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Alimentary Tract

Reflux symptoms in professional opera soloists

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ABSTRACT

Background: Professions distinguished by repeated vocal stress carry a high risk of developing gastroesophageal reflux symptoms (GERS) which may affect vocal performance.
Aims: To investigate the prevalence of self-reported GERS in professional opera soloists.
Methods: A validated questionnaire regarding self-reported GERS (heartburn, regurgitation, chest pain, dysphagia, hoarseness, and cough) and lifestyle habits was administered to 116 professional opera soloists (mean age 34.1 ± 7.3 years, F:M ratio 1:1.1). Age and sex-matched opera choristers and control subjects were used as control. Prevalence rate ratios (PRRs) adjusted for confounding factors were evaluated.
Results: Among GERS, belching (33.6%), heartburn (19.8%), and dysphagia (15.5%) were the most commonly reported by soloists. In particular, a higher risk of heartburn (PRR 2.61, 95% CI 1.45–4.69) and dysphagia (PRR 2.58, 95% CI 1.31–5.10) was reported in soloists as compared to choristers. The prevalence of obesity and late dinner was higher in both choristers and soloists in comparison to the population sample ($p < 0.001$). GERS was more common among soloists who received pharmacologic treatment and their prevalence was unrelated to the years of singing activity.
Conclusions: Professional opera soloists, regardless of the length of their career, are predisposed to developing GERS. Physicians should encourage patients to correct preventable risk factors. A prolonged pharmacological treatment might be needed.

1. Introduction

According to the Montreal classification, gastroesophageal reflux disease (GERD) is defined as a condition which develops when the reflux of stomach contents causes troublesome symptoms and/or complications [1]. Up to one third of the general population in the Western world suffers from this condition, and patients may experience different gastroesophageal reflux symptoms (GERS) including, among others, heartburn, regurgitation, dysphagia, hoarseness, and cough [2,3]. GERD complications may be life-threatening and range from reflux esophagitis to Barrett's esophagus and, eventually, esophageal adenocarcinoma [4]. The transient relaxation of the lower esophageal sphincter and increase in intra-abdominal pressure, the spontaneous reflux through a hypotonic sphincter, and the anatomic distortion of the gastroesophageal junction are the main mechanisms underlying GERS [5,6]. A number of risk factors have been shown to predispose to GERD and its related symptoms, namely weight gain and obesity [7], and a high dietary fat intake [8]. Other factors, including smoking, coffee [9,10], and alcohol consumption [4,11], have not been definitely associated with GERD, but are likely to have a role.

GERS decrease the quality of life, worsen work productivity, and affect the time off from work [12,13]. In particular, GERS have been associated with occupations characterised by frequent night shifts [14,15], rapid or repeated blows (wind players, glassblowers) [16], and voice overuse (singers, teachers) [17–19]. The predisposition to GERS in opera singers might be due to the rapid changes of subglottal pressure and the frequent use of the diaphragm, typically associated with this profession. In a previous study of ours, a higher risk of suffering from GERS was found in opera choristers in comparison to the general population [18]. The relevance of GERS in professional voice users is crucial, as they may jeopardise the singer's career, deteriorating the vocal performance. However, no

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data regarding this condition are available in professional opera soloists who have dramatically different workloads, stress levels, life habits, and performance expectations as compared to those of opera choristers.

Aim of the present study was therefore to investigate the prevalence of GERS in professional opera soloists and to evaluate the impact of lifestyle factors on this condition.

