

Assessment of the Vocal Risk Screening for Choristers Scale

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ABSTRACT

Choral singing has grown rapidly across schools, communities, and universities, celebrated for its social and educational benefits. However, the increasing vocal demands associated with choir participation have raised concerns regarding singers' vocal health and the need for preventive approaches. This study aimed to develop and validate a new self-report instrument, the Vocal Risk Screening for Choristers Scale (VRS-CS), to facilitate accessible vocal health screening and promote early identification of voice-related risk factors among Chinese choristers. The VRS-CS was initially constructed based on five domains identified from existing literature: dietary habits, speaking habits, health-related conditions, choral rehearsal practices, and peer influence. A total of 306 choristers aged 12 to 24 years participated in the study. Internal consistency reliability was examined using Cronbach's alpha, and test-retest reliability was evaluated through the intraclass correlation coefficient (ICC) over a four-week interval. Construct validity was assessed using exploratory and confirmatory factor analyses (EFA and CFA). The results showed excellent internal consistency ($\alpha = 0.881$) and test-retest reliability (ICC = 0.986). Factor analyses confirmed a stable five-factor structure with satisfactory model fit indices ($\chi^2/df = 1.866$, RMSEA = 0.053, GFI = 0.916, CFI =

0.957). The findings provide strong psychometric evidence for the VRS-CS as a valid and reliable tool for evaluating behavioural, environmental, and health-associated risks to vocal well-being in choral settings. The scale offers practical value for educators, conductors, and clinicians in supporting early screening, promoting vocal health awareness, and fostering sustainable vocal practices among young choristers in China.

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INTRODUCTION

There is a significant rise in choral participation in the past two decades in China, making choirs to becoming an essential part of educational and social programmes (Chen et al., 2022; Zhu, 2024). However, this growing popularity has also drawn attention to the potential vocal health risks associated with choral performance, particularly vocal fatigue, vocal strain, and the occurrence of voice issues in amateur vocalists, the methods they resort to cope with the difficulties, are scarce (Levett & Pring, 2023; Meerschman et al., 2025). In China, studies have indicated that choristers and other professional voice users generally lack adequate training and awareness in voice care and the prevention of voice disorders (Xiao & Mazlan, 2024; Zhou et al., 2025). Research conducted both domestically and internationally suggests that amateur choristers typically receive limited systematic vocal training and instruction in vocal hygiene.

Vocal training alone appears insufficient in addressing a range of voice-related problems; it should be complemented with vocal hygiene education to enhance singers' understanding and awareness of vocal health management (Levett & Pring, 2023; Ma & Leung, 2021; Rosa & Behlau, 2017). Additionally, a scope review by Xiao and Mazlan (2024) found that empirically, studies assessing vocal health in China have been limited since 2020, suggesting that this is a timely period to draw greater attention to issues concerning vocal well-being and risk awareness among singers.

Early detection of voice problems is essential to prevent minor functional issues from progressing into chronic or irreversible vocal pathologies. In the context of choral singing, where vocal demands are frequent and sustained, timely identification of potential risks enables targeted preventive and educational interventions. Such proactive measures not only reduce the incidence of vocal fatigue and injury but also promote long-term vocal sustainability and performance quality. Consequently, the need for reliable and contextually appropriate screening tools becomes critical to support singers' vocal well-being within educational and professional settings.

To facilitate easy access to vocal health screening and promote early identification of potential voice-related risks, this study first developed the Vocal Risk Screening for Choristers Scale (VRS-CS) and subsequently examined its reliability and validity. The instrument was designed to assess behavioural, environmental, and health-associated factors that may compromise the vocal well-being of choristers in China. By establishing its psychometric properties, this study contributes a reliable and contextually relevant tool to support healthy and sustainable choral participation in the Chinese context.

LITERATURE REVIEW

Voice disorders have been an area of growing concern as a public health problem for both professional and amateur users of the human voice. Many authors have observed that some of the shared manifestations

among choristers include voices that may be tired, hoarse, or painful, depending on factors such as poor use of the voice or unfavourable performance conditions (Levett & Pring, 2023; Meerschman et al., 2022). Rosa and Behlau (2017) observed that one in five amateur choristers suffered from persistent voice problems, particularly for female participants, in addition to vocally demanding professionals. Moreover, Ravall and Simberg (2020) found that 21% (n = 66) participants, attending an adult choir, presented functional vocal disorder. The study aimed at investigating the factors related to vocal health in cathedral choirs, and it was found that 58% of participants regularly experienced frequent voice symptoms, complaining of more than two regular vocal problems frequently after singing, including vocal tiredness, loss of upper range, hoarseness, pitch break, discomfort, and feeling dryness in the throat (Sharma et al., 2021). Importantly, a considerable number of participants never offered support for their vocal problems, without knowing whether amateur participation requires contacting professionals, and from whom (Levett & Pring, 2023).

