associated risks and protective factors for voice disorders in relation to the act of singing *Fado*.

2. Materials and Methods

All subjects provided their informed consent for inclusion before participating in the study. The study was conducted in accordance with the Declaration of Helsinki, and the project was approved by the Ethics Committee of Universidade Fernando Pessoa (FCS-06/02/2017).

The adopted methodology regarding data collection and questionnaire administration for this study was the same as the one that was previously described in another paper [18].

2.1. Sample

Eligible singers were recruited using convenience/snowball sampling techniques [19]. The primary inclusion criteria for these participants were as follows: singer of the *Fado de Lisboa* substyle; older than 18 years old; an active singer. One hundred sixty-one subjects

were recruited to participate in this study. The questionnaire was completed by 111 (68.9%) singers. Fifteen individuals (9.3%) were excluded from the study because they did not complete the entire questionnaire. The remaining 21.7% of subjects did not answer the questions, were unavailable, or were unwilling to participate.

2.2. Questionnaire Development

The singers were asked to fill out a questionnaire built to fit the research questions of a more comprehensive study conducted by the authors. It was built using the following strategy:

1st Phase: The survey was developed after identifying studies with similar goals regarding voice disorders [20–35]. The findings were based on the search strategy of the authors' previous research [36]. The most pertinent topics from each survey were collected. The number and type of questions were scattered and shaped to organize them according to the constructs under investigation. The very first version was composed of 114 questions.

2nd Phase: The previous version was still heterogeneous and long. The questions were selected to reduce the survey's length and remove those that assessed the same constructs. This phase was conducted by the first author, a speech–language pathologist specializing in voice disorders (the second author), and a statistician (the third author). The number of questions was reduced to 92.

3rd Phase: The goal of this phase was to select only the questions that assessed the constructs under study in this research. The selected questions were syntactically improved to be more understandable for the subjects. The way that some of the questions were measured was also changed. They were organized according to the following six different parts: personal and demographic data; musical experience and knowledge; performance demands and habits; personal and social habits; vocal health and wellbeing; and strategies adopted to overcome voice problems. A reduction to 55 questions was achieved.

4th Phase: A pilot test was conducted with two singers to identify potential flaws. Two questions were reformulated to ensure the comprehension of the remaining participants.

For this study, a cross-sectional design based on the self-completion questionnaire method was adopted.

2.3. Questionnaire Fulfillment

An online version of the questionnaire was built using LimeSurvey, version 2.63.1 + 170,305 ((https://www.limesurvey.org/), accessed on 10 January 2017)) and hosted in a private domain. The overall administration began on 21 February 2017 and lasted until 2 March 2018. After the subjects completed the questionnaire, leaflets with scientifically based information on vocal hygiene for singers were sent to them. Confidentiality was ensured, along with the impossibility of responding more than once, through the creation of individual tokens.

2.4. Data Analysis

A statistical analysis was performed using IBM© SPSS® Statistics, version 25 (IBM© Corporation, Chicago, IL, USA). The level of significance was set to 0.05 for all inference situations. The categorical dichotomic variables were described using counts and percentages (*n*; %) and the ordinal ones using medians and corresponding interquartile ranges, while the quantitative ones were described using averages and standard deviations (av (st.dev.)) and ranges (minimum–maximum) (Tables 1 and 2). The prevalence of the subjects having had a voice disorder and being satisfied with their voice quality was calculated along with confidence intervals using the adjusted Wald method. Bivariate analyses of associations with voice problem outcomes were evaluated for statistical significance using a univariate logistic regression, which allowed for the estimation of the odds ratios (ORs) and the corresponding confidence intervals (95% CIs) (Table 3). Multivariable binary logistic regression models (the Wald backward stepwise method, $p = 0.05$ for covariate inclusion and $p = 0.10$ for exclusion) were used to predict the associations (as risk or protective factors)

between the covariables identified in previous binary logistic regression analyses (Table 3) and having "Voice Problems", which were adjusted for age and sex (Table 4). The quality of the logistic regressions was assessed using the following measures: the percentage of correctly predicted problems, the −2 log likelihood, the Cox and Snell and the Nagelkerke determination coefficients, and the area under the ROC curve (AUC), which indicates the adjustment of the model for the prediction of voice problems.

Table 1. Sample characterization.

Variable	Categories	Statistics	
Gender	Male	52 (46.8%)	
	Female	59 (53.2%)	
Age (years)	min-max	18–74	
	av (st.dev)	42.2 (16.5)	
			95% CI
Voice Problems (past/present)	yes	45 (40.5%)	31.9%–49.9%
Satisfaction with voice quality	yes	98 (88.3%)	80.9%–93.6%

Table 2. Descriptive characterization of the influencing factors on voice disorders.