2. Methods

2.1. Study design and subjects

Our study was designed to evaluate the prevalence of self-reported GERS in a series of professional opera soloists actively performing in the twenty most remarkable opera houses or festivals in Europe, including Teatro alla Scala (Milan, Italy), Teatro Regio (Turin, Italy), Teatro La Fenice (Venice, Italy), Teatro del Maggio Musicale Fiorentino (Florence, Italy), Teatro dell'Opera di Roma (Rome, Italy), Teatro di San Carlo (Naples, Italy), Rossini Opera Festival (Pesaro, Italy), Teatro Massimo (Palermo, Italy), The Royal Opera House (London, UK), Glyndebourne Opera Festival (Lewes, UK), Dutch National Opera (Amsterdam, The Netherlands), Wiener Staatsoper (Wien, Austria), Salzburger Festspiele (Salzburg, Austria), Teatro Real (Madrid, Spain), Gran Teatre del Liceu (Barcelona, Spain), La Monnaie (Bruxelles, Belgium), Opéra Bastille (Paris, France), Théâtre des Champs-Élysées (Paris, France), Deutsche Oper Berlin (Berlin, Germany), Bayerische Staatsoper (Munich, Germany). Between June 2016 and June 2017, a study questionnaire structured in an anonymous format was administered to professional opera soloists. Data collected in a previous study of ours from opera choristers and a sample of the general population were used as controls [18]. Each enrolled subject who took part in the study gave informed consent for anonymised publication of data.

2.2. Data collection

The questionnaire (modified questionnaire by Locke et al.) [20,21] was the same used in a previous study investigating GERS in professional opera choristers [18]. The questionnaire contains general questions about individual characteristics (age, gender, weight, height), lifestyle habits (tobacco and alcohol consumption, physical activity in leisure time, dinner late in the evening), and specific questions investigating GERS. In particular, the six GERS identified in the Montreal classification [1] were investigated, including heartburn (an epigastric or retrosternal burning pain or discomfort feeling that rises into the chest), regurgitation (a bitter- or sour-tasting fluid influx into the throat or mouth), chest pain (any pain or discomfort felt inside the chest but not including heartburn or any pain that is primarily in the abdomen), non-troublesome dysphagia (a feeling that food sticks in the throat or chest), hoarseness (rough and harsh voice), and cough (persistent coughing episodes as often as 4–6 times a day). A subject was considered to suffer from GERS when symptoms occurred during the year preceding the study. Other relevant upper gastrointestinal symptoms (epigastric pain, vomiting, nausea, and belching) were also evaluated. Opera soloists were finally requested to record their voice type (soprano, tenor, mezzo-soprano, baritone, and bass), the years of singing activity, and the number of performances in the last year.

2.3. Data analysis

Continuous variables were expressed as mean ± standard deviation (SD) and comparisons between groups were performed with the *t* test. Comparisons of categorical variables were performed with the χ^2 test. The comparison of the frequency distribution of each symptom between the groups was performed with the χ^2 test. The crude prevalence rate ratios (PRR) of each symptom, according to the presence in the year before the survey ("ever/never in the last year") and the presence "once or more in a week" among opera soloists, opera choristers, and general population sample were computed. PRR adjusted for gender, age, body mass index, alcohol consumption, physical activity, smoking, and eating habits were computed. The adjusted PRR of symptoms according to voice type were also computed; 95% confidence interval (CI) was calculated. A level of $p < 0.05$ (2-tailed) was considered significant. Data were analysed using the SAS statistical software (SAS/STAT version 9.3; SAS Institute Inc, Cary, USA).

3. Results

3.1. General and anthropometric characteristics

Of the 140 opera soloists who were contacted and invited to take part in the study, 24 (17.1%) refused to participate, mainly due to lack of time or because not interested. Among the 116 enrolled professional opera soloists (mean age 34.1 ± 7.3 years, F:M ratio 1:1.1), 62 were men (Supplementary Table 1). The median number of performances/year was 43 (range 23–58). Among the 62 men, 26 were tenors, 19 were baritones, and 17 were basses. Among the 54 women, 32 were sopranos, and 22 were mezzo-sopranos. Among the 351 professional opera choristers (mean age 40.8 ± 10.3 years, F:M ratio 1.2:1) who completed the survey, 157 were men and 194 were women (Supplementary Table 1). Among the 157 men, 76 reported being tenors, 38 baritones, and 36 basses. Among the 194 women, 102 reported being sopranos, 46 mezzo-sopranos, and 39 altos. For 14 subjects the information was not available. The control group was composed by 578 subjects from the general population (mean age 36.2 ± 11.8 years, F:M ratio 1.3:1; Supplementary Table 1). Four hundred and nine out of the 578 (70.7%) were currently employed – the clerk being the most common occupation (26.4%) – and none of them reported to be a professional singer.

