



Article

# Validity and Reliability of the Singer Reflux Symptom Score (sRSS)

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## Abstract

**Objectives:** To investigate the reliability and validity of the Singer Reflux Symptom Score (sRSS), a new patient-reported outcome questionnaire documenting the severity of reflux symptoms in singing voice is proposed. **Methods:** Amateur and professional singers consulting the European Reflux Clinic for laryngopharyngeal reflux disease (LPRD) symptoms and findings were prospectively recruited from January 2022 to February 2023. The diagnosis was based on a Reflux Symptom Score (RSS) > 13 and Reflux Sign Assessment (RSA) > 14. A control group of asymptomatic singer subjects was recruited from the University of Mons. The sRSS was rated within a 7-day period to assess test–retest reliability. Internal consistency was measured using Cronbach’s  $\alpha$  in patients and controls. A correlation analysis was performed between sRSS and Singing Voice Handicap Index (sVHI) to evaluate convergent validity. Responsiveness to change was evaluated through pre- to post-treatment sRSS changes. The sRSS threshold for suggesting a significant impact of LPRD on singing voice was determined by receiver operating characteristic (ROC) analysis. **Results:** Thirty-three singers with suspected LPRD (51.5% female; mean age:  $51.8 \pm 17.2$  years) were consecutively recruited. Difficulty reaching high notes and vocal fatigue were the most prevalent LPRD-related singing complaints. The sRSS demonstrated high internal consistency (Cronbach- $\alpha = 0.832$ ), test–retest reliability, and external validity (correlation with sVHI:  $r = 0.654$ ;  $p = 0.015$ ). Singers with suspected LPRD reported a significant higher sRSS compared to 68 controls. sRSS item and total scores significantly reduced from pre-treatment to 3 months post-treatment except for the abnormal voice breathiness item. ROC analysis revealed superior diagnostic accuracy for sRSS (AUC = 0.971) compared to sRSS-quality of life (AUC = 0.926), with an optimal cutoff at sRSS > 38.5 (sensitivity: 90.3%; specificity: 85.0%). **Conclusions:** The sRSS is a reliable and valid singer-reported outcome questionnaire for documenting singing symptoms associated with LPRD leading to personalized management of Singers. Future large-cohort studies are needed to evaluate its specificity for LPRD compared to other vocal fold disorders in singers.



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**Keywords:** laryngeal; otolaryngology; otorhinolaryngology; voice; laryngopharyngeal; reflux; singing; singer; professional; dysphonia; hoarseness

## 1. Introduction

Laryngopharyngeal reflux disease (LPRD) is a disease of the upper aerodigestive tract resulting from the direct and/or indirect effects of gastroduodenal content reflux, inducing morphological and/or neurological changes in the upper aerodigestive tract [1]. The backflow of gastroduodenal content into the vocal folds may alter the vocal fold structure and biomechanical properties, leading to vocal fold function impairments in both speaking and singing voices [2,3]. LPRD has a high prevalence in laryngology, affecting approximately 50% of voice clinic patients [4]. As for many laryngopharyngeal conditions, LPRD is associated with non-specific symptoms, which supports the need to use validated patient-reported outcome questionnaire for improving patient management [1]. Professional voice users report a high LPRD incidence compared to the general population [5], which is attributed to their vocal demands, diet habits (late-night eating), and stress patterns [2,5,6]. Currently, no singer-reported outcome questionnaire specifically assessing LPRD-related symptoms in singing voice has yet been prospectively validated [2]. Indeed, currently available patient-reported outcome questionnaires documenting LPRD symptoms were not developed for singing voice, and some subtle symptoms found only during singing may not be detected/evaluated with existing questionnaires (e.g., the difficulty to reach high pitches, loss of voice intensity in singing). Developing such a patient-reported outcome questionnaire is important for detecting potential reflux consequences on singing voice, rating the LPRD impact on singing voice and measuring treatment outcomes for non-specific symptoms.

This study aims to investigate the reliability and validity of the Singer Reflux Symptom Score (sRSS), a newly developed patient-reported outcome questionnaire designed to document the severity of non-specific reflux symptoms in singing voice.

## 2. Materials and Methods

### 2.1. Development of Singer Reflux Symptom Score

The development of the sRSS started after a multidisciplinary panel discussion during the Congress of the International Federation of Otorhinolaryngological Societies (IFOS, Paris, 2016), in which international experts discussed dysphonia related to LPRD and the potential impact of gastroduodenal content reflux on speaking and singing voice. A summary of key singing symptoms was compiled at the end of the session, and the author of this paper (JRL) developed the French version of the sRSS after having developed and validated the Reflux Symptom Score (RSS) [7]. Six singers were invited to validate the main symptoms of sRSS and to rephrase some items. The French and English versions of the sRSS are available in Figures 1 and 2. Note that the present validity study was conducted according to a checklist of recommendations and key characteristics to obtain valid and reliable patient-reported outcome measurements [7,8].

The sRSS consists of eight items, with the possibility to add a ninth item. Consistent with the RSS [7], the frequency and severity of each symptom are rated on a 5-point scale with each point of the frequency measure being precisely defined (Figures 1 and 2). The severity score of each item is multiplied by the frequency score to obtain a symptom score ranging from 0 to 25. The sum of these symptom scores is calculated to obtain the final sRSS score, which ranges from 0 to 200 (225 in case of a ninth symptom). In addition to severity and frequency, sRSS evaluates the impact of symptoms on the singer's quality of life (5-point Likert scale). The sRSS-quality of life score is calculated by the sum of each item score, ranging from 0 to 40. For this validity study, singers were invited to judge whether the questionnaire assessed all singing voice symptoms (yes/no).