China has seen a tremendous growth in choral endeavours, yet the training in choral vocal health has remained lagging. According to Zhu (2024), choral training in China emphasises collectivism and emphasises the improvement of musical knowledge and choral skills. Choral singing also requires its participants to sing in choral harmony; adjusting various sound elements,

such as timbre, pitch, and volume, in relation to the choral sound, can lead to simple vocal misuse (Kirsh et al., 2013; Meerschman et al., 2025). Zhou et al. (2025) also carried out a huge study, where 920 participants from various vocally demanding vocations in China were identified, asserting that there was a lack of knowledge and discrepancies in choral hygiene. The study proposed better integration and collaboration with health professionals through educational efforts for improved choral health.

Several proven self-administered questionnaires exist to evaluate vocal health and the perceived handicap imposed by it. The Voice Handicap Index (VHI) and its shortened form, the VHI-10, are well-known, reliable, and highly valid instruments used in practice (Rosen et al., 2004). Of more relevance to singers is the Singing Voice Handicap Index-36 (SVHI-36) that will examine the significance of impaired voices when it comes to actual singing (Cohen et al., 2007). The use, however, remains to evaluate subjectively the perceived handicap posed by the voice, rather than a potential health hazard that could arise from choir singing.

Conceptual Framework

The conceptual framework for this study, as illustrated in figure 1, has categorised the two types of independent variables, choral rehearsals and individual factors, that can affect the dependent variable, vocal wellness. The framework reflects the multidimensional concept that different factors could contribute to the problems that

child choristers experience when it comes to their voices.

The domain Choral Rehearsals comprises factors such as environmental factors, conductorial elements, and social factors. The factors were derived from research that emphasised how factors such as poor acoustics, background noise, poor air quality (Rantala et al., 2012), too much practice time, poor modelling, lack of vocal hygiene and vocal training (Niebudek-Bogusz et al., 2008; Thibeault et al., 2004), difficult song choices, and vocal competition (Freer, 2009; Smith & Sataloff, 2006; Tepe et al., 2009) can cause vocal problems.

The individual factors dimension covers physical and mental well-being, lifestyle habits, and speaking/singing habits. The underlying factors covered by the variables include hydration, amount and quality of sleep, eating habits, too much talking, mental stress, anxiety, reflux, and allergies

(Duffy & Hazlett, 2004; Morawska & Niebudek-Bogusz, 2017).

Current literature also identifies that novice choristers are also susceptible, particularly due to GBT, poor vocal practice, and ignorance of warm-down and warm-up methods. The practice of warm downs can often include outdated methods, or, in contrast, warm-ups can include cool-down routines that are regularly overlooked. Physical rehearsals (swaying, gestural singing, etc.) can improve vocal awareness, although acceptance by conductors depends on openness.

This model served as the basis for designing the Vocal Risk Screening for Choristers Scale (VRS-CS) to provide an understanding of how both group settings and individual behaviours contribute to vocal risk, facilitating the early detection and prevention methods for risk in a choir setting.

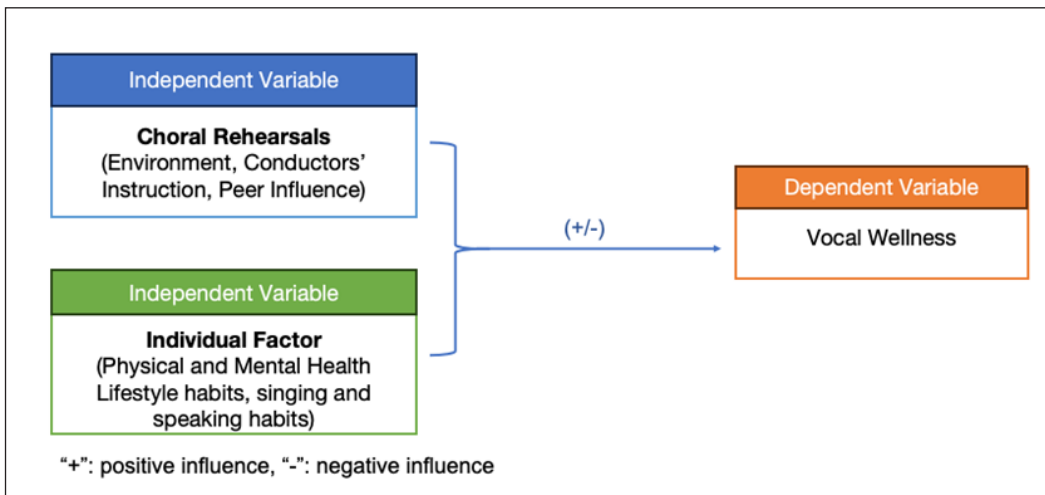


Figure 1. Conceptual framework of factors influencing vocal wellness in choirs

METHODOLOGY

The paradigm on which the research was based is that of positivism. This involved a focus on measurement and proof by statistics. This approach enabled the findings to be replicated to offer further evidence to support the use of the VRS-CS to determine the level of risk to which choristers were exposed based on vocal health.

The design applied in the research was quantitative, cross-sectional, and survey-based. The research utilised psychometric testing. The research methodology followed the standard procedure for testing an instrument as proposed by Hair et al. (2019). The procedure adopted in the research included three phases: the development of an instrument, pilot testing, and psychometric testing.