Main anthropometric characteristics of opera soloists, choristers, and controls according to gender and comparison between variables are summarised in Supplementary Table 1. The distribution of individual characteristics and lifestyle habits in the three groups are summarised in Table 1. Overall, the prevalence of overweight and obesity in opera soloists did not differ from opera choristers, while it was significantly higher in comparison to the general population sample. In addition, the prevalence of subjects who reported to be physically active in their leisure time as well as those who reported consuming dinner late in the evening was significantly higher in opera soloists in comparison to controls but did not differ from opera choristers. Opera soloists also reported an alcohol intake similar to the general population sample, but higher in comparison to opera choristers. Finally, there are fewer current smokers among opera soloists and choristers compared to the general population.

3.2. GERS and other upper gastrointestinal symptoms

The crude prevalence of self-reported GERS and other symptoms in opera soloists, opera choristers and in the general population sample according to frequency (once or more in a week/once or more in a year) are shown in Table 2. When considering the PRR adjusted for gender, age, body mass index, alcohol consumption, physical activity, smoking and eating habits, and adopting the "ever/never in the last year" classification, opera soloists reported a significant higher prevalence of heartburn, regurgitation, hoarse voice, dysphagia, and epigastric pain than the general population, but only a higher prevalence of dysphagia in comparison to opera

Table 1
Distribution of participants according to selected individual characteristics.

	General population sample N. 578		Opera choristers N. 351		Opera soloists N. 116	
	N.	%	N.	(%)	N.	(%)
Gender						
Male	246	(42.5)	157	(44.7)	62	(53.4)
Female	332	(57.4)	194	(55.2)	54	(46.5)
				0.5178§		**0.0312**[a]
						0.1028[b]
BMI						
Underweight/normal (<25)	408	(70.7)	194	(55.2)	57	(52.7)
Overweight (≥25 and <30)	139	(24.0)	133	(37.8)	39	(36.1)
Obese (≥30)	30	(5.2)	24	(6.8)	12	(11.1)
				<0.0001[c]		**0.0007**[a]
						0.3523[b]
Smoking status						
Never smoker	308	(53.3)	218	(62.1)	68	(59.1)
Ex smoker	107	(18.5)	78	(22.2)	44	(38.2)
Current smoker	162	(28.0)	55	(15.6)	3	(2.6)
				<0.0001[c]		**<0.0001**[a]
						<0.0001[b]
Never	308	(53.3)	218	(62.1)	68	(59.1)
Ever	269	(46.6)	133	(37.8)	47	(40.8)
				0.0093[c]		0.2582[a]
						0.5692[b]
Alcohol consumption						
No	112	(19.3)	89	(25.4)	16	(13.7)
Yes	466	(80.6)	261	(74.5)	100	(86.2)
				0.0301[c]		0.1570[a]
						0.0093[b]
Physical activity in leisure time						
No	310	(53.9)	143	(40.8)	48	(41.7)
Yes	265	(46.0)	207	(59.1)	67	(58.2)
				0.0001[c]		**0.0171**[a]
						0.8675[b]
Late dinner in the evening						
No	305	(52.9)	106	(30.2)	22	(21.3)
Yes	271	(47.0)	245	(69.8)	81	(78.6)
				<0.0001[c]		**<0.0001**[a]
						0.0796[b]

Bold values are statistically significant.
[a] Chi squared test, general population sample as reference group.
[b] Chi squared test, opera choristers as reference group.
[c] Chi squared test, general population sample as reference group.

choristers (Table 3). When considering the adjusted PRR for reflux symptoms adopting the "once or more in a week" classification, opera soloists reported a statistically significant higher prevalence of heartburn, regurgitation, dysphagia, and epigastric pain than the general population, but also a higher prevalence of heartburn, dysphagia, and epigastric pain in comparison to opera choristers (Table 4).