The local ethics committee approved the study protocol (n°BE076201837630). All patients were invited to participate, and informed consent was obtained from those who enrolled in the study.

#### Singer Reflux Symptom Score (Singer RSS).

Nom et prénoms : .....

Niveau de stress au quotidien : .../10 (0 = jamais de stress ; 10 = mon stress est très intense et m'empêche de dormir).

Pouvez vous remplir ce questionnaire de symptômes :

Sévérité des plaintes: 0= pas de plainte ; lorsque les plaintes surviennent, elles sont très handicapantes = 5.

Fréquence des plaintes: 0 = jamais ; 1, 2, 3, 4, 5 = survient environs 20, 40, 60, 80% du temps quand je chante; 5 = survient à chaque fois que je chante.

Impact sur mon bien être et ma qualité de vie : 0 = aucun impact ; 5 = le problème m'handicape au quotidien.

|                                                                      | Sévérité des plaintes | Fréquence des plaintes | Impact sur la qualité de vie |
|----------------------------------------------------------------------|-----------------------|------------------------|------------------------------|
| <b>Symptômes spécifiques pour les chanteurs</b>                      | Score total:.....     | Score total:.....      | Score total:.....            |
| 1. Je souffre d'un problème de voix                                  | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |
| 2. Je souffre d'une voix soufflée                                    | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |
| 3. J'ai des difficultés à atteindre les notes aiguës                 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |
| 4. Je dois faire des efforts supplémentaires lorsque je chante       | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |
| 5. J'ai un manque de puissance                                       | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |
| 6. J'ai un manque de résistance vocale et un excès de fatigue vocale | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |
| 7. J'ai un excès de sécrétions                                       | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |
| 8. J'ai une gorge anormalement sèche                                 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |
| 9. Autre: .....                                                      | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  | 0 - 1 - 2 - 3 - 4 - 5        |

**Figure 1.** The French version of the Singer Reflux Symptom Score. The severity score of each item is multiplied by the frequency score to obtain a symptom score ranging from 0 to 25. The sum of these symptom scores is calculated to obtain the final sRSS score, which ranges from 0 to 200 (225 in case of a ninth symptom). In addition to severity and frequency, sRSS evaluates the impact of symptoms on the singer's quality of life (5-point Likert scale). The sRSS-quality of life score is calculated by the sum of each item score, ranging from 0 to 40.

#### Singer Reflux Symptom Score (Singer RSS).

|                                                               | Severity              | Frequency             | Quality of Life Impact |
|---------------------------------------------------------------|-----------------------|-----------------------|------------------------|
| <b>Symptoms</b>                                               | Total score:.....     | Total score:.....     | Total score:.....      |
| 1. I suffer from hoarseness                                   | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |
| 2. I suffer from voice breathiness                            | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |
| 3. I have difficulty in reaching high notes/pitch             | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |
| 4. I must do additional effort during singing                 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |
| 5. I have a lack of voice power                               | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |
| 6. I have a lack of vocal resistance and I have vocal fatigue | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |
| 7. I have excess throat mucus                                 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |
| 8. I have excessive throat or mouth dryness                   | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |
| 9. Other: .....                                               | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5 | 0 - 1 - 2 - 3 - 4 - 5  |

**Figure 2.** The English version of the Singer Reflux Symptom Score. The English version is not yet validated.

## 2.2. Subjects and Setting

Amateur and professional singers consulting the European Reflux Clinic (Brussels, Belgium) and Elsan Poitiers Polyclinic (Poitiers, France) for LPRD symptoms and findings were prospectively recruited from January 2022 to February 2023. The diagnosis was based on RSS > 13 [7] and Reflux Sign Assessment (RSA) > 14 [9], which were both validated criteria for the clinical diagnosis of LPRD in the general population. Nasovideolaryngostroboscopy was used for the RSA, considering oral, nasopharyngeal, laryngeal, and oral signs. A control group was composed of asymptomatic singers from the University of Mons. The 24 h hypopharyngeal–esophageal multichannel intraluminal impedance-pH testing (HEMII-pH) was not performed in singers because most feared the 24 h HEMII-pH probe tolerance, preferring to start an empirical therapeutic trial to achieve symptom relief whenever possible. Because LPRD diagnosis is based on the documentation of more than one pharyngeal reflux event at the 24 h HEMII-pH and the presence of LPRD symptoms (Dubai consensus) [1], asymptomatic individuals (no symptoms) did not undergo 24 h

HEMII-pH either. The absence of LPRD symptoms ( $\text{RSS} > 13$ ) may be consistent with the lack of LPRD diagnosis [1].

Singers and controls were excluded if they reported one of the following conditions: alcohol dependence, pregnancy, neurological or psychiatric illness, upper respiratory tract infection within the last month, current use of anti-reflux treatment (i.e., proton pump inhibitors (PPIs), histamine-H2 blockers, alginates and antacids), previous history of neck surgery or trauma, benign vocal fold lesions, malignancy, history of upper aerodigestive tract radiotherapy, untreated allergies, and inhaled corticosteroid-induced laryngitis (asthma).