The research focussed on the validity and reliability of a self-assessment scale known as the Vocal Risk Screening for Choristers Scale (VRS-CS), which was used to determine the factors that influence the vulnerability of choristers' voices. The scale was designed to define the phenomenon of voices at risk within the choral setting. Factors that pose risks to voices were considered, including those related to behaviour and environment. The study particularly focussed on the design of the scale as being suitable for both adolescent and undergraduate choristers.

Participants

The sample was selected in 17 provinces in China, and the sample was to include individuals whose location was in diverse

parts of China, which are representative of the expanding choral movement in China. Applying the definition provided by the World Health Organisation (2021), it was possible to define the participants as individuals between the ages of 12 and 24, as individuals of this age group are more vulnerable to vocal health issues.

The research employed a voluntary response sampling method, where participants were given free will, and to make the research ethically appropriate, since the intention of the research was to gather responses of self-perceptions of the participants regarding their vocal health. The study adopted this methodology since it made it possible for choristers from various educational institutions to contribute, thereby facilitating voluntary, free participation by respondents, who also acted upon well-consulted, free, and well-informed choices. The applied procedure involved the sending of invitation emails that comprised study descriptions, informed consents and safe links to the email lists of the different choirs in 17 different provinces. The interested choirs then voluntarily took part by free choice of enrolling themselves through completing online questionnaires and thus ensured both autonomy and confidentiality. It collected 306 responses, registering an 85% rate. The population sample of interest was made up of 105 males (34.3%), and 201 females (65.7%), who were recruited in educational institutions of secondary and university, from Shanxi, Guangxi, Guangdong, Henan, Jiangxi, Shandong, Hebei, Hunan, Chongqing,

Jiangsu, Anhui, Shaanxi, Hubei, Fujian, Yunnan, Zhejiang, and Liaoning provinces.

However, the final sample size adhered to the recommended criteria for performing factor analysis. This is because, according to Hair et al. (2010), a minimum of five and preferably ten times the number of variables is required, recommending that the scale consisting of 39 items could range from 195 to 390. Additionally, it was recommended by Hair et al. (2019) that for medium to higher communality values (values ≥ 0.50), a sample size of 300 would be sufficient for both exploratory and confirmatory factor analysis. The study's sample size was 306.

Instrument Development

The Vocal Risk Screening for Choristers Scale (VRS-CS) has a total of 39 items, assessing five factors, namely dietary habits, speaking habits, health-related conditions, choral rehearsals, and peer influence. In addition, it contains items that assess demographics and vocal health. The scale used by the instrument is a four-point scale, also called the Likert scale, wherein a total sum can range from 0 to 156, where the higher the sum, the greater the risk level for vocal health problems.

The conceptualisation and development process that aims to produce the VRS-CS was largely influenced by the study that has identified and mapped the existence of vocal risk factors for amateur choristers, which was conducted by Rosa and Behlau (2017) using a descriptive analysis technique via a customised form, whose purpose is to identify closed-ended responses related

to the profiles, health, and perception of vocal risk. Although it has limitations, since it is not a psychological scale, it is also important to note that the study by Rosa and Behlau (2017) has played a crucial role in the process that resulted in the narrowing down of the domain related to the vocal risk factors for amateur choristers via its descriptive analysis technique. The study strives to further broaden the scope from that highly valuable, albeit preliminary, foundation.

Additionally, items concerned with behaviour and environment, informed by recent literature, were added to enhance its relevance and accuracy. Thus, it can be concluded that it is the first standardised screening instrument that endeavours to objectively evaluate vocal risk for choristers, a first step introduced through the valuable study by Rosa and Behlau (2017).

Procedure

The process for developing and validating the VRS-CS has passed through three levels. All the professionals who have reviewed the VRS-CS have been a total of eight in the field of choral musicianship and vocal health. The VRS-CS items were analysed in terms of relevance, clarity, and applicability in choral-singing groups that were divided into adolescent and young adult groups. This has made it possible to revise wordings and make corrections on redundancies detected in the items.

The pilot study, which was conducted, entailed 29 adolescents between the ages of 13 and 15 years, whereas the purpose

of the study was to examine the clarity and understanding associated with each item. This was done through semi-structured interviews on ambiguities, and the cases were discussed towards attempts to enhance clarity and accuracy in connection with responses. The pilot study attempted to justify the fact that the instrument was appropriate and understandable to the participants.

After the refinement stage, the refined VRS-CS internet questionnaire was conducted on secondary educational and university choristers in China. In terms of determining its reliability, the questionnaire was given to the respondents who were required to give answers twice, with a four-week spacing of four weeks. Cronbach's alpha and Test-Retest tests were used to test the reliability. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were used to test the construction, convergent, and discriminant validity tests to design a valid scale for estimating the risk of possible vocal health issues in choristers.