When considering the crude prevalence of self-reported GERS according to voice type in the 116 opera soloists, we found a significant higher prevalence of regurgitation in mezzo-sopranos, baritones, and basses as compared to sopranos and tenors when the "once or more in a year" classification was adopted (Supplementary Table 2). The adjusted PRR and 95% CI for GERS according to voice types are reported in Supplementary Table 3.

When considering the pharmacologic treatment for reflux symptoms (proton pump inhibitors [PPIs], antacids, histamine-2 blockers), 26 out the 116 opera soloists (22.4%) were treated with a medication. However, GERS had a significantly higher prevalence in treated than in untreated opera soloists (Supplementary Table 4).

The prevalence of self-reported GERS (once or more in a year) did not differ in opera soloists according to the years of singing activity (Supplementary Table 5). Apart from belching, the other GERS prevalence was not associated with an earlier start of singing activity (Supplementary Table 6).

4. Discussion

We here show a higher prevalence of GERS and other upper gastrointestinal symptoms in a series of professional opera soloists compared to both opera choristers and control subjects. Professional opera soloists can be considered an occupational category with a high risk of developing GERS and, possibly, overt GERD, regardless of the years of singing activity. The importance of these findings is that GERS may heavily affect opera soloists' performance, inducing them to consider early retirement, as previously observed in a small series [17], and therefore a flawless clinical management aimed at correcting risk factors is warranted.

Regarding individual characteristics and lifestyle habits (Table 1), we found that overweight/obesity and having late dinner were more frequent in both opera soloists and opera choristers than the general population. Both of these findings are consistent with the singer lifestyle, who often spends a lot of time away for work and is forced to eat late in the evening after performances. Moreover, opera soloists showed a higher alcohol consumption as compared to the opera choristers, likely due to the stressful

Table 2
Prevalence of self-reported gastroesophageal reflux symptoms in 116 opera soloists, 351 opera choristers and 578 subjects from the general population.

	General population sample (578)		Opera choristers (351)		Opera soloists (116)	
	N.	(%)	N.	(%)	N.	(%)
Heartburn						
Once or more in a year	144	24.9	148	42.1	62	53.4
Once or more in a week	29	5.0	26	7.4	23	19.8
Regurgitation						
Once or more in a year	101	17.4	122	34.7	47	40.5
Once or more in a week	16	2.7	12	3.4	10	8.6
Chest pain						
Once or more in a year	96	16.6	73	20.9	26	22.4
Once or more in a week	16	2.7	8	2.3	3	2.5
Dysphagia						
Once or more in a year	109	18.8	72	20.5	43	37.0
Once or more in a week	32	5.5	24	6.8	18	15.5
Epigastric pain						
Once or more in a year	248	42.9	152	43.3	68	58.6
Once or more in a week	47	8.1	25	7.1	16	13.7
Belching						
Once or more in a year	251	43.4	186	53.1	68	58.6
Once or more in a week	138	23.8	94	26.7	39	33.6
Nausea						
Once or more in a year	183	31.6	95	27.0	44	37.9
Once or more in a week	30	5.1	14	3.9	8	6.9
Vomiting						
Once or more in a year	88	15.2	45	12.8	18	15.5
Once or more in a week	8	1.3	3	0.8	1	0.8
Cough						
Once or more in a year	200	34.6	153	43.5	43	37.0
Once or more in a week	42	7.2	19	5.4	8	6.0
Hoarse voice						
Once or more in a year	115	19.9	153	43.5	55	47.4
Once or more in a week	25	4.3	11	3.1	9	7.7

Table 3
Prevalent rate ratio (PRR) and 95% confidence interval for symptom ever/never in the last year. Model adjusted for dinner late in the evening, smoking habit (ever/never), age, gender, body mass index (continuous), alcohol consumption and physical activity.