Variable	Categories	*n* (%)	Me (P25–P75)
Vocal fatigue after performances	Never	21 (18.9%)	Occasionally (Occasionally–Sometimes)
	Occasionally	49 (44.1%)	
	Sometimes	36 (32.4%)	
	Often	4 (3.6%)	
	Always	1 (0.9%)	
Use of voice amplification system	Never	12 (10.8%)	Occasionally (Occasionally–Sometimes)
	Occasionally	44 (39.6%)	
	Sometimes	42 (37.8%)	
	Often	12 (10.8%)	
	Always	1 (0.9%)	
Previous smoking habits	No	82 (73.9%)	
	Yes	29 (26.1%)	
Nose-related disorders, Decongestants, or Antihistamines	No	87 (78.4%)	
	Yes	24 (21.6%)	
Corticosteroids	No	94 (84.7%)	
	Yes	17 (15.3%)	
Oral contraceptive or hormone replacement therapy	No	98 (88.3%)	
	Yes	13 (11.7%)	
Water intake during performances	Stop	5 (4.5%)	Increases (Maintains–Increases)
	Decreases	9 (8.1%)	
	Maintains	23 (20.7%)	
	Increases	49 (44.1%)	
	Increases a lot	25 (22.5%)	
Has any disease and/or takes medicines	No	42 (37.8%)	
	Yes	69 (62.2%)	
Having asthma or taking medications	No	102 (91.9%)	
	Yes	9 (8.1%)	
Vocal behavior strategies to overcome voice problems	No	73 (65.8%)	
	Yes	38 (34.2%)	

Table 3. Univariate logistic regression analysis of risk factors independently associated with voice problems (n = 111 for most variables).

Covariate	Category	Voice Problems		p	OR (95% CI OR)
		No	Yes		
Gender	Male	36 (54.5)	16 (35.6)		1
	Female	30 (45.5)	29 (64.4)	0.051	2.175 (0.998–4.741)
Age	<40 years	37 (56.1)	23 (51.1)		1
	≥40 years	29 (43.9)	22 (48.9)	0.608	1.22 (0.571–2.610)
Vocal fatigue after performances	Never/Occasionally	47 (71.2)	23 (51.1)		1
	at least Sometimes	19 (28.8)	22 (48.9)	**0.033**	2.366 (1.073–5.218)
Use of voice amplification system	Never/Occasionally	37 (56.1)	19 (42.2)		1
	at least Sometimes	29 (43.9)	26 (57.8)	0.154	1.746 (0.812–3.754)
Previous smoking habits	No	53 (80.3)	29 (64.4)		1
	Yes	13 (19.7)	16 (35.6)	0.065	2.249 (0.951–5.318)
Water intake during performances	Maintains or increases a lot	55 (83.3)	42 (93.3)		1
	Stop or Decreases	11 (16.7)	3 (6.7)	0.132	0.357 (0.094–1.362)
Has any disease and/or takes medicines	No	25 (37.9)	17 (37.8)		1
	Yes	41 (62.1)	28 (62.2)	0.991	1.004 (0.460–2.194)
Nose-related disorders, use of decongestants or antihistamines	No	56 (84.8)	31 (68.9)		1
	Yes	10 (15.2)	14 (31.1)	**0.049**	2.529 (1.005–6.362)
Having asthma or taking medications	No	63 (95.5)	39 (86.7)		1
	Yes	3 (4.5)	6 (13.3)	0.111	3.231 (0.764–13.667)
Corticosteroids	No	29 (43.9	28 (62.2)		1
	Yes	37 (56.1)	17 (37.8)	0.102	0.523 (0.242–1.128)
Oral contraceptive or hormone replacement therapy	No	62 (93.9)	36 (80)		1
	Yes	4 (6.1)	9 (20)	**0.033**	3.875 (1.113–13.489)
Vocal behavior strategies to overcome voice problems	No	47 (71.2)	26 (57.8)		1
	Yes	19 (28.8)	19 (42.2)	0.145	1.808 (0.815–4.008)

Table 4. Multivariate logistic regression analysis of risk factors independently associated with voice problems (n = 111).

Covariable	p	OR (95% CI OR)
Vocal fatigue after performances (YES)	**0.023**	2.868 (1.157–7.109)
Previous smoking habits (YES)	**0.006**	3.955 (1.488–10.515)
Nose-related disorders, Decongestants or Antihistamines (YES)	**0.011**	5.552 (1.481–20.817)
Corticosteroids (YES)	0.057	0.219 (0.046–1.048)
Oral contraception or hormone replacement therapy (YES)	**0.026**	4.955 (1.210–20.293)
Constant	**<0.001**	0.216

Variables entering the first step of the analyses: vocal fatigue after performances; use of voice amplification system; previous smoking habits (no missing); water intake during performances; has any disease and/or takes medicines; nose-related disorders and medications; having asthma or taking medications; vocal behavior; allergies or taking corticosteroids; and oral contraception or hormone replacement therapy. This model predicted 70.0% of the results correctly. Model quality: −2 log likelihood = 127.2; Cox and Snell R^2 = 0.185; Nagelkerke R^2 = 0.249; and AUC = 0.735 (95% CI: 0.638–0.831).