Data Analysis

The results were analysed using the IBM SPSS (Version 27.0) and AMOS (Version 26.0) software packages. Descriptive analysis is used to examine the demographics and responses of the study participants. The reliability, content validity, construct validity, convergent, and discriminant validity tests were used to assess the VRS-CS scale.

Reliability Assessment

Internal consistency was checked through Cronbach's alpha, for which values exceeding 0.70 were deemed acceptable (Hair et al., 2010). The alpha value in the present study, that is, 0.85, reflected excellent internal reliability. The test-retest reliability was checked through intra-class correlation coefficients, for which values above 0.75 were deemed excellent (Cicchetti, 1994).

Content Validity

The content validity of the items was checked by administering them to eight choral conductors and voice therapists. The items were rated on a four-point scale, with 1 indicating not relevant and 4 indicating highly relevant. The item-level content validity index (I-CVI) was then determined by calculating the number of raters who responded with ratings 3 and 4, while the scale-level content validity index (S-CVI) was also assessed using both average (S-CVI/Ave) and universal (S-CVI/UA) methods. If the scale exceeds 0.78, then it attains strong content validity, and when using the average, it is greater than 0.80 (Polit & Beck, 2004).

Construct Validity

The construct validity was checked through EFA for unobserved factors and the extent to which VRS-CS has a sound structure. The Kaiser-Meyer-Olkin (KMO) value was greater than 0.60, and the result for Bartlett's

Test of Sphericity was significant at $p < .001$, thereby establishing that the data were suitable for factor analysis (Hair et al., 2010). The EFA, using PCA with Direct Oblimin rotation, resulted in a simple structure for factors related to the dimensions, thereby having construct validity.

Convergent Validity

To establish the convergent validity, confirmatory factor analysis (CFA) was used. The standardised factor loadings for each construct were well above 0.50, and the average variance extracted for each factor was greater than 0.50, ensuring convergent validity. The values for the different constructs' composite reliability were also greater than 0.70, ensuring the reliability and internal consistency of the constructs. The confirmatory factor analysis also checked that the model fitness values satisfied the recommended level for model fitness, given by Hu & Bentler (1999), and Browne and Cudeck (1992) for RMSEA < 0.08 , RMR < 0.05 , GFI values greater than 0.90, and Chi-Squared to Degrees of Freedom, respectively.

Discriminant Validity

The first method used to establish the discriminant validity was by comparing the average variance extracted (AVE) for each factor and the squared correlations (r^2) between factors, using the cut-off recommended by Fornell and Larcker (1981). The second procedure involved using a series of independent samples t-tests to examine the average scores for VRS-CS for choristers both with and

without perceived voice handicap, using the suggestion proposed by Hair et al. (2010). Significance in each t-test would indicate that the instrument can discriminate well between theoretically different groups.

RESULTS

The demographic characteristics of study participants are presented in Table 1. The three stages of adolescence include early adolescence (between the ages of 10-13 years), middle adolescence (between the ages of 14-17 years), and late adolescence (between the ages of 18-21 and beyond). Each stage covers the different growth and developmental stages that can produce distinctive changes in the participants' vulnerability to voice problems (Allen & Waterman, 2024). Thus, participants were randomly categorised according to the study objectives, composing two groups: first, participants aged 12-17 years, totalling 181 participants (59.2%), and second, participants aged 18-24 years, totalling 125 participants (40.8%). The participants were aged 12 to 24 years, having a mean age of 16.85 years ($SD = 3.21$).

The study involved 306 participants, with 105 males (34.3%) and 201 females (65.7%). Of the 360 students contacted by email, 306 (85%) agreed to participate in the study. Concerning the participants' choir experience, 180 (58.8%) were choir members for less than a year, 76 (24.8%) for one to two years, 40 (13.1%) for three to four years, and 10 (3.3%) for more than four years. The majority, 51.3% ($n = 157$) of the respondents, were previously vocally trained.

Table 1
Demographics and characteristics

Sample characterisation			
(n = 306)		n	%
Gender	Male	105	34.3
	Female	201	65.7
Age	12-17	181	59.2
	18-24	125	40.8
Time in Choir (years)	Below 1	180	58.8
	1 - 2	76	24.8
	3 - 4	40	13.1
	Above 4	10	3.3
Vocal Training	Yes	157	51.3
	No	149	48.7
Singing Voice Handicap (MSVHI-10)	Yes	182	59.5
	No	124	40.5
Voice Part	Soprano	72	23.5
	Tenor	122	39.9
	Alto	69	22.5
	Bass	43	14.1

The participants were also grouped according to whether they felt that their voice suffered from a handicap, using the Mandarin Singing Voice Handicap Index-10 (Fu et al., 2022). Choristers without a voice handicap were 124 (40.5%), while the others, totalling 182 (59.5%), experienced a voice handicap. The distribution by vocal category for the choristers was as follows: soprano, 72 (23.5%); tenor, 122 (39.9%); alto, 69 (22.5%); and bass, 43 (14.1%).