	Opera soloists/general population sample		Opera soloists/opera choristers	
	PRR	CI 95%	PRR	CI 95%
Heartburn	**2.17**	**1.70–2.79**	1.18	0.94–1.47
Regurgitation	**2.11**	**1.57–2.85**	1.14	0.85–1.52
Cough	1.06	0.79–1.41	0.77	0.57–1.04
Hoarse voice	**2.67**	**2.02–3.54**	1.10	0.85–1.41
Chest pain	1.18	0.76–1.84	0.93	0.58–1.49
Dysphagia	**2.01**	**1.46–2.75**	**1.52**	**1.07–2.18**
Epigastric pain	**1.28**	**1.05–1.56**	1.09	0.87–1.36
Nausea	1.03	0.78–1.36	1.11	0.80–1.54
Vomiting	0.94	0.56–1.57	1.15	0.66–1.99
Belching	1.20	0.98–1.47	0.95	0.79–1.15

Bold values are statistically significant.

and demanding work that contributes to the development of unhealthy habits and addictions. Music performance anxiety was also found to be associated with tachycardia and hypertension, thus suggesting the need of a multidimensional approach for these patients [22]. Regarding smoking status, unsurprisingly there are fewer current smokers among soloists and choristers, probably because smoking have a negative impact on the voice output [23], and singers who reach a very high career level are likely to discontinue smoking for this reason. As all the above-mentioned risk factors are preventable, primary prevention would be the first desirable approach. In particular, weight loss has been associated with a clear improvement of GERS and a high rate of PPI therapy discontinuation [24].

Table 2 reports the crude prevalence of self-reported GERS (either once or more in a year and once or more in a week) in the three groups. We therefore calculated the adjusted PRRs (Tables 3 and 4) for potential confounders. Heartburn and regurgitation, the cardinal symptoms of GERD, were more prevalent among opera soloists compared to both the general population and the opera choristers. We are aware that the questionnaire is a limit of the study, as some symptoms might be exaggerated — especially those experienced over the last week — and some others undervalued — especially those experienced over the last year. Further, no conclusion can be drawn regarding the true prevalence of GERD in this population, as no objective testing is available and we cannot rely on the reported symptoms only. Nonetheless, most of our

Table 4
Prevalent rate ratio (PRR) and 95% confidence interval for symptom once or more in a week. Model adjusted for dinner late in the evening, smoking habit (ever/never), age, gender, body mass index (continuous), alcohol consumption and physical activity.

	Opera soloists/general population sample		Opera soloists/opera choristers	
	PRR	CI 95%	PRR	CI 95%
Heartburn	**4.64**	**2.51–8.59**	**2.61**	**1.45–4.69**
Regurgitation	**2.99**	**1.28–7.00**	2.08	0.79–5.43
Cough	0.83	0.35–1.97	1.47	0.56–3.86
Hoarse voice	1.77	0.73–4.29	2.50	0.89–7.00
Chest pain	0.87	0.19–3.92	1.26	0.24–6.51
Dysphagia	**3.82**	**2.08–7.02**	**2.58**	**1.31–5.10**
Epigastric pain	**1.94**	**1.10–3.43**	**1.92**	**1.01–3.67**
Nausea	1.57	0.72–.41	1.76	0.68–4.57
Vomiting	0.59	0.10–3.43	–	–
Belching	1.31	0.95–1.81	1.15	0.82–1.61

Bold values are statistically significant.