3. Results

An overview of the sample is shown in Table 1, which displays the summary statistics for sample characterization. The authors attempted to have a balanced sample regarding gender, and 59 of the interviewed singers (53.2%) were female. The mean age of the participants was 42.2 years (±16.5), ranging from 18 to 74 years.

The singers were asked whether they had voice problems. Based on this self-reported measure, 40.5% (95% CI: 31.9–49.9%) stated so. Regarding self-perceived voice quality, a

great majority of the singers, 88.3% (95% CI: 80.9–93.6%), affirmed they were satisfied with their own voice quality.

Even though every variable of the previously described questionnaire was analyzed, the authors opted only to show those that were later identified as important in the univariate and multivariate logistic regression analyses in order to improve the readability of the paper. Thus, Table 2 displays the descriptive statistics for those selected variables.

Vocal fatigue at the end of performances was revealed to be occasionally associated with at least half of the singers. Very few subjects referred to frequently feeling vocally tired. Infrequent use of amplification systems was shown by most of the subjects, since they only used them occasionally. The great majority stated that they had never smoked. The majority did not report the following: nose-related disorders and the use of decongestants or antihistamines (78.4%); the use of corticosteroids (84.7%); and hormone replacement therapy or the use of oral contraception (88.3%). More than half stated that they usually increase their water intake at the time of shows. At least 44 (39.6%) of the singers said that they had at least one disease of any order or took medicines. Specifically, asthma and the use of related medicines were reported by nine singers. Only less than half of the subjects reported having access to information that helps them maintain vocal health.

The singers were qualitatively asked about the strategies that they usually adopted to overcome voice problems (Table 2). Only those strategies that were related to vocal behavior (such as vocal exercises or avoiding bad vocal habits) were associated with voice disorders.

Using a univariate logistic regression, it was possible to identify several variables independently associated with the outcome "voice problem" (Table 3). The covariables vocal fatigue after performances (OR ≅ 2.4; $p = 0.033$), oral contraception or hormone replacement therapy (OR ≅ 3.9; $p = 0.033$), and nose-related disorders and medications (OR ≅ 2.5; $p = 0.049$) were found to be risk factors independently associated with voice problems, while having access to information that helps maintain vocal health (OR = 0.4; $p = 0.024$) was identified as a protective factor (decreasing the probability of having voice problems by 60%). Moreover, gender (female OR ≅ 2.2) and previous smoking habits (OR ≅ 2.2), although not significantly associated with voice problems for the represented population, were very significant as risk factors for this sample.

A multivariate logistic regression (adjusting the results per age and sex) helped to identify vocal fatigue after performances (OR ≅ 2.9; $p = 0.023$), previous smoking habits (OR ≅ 4; $p = 0.006$), nose-related disorders and medications (OR ≅ 5.6; $p = 0.011$), and oral contraceptive or hormone replacement therapy (OR ≅ 5; $p = 0.026$) as significantly and independently associated risk factors for having "voice problems" (Table 4) for the population of *Fado* singers. Taking corticosteroids (OR ≅ 0.22) was retained by the model as a protective factor for having "voice problems", although not a significant one ($p = 0.057$).

4. Discussion

Fado singing is commonly and popularly associated with some possible unhealthy habits, including singing with no formal training, performing frequently without an amplification system, singing in venues with unfavorable characteristics, going to bed late, etc. This led us to the hypothesis that singing *Fado* is a highly demanding task for the vocal tract that is associated with probable vocal overload and, consequently, a likely increase in the risk of developing voice disorders.

The lack of access to information to help maintain vocal health was revealed to be a protective factor in the univariate analysis. This apparently odd result can be explained by the assumption that singers who seek clinical guidance are likely to be those who already have voice disorders. Those who do not have any voice problems are less likely to seek clinical guidance as a voluntary or preventive initiative. Therefore, this variable was not included in the multivariable model.

Nose-related disorders, such as rhinitis and sinusitis, as well as related medications (decongestants or antihistamines), were found to be the most impactful factor for voice disorders in *Fado* singers, increasing the risk by more than five times. This can be interpreted

in the following two different ways: the cause may arise from the disorder or from the medication intake. This is not surprising since allergic rhinitis is commonly associated with voice changes [37–41]. Singers tend to be in environments, such as stages, that are more prone to air, dust, or pollutants, which trigger these kinds of disorders [42–44].