Descriptive Statistics

The sample size of 306 participants produced a skewness value of 1.087 and a kurtosis value of 3.008. According to statistical guidelines, skewness values between -2 and +2 (Tabachnick & Fidell, 2007) and

kurtosis values between -7 and +7 (Byrne, 2010) indicated a normal distribution. These results suggested that the data were normally distributed.

Table 2 summarised the descriptive statistics for the VRS-CS, presenting mean scores, standard deviations, and p-values from independent-samples t-tests comparing adolescents (aged 12-17 years) and young adults (aged 18-24 years). Significant differences were found in 27 items, with 11 showing highly significant differences ($p < .001$). The total mean score for the VRS-CS-39 was 102.48 (SD = 17.00). For the VRS-CS-20, adolescents had a mean score of 24.79 (SD = 8.97), whereas young adults scored higher, with a mean of 28.58 (SD = 8.57). These differences were

Table 2
Descriptive statistics

Variable	Mean	SD	Sig. ^{1,2}	MD ^{1,2}	Variable	Mean	SD	Sig. ^{1,2}	MD ^{1,2}
Q1	2.76	0.967	0.003	-0.330	Q22	1.91	0.922	0.422	0.089
Q2	2.91	1.210	<0.001	-0.650	Q23	1.47	0.895	<0.001	-0.427
Q3	2.81	0.906	0.004	-0.301	Q24	1.58	0.979	0.001	-0.388
Q4	2.98	0.928	0.017	-0.258	Q25	2.03	1.011	<0.001	-0.391
Q5	2.29	0.882	<0.001	-0.414	Q26	2.44	1.192	<0.001	-0.517
Q6	3.12	1.017	0.053	0.223	Q27	3.55	1.225	<0.001	0.915
Q7	3.50	0.979	0.002	0.358	Q28	2.89	1.294	0.021	0.348
Q8	3.38	0.999	0.019	0.268	Q29	2.12	0.964	0.002	-0.345
Q9	2.82	0.981	0.060	-0.215	Q30	3.74	1.112	0.071	-0.226
Q10	2.29	0.961	0.328	0.105	Q31	3.24	1.197	0.534	0.087
Q11	3.24	1.021	0.021	0.274	Q32	3.65	1.080	0.087	0.215
Q12	2.05	0.917	0.023	-0.242	Q33	3.47	1.215	0.053	0.274
Q13	2.31	0.929	0.187	-0.138	Q34	3.47	1.105	<0.001	0.504
Q14	2.53	1.075	<0.001	-0.520	Q35	3.60	1.130	0.101	0.211
Q15	2.35	1.156	0.014	-0.315	Q36	3.13	1.088	0.420	0.099
Q16	2.64	0.942	0.005	-0.297	Q37	2.17	0.961	0.117	-0.181
Q17	2.54	1.015	0.015	-0.287	Q38	1.77	0.933	0.008	-0.287
Q18	1.93	0.947	0.005	-0.305	Q39	2.04	0.957	0.038	-0.231
Q19	2.05	1.042	<0.001	-0.572	Total-39	102.477	17	0.028	-4.589
Q20	1.68	0.918	<0.001	-0.412	Total-20 ¹	24.79	8.971	<0.001	-3.794
Q21	1.77	0.941	<0.001	-0.549	Total-20 ²	28.58	8.565		

Note. SD= Standard Deviation, MD= Mean Difference, ¹= ages 12-17, ²= ages 18-24

statistically significant ($p = .028$ for VRS-CS-39; $p < .001$ for VRS-CS-20). Overall, young adults reported greater vocal risk than adolescents, suggesting that age-related factors may have influenced perceptions of vocal-health risk among choristers.

Cronbach's Alpha

The Cronbach's alpha reliability coefficient for the VRS-CS scale was $\alpha = 0.881$ ($N = 39$) (Table 3). This was beyond the acceptable level of ≥ 0.70 (Hair et al., 2010), proving

that the scale has almost perfect reliability for the measurement of its constructs.

Test-Retest Reliability

The test-retest reliability analysis, using the Intraclass Correlation Coefficient (ICC), gave a reliability coefficient of 0.986, while the 95% confidence interval for ICC was 0.982 to 0.989 (Table 4). This, according to Cicchetti (1994), showed significant excellence, since ICC values ranging from 0.75 to 1.00 indicate excellent reliability,

Table 3
Reliability statistics

Cronbach's Alpha	N of Items
0.881	39

Table 4
Intra-class correlation coefficient

	Intra-class Correlation ^b	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	0.972 ^a	0.965	0.978	70.585	305	305	0.000
Average Measures	0.986 ^c	0.982	0.989	70.585	305	305	0.000

Note. Two-way mixed effects model where people effects are random and measures effects are fixed

^a The estimator is the same, whether the interaction effect is present or not.

^b Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.

^c This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

and it clearly indicated that the VRS-CS has outstanding stability and reliability.