The LPRD treatment included adherence to a standardized and validated anti-reflux diet [10], and the 3- to 6-month intake of post-meal alginates (Gaviscon Advance<sup>®</sup>, Reckitt Benckiser, Slough, UK) or antacid/magaldrate (Riopan<sup>®</sup>, Takeda, Zaventem, Belgium). Singers received a validated grid with diet recommendations and behavioral changes, which considered the patient's personalized habits (late meals, alcohol intake after singing performances, etc.) [10].

### 2.3. Statistical Analyses

Statistical analyses were performed using the Statistical Package for the Social Sciences for Windows (SPSS version 29.0; IBM Corp, Armonk, NY, USA).

The reliability analysis included test–retest reliability and internal consistency. The sRSS was rated within a 7-day period to assess test–retest reliability with Spearman's rank correlation coefficient. Internal consistency was assessed with the Cronbach- $\alpha$  for all sRSS items in patients and controls.

The validity analysis consisted of external and internal validity assessments. External validity was measured by correlations between sRSS, and the French version of the Singing Voice Handicap Index (sVHI) [11] with Spearman's rank correlation coefficient. A statistical comparison between the sRSS of singers and asymptomatic individuals was carried out to evaluate internal validity (Mann–Whitney U test). Responsiveness to change was evaluated by comparing baseline and 3-month post-treatment sRSS scores (Wilcoxon signed-rank test). The sRSS threshold for supporting the presence and absence of LPRD-related singing symptoms was determined by receiver operating characteristic (ROC) analysis. A level of significance of  $p < 0.05$  was used.

## 3. Results

Thirty-three singers with  $\text{RSS} > 13$  and  $\text{RSA} > 14$  were consecutively recruited from the European Reflux Clinic. The diagnosis was confirmed in two singers with one confounding laryngopharyngeal condition through 24 h HEMII-pH testing. The epidemiological, clinical, and singing characteristics are described in Table 1. There were 17 (51.5%) females and 16 (48.5%) males, respectively. The mean age was  $51.8 \pm 17.2$  years. The tobacco, marijuana, and alcohol consumption details are described in Table 1. There were eight (24.2%) professional singers. Most singers were soloists ( $n = 27$ , 81.8%). The primary voice classifications in females and males were mezzo-soprano ( $n = 9$ , 27.3%) and tenor ( $n = 5$ , 15.2%). A small number of singers carried out cool-down exercise after singing ( $n = 5$ , 15.2%), while 15 (45.4%) started singing with a warmup. The primary musical/singing styles were classical, pop, pop-rock, and modern singing styles (Table 1). A control group of amateur singers was composed ( $n = 68$ ; 50 (73.5%) females; age range: 18–32).

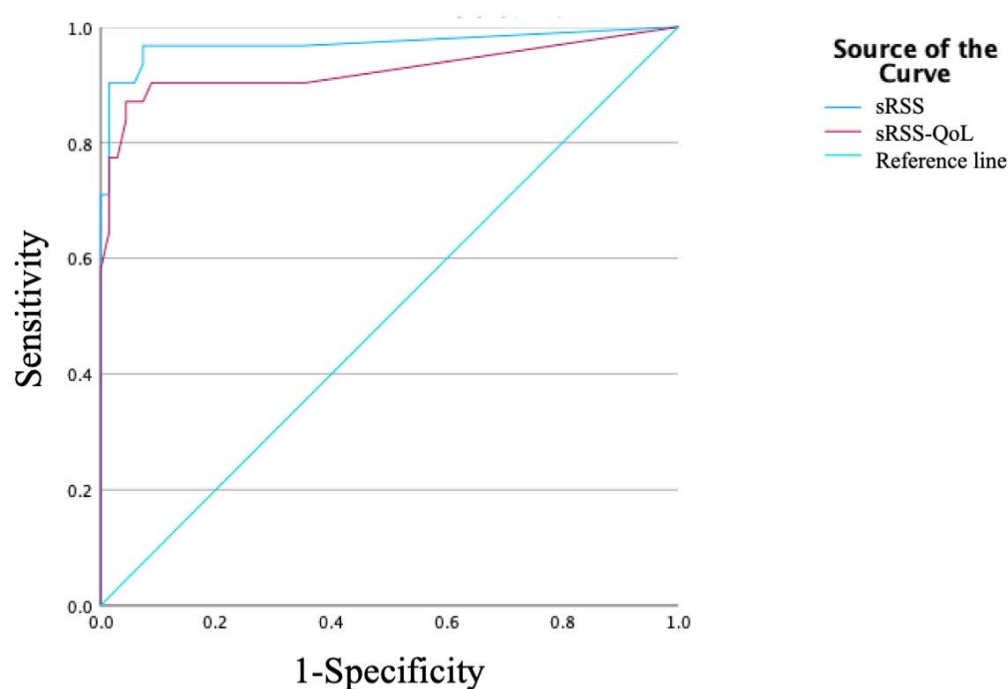
The prevalence of singing symptoms associated with LPRD are reported in Table 2. The difficulty to reach high notes and vocal fatigue/lack of vocal resistance were the two most prevalent complaints. The sRSS internal consistency analysis reported an adequate Cronbach- $\alpha$  ( $=0.832$ ). Test–retest analysis was adequate for all sRSS items and total scores