knowledge about GERS is mainly based on questionnaires [25–28], and this is the largest study exploring this issue in opera singers. We also found that some GERS are more common in opera soloists than in the general population (heartburn, regurgitation, hoarseness, dysphagia, and epigastric pain) and occur more frequently in opera soloists than opera choristers (see Tables 3 and 4). As stated in the Montreal classification, epigastric pain can be the major symptom of GERD [1]. There are a few evidences that this symptom may underlie GERD, in particular in a series of dyspeptic patients, a subset of heartburn negative subjects had a pathological esophageal acid exposure along with a higher prevalence of epigastric pain [29]. Indeed, other causes of epigastric pain should also be ruled out in the work-up of these subjects. Dysphagia can be defined as the sensation of impeded passage of solid foods or liquids through the esophagus [1]. A non-troublesome dysphagia (i.e., without food impaction or altered eating patterns) is frequent and has been reported in more than one third of patients with erosive esophagitis, mostly responsive to PPI therapy [30]. In professional voice users, this finding might be explained by the high pressures found in the upper gastrointestinal tract during phonation [31]. The high vocal load experienced by singers might impair esophageal sphincters pressure, predisposing them to non-troublesome dysphagia and even other GERS. In fact, in healthy volunteers, phonation of both low- and high-pitch sounds induces similar pressure increase within the stomach, lower esophageal sphincter, and esophagus, and a more marked increase of the upper esophageal sphincter [31]. In professional voice users, the frequent increase of abdominal pressure may favour the reflux of stomach contents that in turn causes GERS. Indeed, these assumptions need to be demonstrated with proper objective testing. Hoarseness and cough may be related to laryngopharyngeal reflux, also known as extra-esophageal reflux [32]. Other symptoms may include globus pharyngeus, chronic throat clearing and sore throat. To note, some professional voice users may have a silent reflux and may present with only “voice problems” that should therefore prompt a full work-up for GERD and extra-esophageal reflux [33]. Moreover, in another study conducted on singers, they found a high prevalence of abnormal laryngeal findings on initial screening strobovideolaryngoscopy examination, even in subjects without any symptoms [34]. Finally, a survey was recently conducted among 639 participants: 103 controls, 359 patients undergoing esophagogastroduodenoscopy and 177 otolaryngology clinic patients with throat symptoms [35]. The authors developed a self-administered questionnaire (34-item Comprehensive Reflux Symptom Scale), showing a partial overlap between GERD, GERS, and extra-esophageal reflux, thus supporting the idea that they could be part of the same spectrum of disease.

When we analysed the prevalence of GERS according to voice type, we found that, apart from regurgitation (more prevalent among mezzo-sopranos, baritones, and basses than in sopranos and tenors), the analysis did not report differences between the two groups. Supplementary Table 3 shows the adjusted PRRs for the single symptoms among the voice types. Soloists have a higher risk of suffering from hoarse voice, and baritones, sopranos, and mezzo-sopranos are at higher risk of developing heartburn and regurgitation compared to the general population. Instead, the number of years and the starting age of singing activity (Supplementary Tables 5 and 6), differently from opera choristers [18], were not related to the prevalence of most of GERS, therefore we should look to predisposing factors that are not time-related and that do not have a cumulative effect over time.

Supplementary Table 4 essentially indicates that subjects treated for GERS experience more symptoms than the non-treated group. In this study we have just considered an overall treatment, without distinguish among different medications (antiacid drugs, histamine 2 receptor blockers, or PPIs) and the duration of treatment. These results indicate that opera soloists might need a prolonged therapy at a high dose, or that they received a suboptimal therapy. Given the nature of the present study, no further inferences can be drawn.

We are aware of the limitations of this study. First, the lack of objective testing (e.g., esophageal pH monitoring, response to PPI treatment) does not allow to confirm GERD diagnosis in all cases. This is why, for the sake of accuracy, we only report the mere prevalence of GERS, without drawing any conclusion regarding the true prevalence of GERD. Second, the lack of more precise information on how patients were treated, and whether they responded or not, limits the strength of the study. Last, no data regarding endoscopic examinations (both upper gastrointestinal and laryngeal) are available. However, we have provided new insights into the prevalence and possible risk factors of GERS in a particular group of patients in which these symptoms may have a huge impact on their profession.

In conclusion, we have shown that opera soloists may suffer from GERS as an occupational-related disorder, regardless of the length of their career. This predisposition seems to be higher than in opera choristers. Some risk factors may play a major role and can be preventable. More studies are needed to better outline the risk for the single voice types, the optimisation of the therapy, and the risk of developing esophageal and laryngeal complications. Invasive tests, such as 24-h double-probe (esophageal and pharyngeal) pH-monitoring, esophageal manometry, and upper gastrointestinal endoscopy could be useful for the correct assessment and evaluation of these patients.

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Conflict of interest

None declared.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.dld.2018.11.026.

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