Content Validity

The content validity test was carried out using a pool of eight experts from choral music and vocal health. The experts rated each item for clarity, relevance, and comprehension to determine its adequacy for use by choristers. The average scale-level content validity index (S-CVI/Ave) for the items from the expert judgement scores was 0.98, using the I-CVI, while the scale-level universal agreement index (S-CVI/UA) was 0.87 (Table 5). This scale was beyond the acceptable level for both I-CVI ≥ 0.78 and S-CVI ≥ 0.80 , offering

conclusive evidence on the scale's content validity (Polit & Beck, 2004).

Construct Validity

The correlation matrix gave an initial interpretation for the factor analysis process (Table 6). Values that exceeded 0.30 offered valuable associations, while correlations exceeding 0.50 offered significance from the perspectives of practice (Hair et al., 2010). Those that were lower than 0.30 were discarded for better clarity and significance during the process. Variables that offered strong correlations include 1 and 3 ($r = 0.668$), 1 and 4 ($r = 0.558$), and 3 and 4 ($r = 0.686$) for items that could fall under one category, while others were presented in Table 6.

Table 5
Content validity statistics

Sum of I-CVI	38.375	Sum of UA	34
S-CVI Average (Sum of I-CVI/No.of items)	0.98	S-CVI Relevance (Sum of UA/No. of items)	0.87

Table 6
Correlation Matrix^a

Hypothetic Factor 1					Hypothetic Factor 5			
Variable	1	2	3	4	37	38	39	
1	1				37	1		
2	0.411	1			38	0.592	1	
3	0.668	0.490	1		39	0.538	0.649	
4	0.558	0.471	0.686	1				

Hypothetic Factor 2			
Variable	10	12	13
10	1		
12	0.549	1	
13	0.588	0.548	1

Hypothetic Factor 3						
Variable	18	19	20	21	23	24
18	1					
19	0.694	1				
20	0.378	0.464	1			
21	0.446	0.552	0.613	1		
22	0.406	0.451	0.290	0.376		
23	0.475	0.504	0.480	0.540	1	
24	0.467	0.581	0.570	0.635	0.783	1

Hypothetic Factor 4						
Variable	30	31	32	33	35	36
30	1					
31	0.426	1				
32	0.611	0.615	1			
33	0.395	0.584	0.580	1		
34	0.405	0.567	0.588	0.760		
35	0.473	0.508	0.624	0.608	1	
36	0.427	0.450	0.483	0.457	0.605	1

Note Correlation is practically significant for highlighted values

To further investigate the dimensionality of the scale, an exploratory factor analysis (EFA) was carried out using Principal Component Analysis (PCA) and Direct Oblimin rotation. The dataset was found to fulfil the requirements for factor analysis, namely that it was suitable for factor analysis, reflected by the significance of Bartlett's test of sphericity ($p < .001$) and that the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (0.884) exceeded the recommended threshold level of 0.60 (Hair et al., 2010).

The exploratory factor analysis process produced 19 items that were removed for reasons related to the factors of cross-loading and low values, culminating in the derivation of a 20-item instrument for vocologist risk factors affecting singers. The final model based on Table 7 produced factors cumulatively explaining 69.80% of the total variance. The five factors based on the constructs of 'Dietary habits', 'Speaking habits', 'Health problems', 'Choral Rehearsal', and 'Peer Influence' were found to have sound construct validity since items fit correctly into the factors as seen in Table 8.

Factor 1 (dietary habits) included items regarding pre-bed eating and the consumption of fried and cold foods. Factor 2 (Speaking Habits) reflected items on yelling or talking too much when having a sore throat. Factor 3 (Health Issues) covered items related to allergies, upper respiratory tract infections, treatments for voice, and ENT visits. Factor 4 (Choral Rehearsal) included items related to the clarity of

direction by conductors, the delivery of vocal health education, and factors such as soundproofing and acoustic quality. Factor 5 (Peer Influence) dealt with items related to peer influences, such as noise, competition, and vocal misuse when singing in groups. These findings supported the five-factor model solution, construct validity, and the VRS-CS instrument in evaluating risk factors for voice problems for choristers.

Convergent Validity

Figure 2 showed the graphical display of the final confirmatory factor analysis (CFA) model. The model displayed strong standardised factor loadings and acceptable fit indices, ensuring that the proposed measurement model was appropriate. The output information related to this model is presented in Table 9.

Confirmatory factor analysis (CFA) using AMOS analysis software was conducted to test the overall model of the respondents' questionnaire in the research. The analysis produced a good model fit. The model fit indices satisfied a set of standards of $\chi^2/df = 1.866$, RMSEA = 0.053, GFI = 0.916, and CFI = 0.957. These values surpassed the acceptable cut off values set by Hu and Bentler (1999) and Browne and Cudeck (1992). Furthermore, high factor loadings above 0.50 were observed for all items. The average variance extracted in each construct also exceeded 0.50. The measurements indicated that the convergent validity of the research instrument was satisfactory, as it surpassed 0.50, as recommended by Hair et al. (2017). Furthermore, the measures of

Table 7
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.884
Bartlett's Test of Sphericity	Approx. Chi-Square	5795.444
	df	741
	Sig.	0.000