Oral contraceptives and/or hormone replacement therapy increase the risk of developing voice disorders by five times. As expected, this primarily applies to female singers. Even though some men may undergo hormone replacement therapy, this did not happen in our sample, and, therefore, it has not been considered. The impact of hormonal fluctuations on voice has already been studied for some time [45]. Traditionally, oral contraceptives are considered a risk factor for voice quality. However, some contradictions were found in the literature that defend the innocuous effect or even the improvement in voice parameters or resonance caused by oral contraceptives, whether in professional voice users or not [46–53]. A recent revision of the available literature on the topic was conducted, which, specifically addressing singers, states that oral birth pills improve vocal stability [54]. Hormonal replacement therapy is usually taken by postmenopausal women to regulate hormone levels. Though consequent voice changes are not unexpected, there is a significant decrease in the fundamental frequency and sound pressure levels in postmenopausal women with no hormonal replacement therapy. Hormonal therapy, on the other hand, counteracts the vocal changes related to menopause [55,56]. Indirect effects of replacement therapy could also contribute to positive changes, such as restored libido and wellbeing and improved mood [45,57,58]. The adverse effects of this therapy on voice seem to be underexplored. A recent study found a significant increase in the jitter value, a measure that reflects the short-term frequency instability associated with the irregularity of thyroarytenoid muscle contractions [59].

Smoking was perhaps the most straightforward risk factor among all voice users. It was shown to increase the risk of voice disorders among *Fado* singers by four times. Numerous studies state the highly destructive and adverse effects of smoking cigarettes on vocal folds [60–64].

Another identified significant risk factor was vocal fatigue, which was shown to increase the risk of voice disorders by three times. This may represent both the lack of vocal endurance and the high vocal load that these singers are prone to. Vocal fatigue is seen as a complex clinical phenomenon associated with a perceived effort and discomfort while producing voice that changes according to the usage load, i.e., increases with use and decreases with rest [65,66]. Commonly, some factors, such as increased viscosity of vocal folds, reduced blood circulation, and increased tissue strain (other than muscle), are associated [67,68]. Even though more objective studies are needed, vocal fatigue is accepted as a vocal sign that leads subjects to seek clinical guidance to prevent a possible broad clinical event [65]. A study on the bioenergy of the intrinsic laryngeal skeletal muscle is pointed out as a topic in the contemporary trend to justify vocal fatigue [69]. A recent study revealed that the traditional vocal warm-up, when compared to a physiological approach, may trigger fatigue earlier [70]. Some subpopulations of singers were found to be more prone to fatigue than others [4,30,71–73].

Taking corticosteroids was found to be a protective factor for the sample, although without significance ($p = 0.057$) for the population. This requires a cautious interpretation. This result may be explained by the fact that the singers who take these medications already have problems and, thereafter, feel their reduction. Another possible explanation for this is that most singers take this medication for other reasons than voice disorders. Thus, a secondary effect on the vocal apparatus may exist, particularly on the respiratory tract and resonance.

Indeed, more risk factors were identified than protective ones, which clearly suggests that singing significantly increases the risk of voice disorders. A multiple regression analysis revealed a hazardous combination of risk factors. The univariate analysis suggested that access to vocal health information is effective enough to prevent voice disorders. During the data collection, individual leaflets with scientific information about vocal hygiene were sent

to singers. These results may be interpreted in combination with the low prevalence of self-reported voice disorders compared with similar singing styles [36]. Thus, a combination of protective factors may be hypothesized, which, evidently, requires cautious further study.

5. Conclusions

The purpose of the current study was to determine risk factors contributing to the development of voice disorders in *Fado* singers. The most significant ones were as follows: vocal fatigue after performances; having previous smoking habits; nose-related disorders; use of decongestants or antihistamines; and oral contraception or hormone replacement therapy.

Surprisingly, taking into account the whole applied questionnaire, some predictable variables were not identified as either risk or protective factors among *Fado* singers, such as the use of amplification systems, voice warm-up, voice usage in other occupations other than singing, and strategies adopted to overcome voice problems. Thus, these results contribute to demystifying some preconceptions associated with singing folk and popular music. However, the achieved results are based on self-reported data, and they must be interpreted as such. Future investigations shall include other data collection methods beyond this, such as the so-called instrumental voice analysis. Furthermore, an assessment of the objective vocal load and adequacy of the repertoire regarding voice range and register is required.

As a pioneering study, the authors recommend further investigation of the individual risk factors. These results are important for the prevention of voice disorders in this specific population. Therefore, an awareness program is recommended to highlight these risk factors and state measures for avoiding them.

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