(Table 3). The intraclass correlation analysis reported adequate consistency for the test-retest reliability of the total sRSS (ICC: 0.736). The external analysis reported a significant positive correlation between sRSS and sVHI ( $r = 0.654$ ;  $p = 0.015$ ). The comparison between singers and individuals without LPRD symptoms ( $RSS < 13$ ) demonstrated significantly higher item and total sRSS scores in LPRD singers compared to controls (Table 4), which indicated a high internal validity (Table 4). The pre- to post-treatment evolution of sRSS item, total, and QoL scores is reported in Table 4. Except for the abnormal voice breathiness item, all symptoms demonstrated a significant reduction after a 3-month treatment combining diet, lifestyle changes, and post-meal alginate (Table 4). The ROC curve of sRSS and sRSS-QoL is reported in Figure 3. The area under the curve values of sRSS and sRSS-QoL were 0.971 and 0.926, supporting the superiority of sRSS for determining the LPRD diagnosis. According to the Youden index, a sRSS  $> 38.5$  reported a sensitivity of 90.3% and a specificity of 85.0%, respectively.

**Table 1.** Demographics, singing, and clinical outcomes of studies.

| Demographics                                           | Patients (n = 33) |
|--------------------------------------------------------|-------------------|
| Mean age (SD)                                          | 51.8 $\pm$ 17.2   |
| Body mass index (mean, SD)                             | 27.2 $\pm$ 8.0    |
| Gender (N, %)                                          |                   |
| Females                                                | 17 (51.5)         |
| Males                                                  | 16 (48.5)         |
| Smoker (current Cig/d) and smoking history (Paq. Year) | 3 (9.1)           |
| Cannabis consumption                                   | 1 (3.0)           |
| Alcohol (daily consumption)                            | 3 (9.1)           |
| Alcohol (mean and SD for unit/day in consumers)        | 0.2 $\pm$ 0.6     |
| Coffee/cafeine drink/day                               | 8 (24.2)          |
| Singer types                                           |                   |
| Soloist                                                | 27 (81.8)         |
| Chorister                                              | 6 (18.2)          |
| Voice range/classification                             |                   |
| Females                                                | n = 17            |
| Soprano                                                | 5 (15.2)          |
| Mezzo-soprano                                          | 9 (27.3)          |
| Alto                                                   | 1 (3.0)           |
| Several ranges                                         | 2 (6.1)           |
| Males                                                  | n = 16            |
| Tenor                                                  | 5 (15.2)          |
| Baritone                                               | 4 (12.1)          |
| Bass                                                   | 1 (3.0)           |
| Several ranges                                         | 6 (18.2)          |
| Singing habits                                         |                   |
| Habit of performing with amplification (microphone)    | 2 (6.1)           |
| Warm up before singing                                 | 15 (45.5)         |
| Cool down after singing                                | 5 (15.2)          |
| Involvement in professional singing activities         | 8 (24.2)          |
| Musical/Singing styles                                 |                   |
| Classical                                              | 12 (36.4)         |
| Pop                                                    | 4 (12.1)          |
| Rock/pop-rock                                          | 3 (9.1)           |
| Gospel                                                 | 2 (6.1)           |
| Jazz                                                   | 1 (3.0)           |
| Opera                                                  | 1 (3.0)           |
| Modern                                                 | 3 (9.1)           |
| Several styles                                         | 7 (21.2)          |

Abbreviations: SD = standard deviation.



**Figure 3.** ROC Curve.

**Table 2.** Symptom prevalence in singers.

| Singer Reflux Symptom Score Outcomes       | Prevalence (N, %) |
|--------------------------------------------|-------------------|
| Hoarseness                                 | 31 (93.9)         |
| Abnormal voice breathiness                 | 20 (60.6)         |
| Difficulty to reach high pitch/notes       | 32 (97.0)         |
| Additional effort during singing           | 31 (93.9)         |
| Lack of voice power                        | 30 (90.9)         |
| Vocal fatigue and lack of vocal resistance | 32 (97.0)         |
| Excess throat mucus during singing         | 29 (87.9)         |
| Throat or mouth dryness during singing     | 25 (75.8)         |

**Table 3.** Test–retest reliability.

| Singer Reflux Symptom Score Outcomes       | Test–Retest r | p-Value |
|--------------------------------------------|---------------|---------|
| Hoarseness                                 | 0.647         | 0.001   |
| Abnormal voice breathiness                 | 0.990         | 0.001   |
| Difficulty to reach high pitch/notes       | 0.630         | 0.001   |
| Additional effort during singing           | 0.679         | 0.001   |
| Lack of voice power                        | 0.729         | 0.001   |
| Vocal fatigue and lack of vocal resistance | 0.763         | 0.001   |
| Excess throat mucus during singing         | 0.516         | 0.001   |
| Throat or mouth dryness during singing     | 0.515         | 0.001   |
| Singer Reflux Symptom total Score          | 0.750         | 0.001   |