Table 8
Rotated factor Matrix^a

	Factor 1 Dietary Habits	Factor 2 Speaking Habits	Factor 3 Health Issues	Factor 4 Choral Rehearsal	Factor 5 Peer Influence
Q1	0.818				
Q3	0.880				
Q4	0.865				
Q10		-0.808			
Q12		-0.784			
Q13		-0.833			
Q20			0.845		
Q21			0.798		
Q23			0.718		
Q24			0.825		
Q30				0.684	
Q31				0.769	
Q32				0.828	
Q33				0.803	
Q34				0.825	
Q35				0.826	
Q36				0.705	
Q37					-0.774
Q38					-0.737
Q39					-0.681

Note. Extraction Method: Principal Component Analysis

Rotation Method: Oblimin with Kaiser Normalisation

^aRotation converged in 9 iterations

Table 9
Reliability and convergent validity

Variables/ Constructs	Items	Standardised Factor Loadings	Cronbach α	Composite Reliability	Average Variance Extracted	Maximum Shared Variance
Dietary Habits	Q1	0.749	0.863	0.845	0.647	0.245
	Q3	0.891				
	Q4	0.765				

Table 9 (continued)

Variables/ Constructs	Items	Standardised Factor Loadings	Cronbach α	Composite Reliability	Average Variance Extracted	Maximum Shared Variance
Speaking Habits	Q10	0.759	0.842	0.794	0.562	0.314
	Q12	0.726				
	Q13	0.764				
Health Issues	Q20	0.657	0.852	0.877	0.643	0.438
	Q21	0.759				
	Q23	0.918				
	Q24	0.850				
Choral Rehearsal	Q30	0.640	0.903	0.888	0.534	0.010
	Q31	0.695				
	Q32	0.800				
	Q33	0.742				
	Q34	0.794				
	Q35	0.788				
	Q36	0.634				
Peer Influence	Q37	0.690	0.836	0.816	0.597	0.438
	Q38	0.842				
	Q39	0.779				

Note. Model Fitness: $X^2 = 285.563$, $df = 153$, $X^2/df = 1.866$, RMSEA = 0.053, RMR = 0.056, GFI = 0.916, CFI = 0.957

the total shared variance for each construct were lower than the measures of average variance extracted. This finding confirmed that the overall model had captured a distinct concept. The Cronbach alpha statistics and values for each dimension exceeded 0.70, confirming that the research instrument was reliable, as the internal consistency surpassed 0.70.

Discriminant Validity

The analysis used the Fornell and Larcker (1981) criterion to evaluate the measurement instrument for its discriminant validity. The instrument was evaluated to determine if each dimension captured a unique concept by estimating the square roots of

average variance extracted (AVE) for each dimension, then comparing them to the correlations amongst constructs. The square roots of average variance extracted for each dimension were presented diagonally in bold (Table 10), while inter-construct correlations were presented in other cells. To establish construct discriminant validity, each element in the diagonal cells needed to exceed the correlations in the corresponding cells. This study met the requirements, thereby confirming that each dimension is unique without overlapping.

To establish how widespread perceived voice handicap is, participants were divided equally along their scores on the Mandarin version of the Singing Voice Handicap