**Table 4.** Singer reflux symptom score internal validity and responsiveness to change.

| Singer Reflux Symptom Score Outcomes       | Baseline Evaluations |            |       |         | Post-Treatment (3 Months) |       |         |
|--------------------------------------------|----------------------|------------|-------|---------|---------------------------|-------|---------|
|                                            | Patients             | Controls   | Z     | p-Value | Patients                  | Z     | p-Value |
| Hoarseness                                 | 14.9 ± 8.2           | 0.4 ± 3.0  | −8.60 | 0.001   | 4.2 ± 5.6                 | −2.24 | 0.025   |
| Abnormal voice                             | 6.8 ± 8.1            | 0.1 ± 0.5  | −6.46 | 0.001   | 1.6 ± 2.6                 | −1.86 | 0.063   |
| breathiness                                |                      |            |       |         |                           |       |         |
| Difficulty to reach high pitch/notes       | 15.9 ± 7.8           | 0.1 ± 3.3  | −8.16 | 0.001   | 7.1 ± 9.2                 | −2.19 | 0.028   |
| Additional effort during singing           | 13.9 ± 8.3           | 0.8 ± 3.3  | −7.69 | 0.001   | 5.1 ± 7.1                 | −2.24 | 0.025   |
| Lack of voice power                        | 12.9 ± 9.2           | 0.7 ± 3.4  | −7.99 | 0.001   | 3.7 ± 5.9                 | −2.52 | 0.012   |
| Vocal fatigue and lack of vocal resistance | 14.4 ± 8.2           | 0.7 ± 3.4  | −8.34 | 0.001   | 5.7 ± 7.6                 | −2.20 | 0.028   |
| Excess throat mucus during singing         | 11.4 ± 9.2           | 0.6 ± 2.7  | −8.32 | 0.001   | 3.8 ± 5.5                 | −2.37 | 0.018   |
| Throat or mouth dryness during singing     | 6.5 ± 7.5            | 0.1 ± 0.2  | −6.72 | 0.001   | 1.5 ± 2.9                 | −2.03 | 0.042   |
| Total Singer Reflux Symptom Score          | 96.6 ± 45.0          | 3.7 ± 11.0 | −7.87 | 0.001   | 30.1 ± 37.4               | −2.93 | 0.003   |
| SRSS—Quality-of-life                       | 21.1 ± 10.9          | 1.4 ± 3.1  | −7.17 | 0.001   | 9.0 ± 9.4                 | −2.19 | 0.028   |

#### 4. Discussion

The development of a singer-reported outcome questionnaire documenting the impact of LPRD on singing voice is warranted given the high prevalence of LPRD in singers, the potentially subtle singing symptoms primarily undetected and unattributed to LPRD, the need to precisely evaluate pre- to post-treatment changes in non-specific symptoms, and the significant impact of LPRD on singers' careers [12–16].

The sRSS internal consistency analysis reported an adequate Cronbach- $\alpha$  ( $\alpha = 0.832$ ). The sRSS is the first clinical instrument developed prospectively for documenting LPRD-related singing symptoms, which limits the discussion of our results with similar instruments. However, in 2022, Nacci et al. proposed a revised Italian version of sVHI adapted to LPRD, combining Reflux Symptom Index outcomes with selected sVHI items [12,13]. In these two cross-sectional studies, authors reported a Cronbach's alpha coefficient of 0.87 for all combined items, with item-total correlation coefficients for each item ranging from 0.461 to 0.670 [12]. In the same vein, the sRSS internal consistency is comparable to those of other singing patient-reported outcome questionnaires, such as the French ( $\alpha = 0.80$ ) [11], Greek ( $\alpha = 0.960$ ) [17], Italian ( $\alpha = 0.853$ ) [18], and Japanese ( $\alpha = 0.981$ ) [19] versions of the sVHI.

Our study suggests an adequate and moderate sRSS external validity regarding the significant association between sRSS and the French version of the sVHI ( $r = 0.654$ ). Nacci et al. similarly observed a significant positive relationship between Reflux Symptom Index (not adapted to singers) and Singing Voice Handicap Index total score in a cohort of 159 singers ( $r = 0.474$ ) [13]. Okui et al. reported a significant positive association between the Japanese sVHI and a visual analog scale score ( $r = 0.736$ ) as external validity [19]. Note there was no external validity analysis in the other above-mentioned sVHI.

Item and total sRSS scores were significantly higher in singers with suspected LPRD compared to controls, which supports adequate internal validity. Internal validity refers to the extent to which the patient-reported outcome questionnaire accurately evaluates what it is intended to evaluate and ensures that observed changes or differences are truly due to the independent variable being manipulated, rather than other factors. The adequate sRSS internal validity data corroborate those of the Greek [17] and Japanese [19] sVHI studies, while Morsomme et al. did not find significant differences between patients and controls for the French sVHI [11].

The test–retest reliability measures the consistency of a clinical instrument over time when applied to the same individual. The sRSS test–retest reliability results demonstrated adequate values for items and total sRSS ( $r = 0.515\text{--}0.990$ ), which corroborates the findings of some sVHI studies [11,17,18]. Giannopoulou et al. reported a correlation coefficient of 0.859 for the test–retest Greek sVHI [17]. In the French and Japanese sVHI studies, Morsomme et al. and Okui et al. reported test–retest validity coefficients of 0.878 and 0.93, respectively [11,19].

A limited number of studies evaluated pre- to post-treatment changes in sVHI scores. In this study, the sRSS demonstrated adequate responsiveness to change despite the small sample size. Cohen et al. evaluated the treatment responsiveness of the English sVHI in 30 singers, demonstrating a significant reduction in sVHI scores after treatment, and a significant correlation between Voice Handicap Index change and sVHI change ( $r = 0.71$ ) from pre- to post-treatment [20]. A ROC curve analysis was conducted to define the threshold of sRSS associated with the highest sensitivity and specificity in detecting LPRD-related singing symptoms. Our analysis suggests a threshold of  $\text{sRSS} > 38.5$  for the French version. Nacci et al. similarly investigated the ROC analysis of their reflux-adapted voice handicap index. The sensitivity and specificity of sVHI-12-LPR were 83.3% and 69.1% for the suspected diagnosis of LPRD with a cut-off score of 15 [12].

To the best of our knowledge, the sRSS is the first singer-reported outcome questionnaire prospectively developed for evaluating LPRD-associated singing symptoms, which is the primary strength of this study. The small sample size (singers), the lack of subgroup analysis (amateurs versus professionals, choristers versus soloists), and the absence of confirmation of LPRD diagnosis at the 24 h HEMII-pH are the main limitations. In clinical practice, it remains difficult to have full adherence from singers for 24 h HEMII due to their concerns about having a probe in their laryngopharynx for 24 h, potential tolerance issues, and their wish for rapid therapeutic intervention. Despite this reality, the lack of HEMII-pH monitoring limits the drawing of valid conclusions regarding the risk of having included patients with unknown confounding conditions associated with LPRD-like symptoms but no actual LPRD. Indeed, allergy [21–23], chronic rhinitis [24–26], chronic rhinosinusitis [27–30], tobacco-induced laryngitis [31], non-reflux chronic cough [32–34], or inhaled corticosteroid laryngitis [35] may lead to similar symptoms or findings compared with LPRD. The small number of singers is also an additional limitation in the drawing of valid conclusions.

Although the validation of new questionnaires typically requires comparison with asymptomatic individuals, future studies could evaluate the specificity of the sRSS in detecting LPRD in singers through comparative studies including various groups of singers with different voice disorders and multidimensional voice quality evaluations [36–39]. These studies are important to identify potential clinical differences across vocal fold disorders and to investigate the non-specificity pattern of most LPRD-related classical and singing symptoms, which are related to non-specific inflammation of vocal folds. Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

## 5. Conclusions

The sRSS is a reliable and valid singer-reported outcome questionnaire for screening potential singing symptoms associated with LPRD, documenting non-specific LPRD singing symptoms in symptomatic singers, and evaluating symptom changes through personalized management. An  $\text{sRSS} > 38.5$  may be suggestive of LPRD, reporting high sensitivity and

specificity, and can be used in clinical practice. Future large-cohort studies are needed to evaluate its specificity for LPRD compared to other vocal fold disorders in singers.

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**Informed Consent Statement:** Patients and controls were invited to participate, and informed consent was obtained from those who enrolled in the study.

**Data Availability Statement:** Data are available on request.

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## Abbreviations

The following abbreviations are used in this manuscript:

|          |                                                                          |
|----------|--------------------------------------------------------------------------|
| LPRD     | Laryngopharyngeal reflux disease                                         |
| sRSS     | Singer Reflux Symptom Score                                              |
| HEMII-pH | Hypopharyngeal–esophageal multichannel intraluminal impedance-pH testing |
| SVHI     | Singing Voice Handicap Index                                             |

## References

1. Lechien, J.R.; Vaezi, M.F.; Chan, W.W.; Allen, J.E.; Karkos, P.D.; Saussez, S.; Altman, K.W.; Amin, M.R.; Ayad, T.; Barillari, M.R.; et al. The Dubai Definition and Diagnostic Criteria of Laryngopharyngeal Reflux: The IFOS Consensus. *Laryngoscope* **2024**, *134*, 1614–1624. [\[CrossRef\]](#) [\[PubMed\]](#)
2. Lechien, J.R.; Briganti, G. Reflux Disease in Singers: A Systematic Review. *J. Voice* **2024**, *in press*. [\[CrossRef\]](#)
3. Lechien, J.R.; Saussez, S.; Harmegnies, B.; Finck, C.; Burns, J.A. Laryngopharyngeal Reflux and Voice Disorders: A Multifactorial Model of Etiology and Pathophysiology. *J. Voice* **2017**, *31*, 733–752. [\[CrossRef\]](#)
4. Koufman, J.A.; Amin, M.R.; Panetti, M. Prevalence of reflux in 113 consecutive patients with laryngeal and voice disorders. *Otolaryngol. Head Neck Surg.* **2000**, *123*, 385–388. [\[CrossRef\]](#)
5. Robotti, C.; Schindler, A.; Lechien, J.R.; Di Sabatino, A.; Capobianco, S.; Schindler, A.; Ottaviani, F.; Sims, H.S.; Bertino, G.; Benazzo, M.; et al. Prevalence of Laryngopharyngeal Reflux Symptoms, Dysphonia, and Vocal Tract Discomfort in Amateur Choir Singers. *J. Voice* **2023**, *37*, 932–944. [\[CrossRef\]](#)
6. Cammarota, G.; Masala, G.; Cianci, R.; Palli, D.; Capaccio, P.; Schindler, A.; Cuoco, L.; Galli, J.; Ierardi, E.; Cannizzaro, O.; et al. Reflux symptoms in professional opera choristers. *Gastroenterology* **2007**, *132*, 890–898. [\[CrossRef\]](#) [\[PubMed\]](#)
7. Lechien, J.R.; Bobin, F.; Muls, V.; Thill, M.P.; Horoi, M.; Ostermann, K.; Huet, K.; Harmegnies, B.; Dequanter, D.; Dapri, G.; et al. Validity and reliability of the reflux symptom score. *Laryngoscope* **2020**, *130*, E98–E107. [\[CrossRef\]](#)
8. Kang, Y.; Guan, T.; Chen, X.; Zhang, Y. Patient-Reported Experience Measures in Adult Inpatient Settings: A Systematic Review. *J. Nurs. Manag.* **2024**, *2024*, 5166392. [\[CrossRef\]](#)
9. Lechien, J.R.; Rodriguez Ruiz, A.; Dequanter, D.; Bobin, F.; Mouawad, F.; Muls, V.; Huet, K.; Harmegnies, B.; Remacle, S.; Finck, C.; et al. Validity and Reliability of the Reflux Sign Assessment. *Ann. Otol. Rhinol. Laryngol.* **2020**, *129*, 313–325. [\[CrossRef\]](#)
10. Daniero, J.J. Decision Making in the Management of Laryngopharyngeal Reflux Disease: Antacids, Alginates, and the Role of Diet. *Otolaryngol. Clin. N. Am.* **2025**, *58*, 519–527. [\[CrossRef\]](#) [\[PubMed\]](#)
11. Morsomme, D.; Gaspar, M.; Jamart, J.; Remacle, M.; Verduyck, I. Voice handicap index adapted to the singing voice. *Rev. Laryngol. Otol. Rhinol.* **2007**, *128*, 305–314.
12. Nacci, A.; Bastiani, L.; Barillari, M.R.; Martinelli, M.; Lechien, J.R.; Simoni, F.; Berrettini, S.; Fattori, B. Reflux Symptom Index (RSI) and Singing Voice Handicap Index (SVHI) in Singing Students: A Pilot Study. *J. Voice* **2022**, *36*, 288.e25–288.e34. [\[CrossRef\]](#)
13. Nacci, A.; Capobianco, S.; Mazzoni, L.; Fattori, B.; Barillari, M.R.; Genovese, E.; Berrettini, S.; Bastiani, L. Development of a New Self-Assessment Tool for Laryngopharyngeal Reflux Screening in Singers (SVHI-12-LPR). *Folia Phoniatr. Logop.* **2023**, *75*, 284–294. [\[CrossRef\]](#)

14. Campagnolo, A.M.; Benninger, M.S.; Priston, P.; Assunção, A. Dysphonia in Performers: Prevalence of Vocal Lesions and Voice Emergencies in a Private Otorhinolaryngology Practice. *J. Voice* **2023**, *37*, 415–418. [\[CrossRef\]](#) [\[PubMed\]](#)
15. Korn, G.P.; Azevedo, R.R.; Monteiro, J.C.; Pinheiro, D.S.; Park, S.W.; Biase, N.G. Difficulty producing high-pitched sounds in singing: Correlations with laryngostroboscopy and electromyographic findings. *Braz. J. Otorhinolaryngol.* **2020**, *86*, 669–675. [\[CrossRef\]](#) [\[PubMed\]](#)
16. Dhar, S.; Mattioni, J.; Sataloff, R.T. Endoscopic Findings in a Professional Singer with Frequent Throat Clearing. *Ear Nose Throat J.* **2019**, *98*, 128. [\[CrossRef\]](#)
17. Giannopoulou, J.; Papadopoulou, E.; Bibas, A.; Papathanasiou, I. Validation of the Singing Voice Handicap Index in Greek Singers: Normal and Voice-Disordered Participants. *J. Voice* **2025**, *in press*. [\[CrossRef\]](#)
18. Nacci, A.; Barillari, M.R.; Capobianco, S.; Fattori, B.; Berrettini, S.; Tonacci, A.; Minichilli, F.; Bastiani, L. Adaptation and validation of the Italian Singing Voice Handicap Index-10 (SVHI-10-IT). *Acta Otorhinolaryngol. Ital.* **2023**, *43*, 114–122. [\[CrossRef\]](#)
19. Okui, A.; Nimura, Y.; Komazawa, D.; Kanazawa, T.; Konomi, U.; Hirotsaki, M.; Okano, M.; Nishida, M.; Watanabe, Y. Validation of the Japanese Version of the Singing Voice Handicap Index. *J. Voice* **2024**, *38*, 544.e15–544.e21. [\[CrossRef\]](#)
20. Cohen, S.M.; Witsell, D.L.; Searce, L.; Vess, G.; Banka, C. Treatment responsiveness of the Singing Voice Handicap Index. *Laryngoscope* **2008**, *118*, 1705–1708. [\[CrossRef\]](#) [\[PubMed\]](#)
21. Sui, H.; Luo, Z.; Zhang, X.; Zhang, J.; Zhen, Z.; Ding, T. The influence of saliva pepsin concentration on subjective severity of seasonal allergic rhinitis. *Acta Otolaryngol.* **2025**, *145*, 329–333. [\[CrossRef\]](#)
22. Kakaje, A.; Alhalabi, M.M.; Alyousbashi, A.; Ghareeb, A. Allergic rhinitis, asthma and laryngopharyngeal reflux disease: A cross-sectional study on their reciprocal relations. *Sci. Rep.* **2021**, *11*, 2870. [\[CrossRef\]](#)
23. Eren, E.; Arslanoğlu, S.; Aktaş, A.; Kopar, A.; Cığır, E.; Önal, K.; Katılmış, H. Factors confusing the diagnosis of laryngopharyngeal reflux: The role of allergic rhinitis and inter-rater variability of laryngeal findings. *Eur. Arch. Otorhinolaryngol.* **2014**, *271*, 743–747. [\[CrossRef\]](#) [\[PubMed\]](#)
24. Eckley, C.A.; Tangerina, R. Using RSI and RFS scores to differentiate between reflux-related and other causes of chronic laryngitis. *Braz. J. Otorhinolaryngol.* **2023**, *89*, 54–59. [\[CrossRef\]](#) [\[PubMed\]](#)
25. Tarmizi, N.E.; Hamizan, A.W.; Ng, C.S.; Gendeh, H.S.; Guan, L.S.; Zahedi, F.D.; Baki, M.M.; Husain, S. The Nasal Endoscopic Features of Postnasal Drip: A Cross Sectional Study. *Int. Arch. Otorhinolaryngol.* **2023**, *28*, e95–e100. [\[CrossRef\]](#)
26. Smallwood, D.; Ledford, D.; Kennedy, D.; Lockey, R. Postnasal Drip. *J. Allergy Clin. Immunol. Pract.* **2024**, *12*, 1472–1478. [\[CrossRef\]](#)
27. Brown, H.J.; Kuhar, H.N.; Plitt, M.A.; Husain, I.; Batra, P.S.; Tajudeen, B.A. The Impact of Laryngopharyngeal Reflux on Patient-reported Measures of Chronic Rhinosinusitis. *Ann. Otol. Rhinol. Laryngol.* **2020**, *129*, 886–893. [\[CrossRef\]](#) [\[PubMed\]](#)
28. Aldajani, A.; Alhussain, F.; Mesallam, T.; AbaAlkhail, M.; Alojary, R.; Bassam, H.; Alotaibi, O.; Alqahtani, M.; Alsaleh, S. Association Between Chronic Rhinosinusitis and Reflux Diseases in Adults: A Systematic Review and Meta-Analysis. *Am. J. Rhinol. Allergy* **2024**, *38*, 47–59. [\[CrossRef\]](#)
29. Yeo, N.K.; Park, S.J.; An, T.H. Laryngopharyngeal reflux in chronic rhinosinusitis patients and the role of endoscopic sinus surgery. *Auris Nasus Larynx* **2022**, *49*, 663–669. [\[CrossRef\]](#)
30. Anzić, S.A.; Turkalj, M.; Župan, A.; Labor, M.; Plavec, D.; Baudoin, T. Eight weeks of omeprazole 20 mg significantly reduces both laryngopharyngeal reflux and comorbid chronic rhinosinusitis signs and symptoms: Randomised, double-blind, placebo-controlled trial. *Clin. Otolaryngol.* **2018**, *43*, 496–501. [\[CrossRef\]](#)
31. Kayalı Dinc, A.S.; Cayonu, M.; Sengezer, T.; Sahin, M.M. Smoking Cessation Improves the Symptoms and the Findings of Laryngeal Irritation. *Ear Nose Throat J.* **2020**, *99*, 124–127. [\[CrossRef\]](#)
32. Arai, Y.; Okuyama, K.; Onishi, Y.; Schelfhout, J.; Tokita, S.; Kubo, T. Clinical characteristics and drug utilisation patterns in patients with chroniccough: A retrospective cohort study using a Japanese claims database. *BMC Pulm. Med.* **2022**, *22*, 429. [\[CrossRef\]](#)
33. Lilly, G.L.; Carroll, T.; Pietsch, K.; Dhillon, V.; Bryson, P.C.; Akst, L.M. Refractory Chronic Cough: A State-of-the-Art Review for Otolaryngologists. *Otolaryngol. Head Neck Surg.* **2025**, *172*, 419–435. [\[CrossRef\]](#) [\[PubMed\]](#)
34. Eapen, A.A.; Gupta, M.R.; Locky, R.F.; Bardin, P.G.; Baptist, A.P. Gastroesophageal reflux disease, laryngopharyngeal reflux, and vocal cord dysfunction/inducible laryngeal obstruction-overlapping conditions that affect asthma. *J. Allergy Clin. Immunol.* **2024**, *154*, 1369–1377. [\[CrossRef\]](#)
35. Koshiyama, S.; Tanimura, K.; Ito, K.; Funayama, S.; Hira, D.; Komase, Y.; Sato, S. Gastroesophageal reflux-like symptoms are associated with hyposalivation and oropharyngeal problems in patients with asthma. *Respir. Investig.* **2021**, *59*, 114–119. [\[CrossRef\]](#)
36. Lloyd, A.T.; Ruddy, B.H.; Silverman, E.; Lewis, V.M.; Lehman, J.J. Quantifying Laryngopharyngeal Reflux in Singers: Perceptual and Objective Findings. *BioMed Res. Int.* **2017**, *2017*, 3918214. [\[CrossRef\]](#) [\[PubMed\]](#)
37. Myint, C.; Moore, J.E.; Hu, A.; Jaworek, A.J.; Sataloff, R.T. A Comparison of Initial and Subsequent Follow-Up Stroboscopylaryngoscopic Examinations in Singers. *J. Voice* **2016**, *30*, 472–477. [\[CrossRef\]](#) [\[PubMed\]](#)

38. Butte, C.J.; Zhang, Y.; Song, H.; Jiang, J.J. Perturbation and nonlinear dynamic analysis of different singing styles. *J. Voice* **2009**, *23*, 647–652. [[CrossRef](#)]
39. Bunch, M.; Chapman, J. Taxonomy of singers used as subjects in scientific research. *J. Voice* **2000**, *14*, 363–369. [[CrossRef](#)]

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