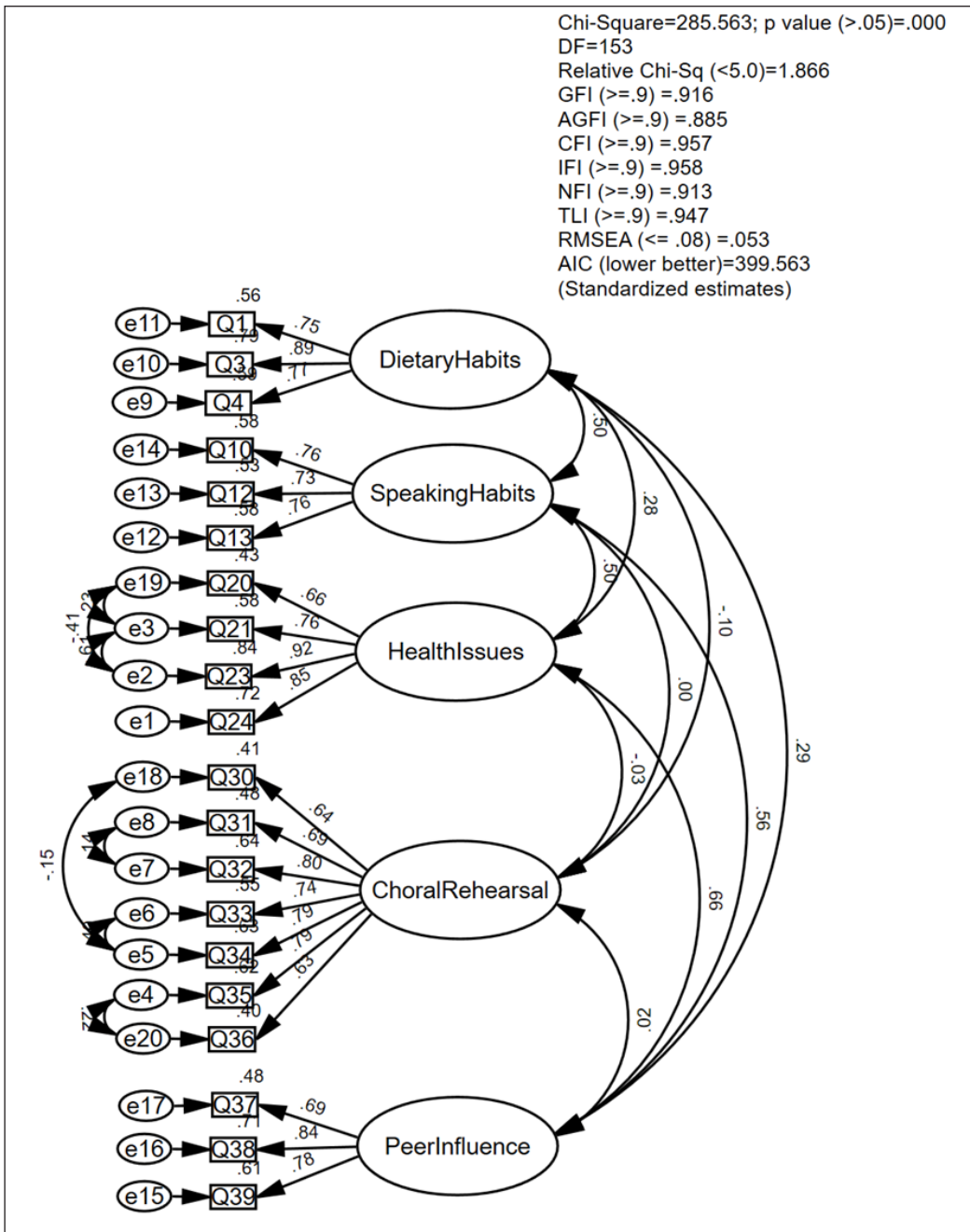


Figure 2. CFA Model

Table 10
Discriminant validity

	Speaking Habits	Health Issues	Choral Rehearsal	Dietary Habits	Peer Influence
Speaking Habits	0.750				
Health Issues	0.504	0.802			
Choral Rehearsal	0.002	-0.028	0.731		
Dietary Habits	0.495	0.281	-0.102	0.804	
Peer Influence	0.560	0.662	0.025	0.292	0.773

Table 11
VRS-CS-20 mean scores for Choristers with and without voice problems

	N	Minimum	Maximum	Mean	Std. Deviation	Sig. (2-tailed)
With Voice Handicap	182	15	53	30.46	7.80	
Without Voice Handicap	124	8	47	20.29	6.99	<0.001

Index-10 (Fu et al., 2022). The group without a voice handicap (NVH) was then contrasted with the group having a voice handicap (VH). The average scores for both groups were evaluated using the Vocal Risk Screening for Choristers Scale-20 (VRS-CS-20) (Table 11). The average score for the NVH group was 20.29 (SD = 6.99), contrasted with a significantly higher average score for the VH group, which was 30.46 (SD = 7.80) for the VRS-CS-20. The result from the independent samples t-test identified that the difference was significantly different at $p < 0.001$. The finding clearly identified that choral singers perceiving a voice handicap were at significantly greater risk than the group without problems. The results significantly

identified that the scores for the VRS-CS-20 clearly offered confirmatory support for the scale's use for discriminant validity.

DISCUSSION

This study resulted in the construction and validation of a scale called the VRS-CS that was multidimensional and helped identify various factors that contributed to the risk of vocal strain in choristers. The results clearly showed that the proposed scale had strong reliability and validity, along with outstanding stability. The creation of a structure comprising five factors, namely diet, speaking habits, health, practice habits, and social factors, helped clearly identify the risk for vocal strain, breaking it down from its multidimensional construct.

The robust performance of the VRS-CS from a psychological perspective clearly established the reliability and validity of the instrument's use for assessing the risk level for vocal health in choristers. The internal consistency reliability, reflected by Cronbach's alpha ($\alpha = 0.881$), clearly signified that the instrument accounted for a definite construct and that various underlying elements were related to each other, forming the domain of vocal behaviour, health, and environmental factors. The reliability on a test and retest basis also clearly signified that it had strong ICC (test-retest) reliability (ICC = 0.986). The factor analysis assumed considerable importance, as it clearly gave strong indications for evaluating the construct validity, and the model identified, consisting of five constructs, indicated a strong conceptual validity model.

The current study contributed to the existing literature by combining various predictors of vocal strain, that is, occupational voice load (Huston et al., 2023), noise level (Perry et al., 2023), and classroom air quality (Vertanen Greis et al., 2023), into a single validated instrument. The VRS-CS transcended existing symptom-oriented or profession-oriented assessments (Pestana et al., 2017) by embracing the interactions that existed at behavioural, biological, and social levels of vocal health, thereby supporting the philosophy advocated by Smith and Sataloff (2006) that choral pedagogy and vocal physiology need to be integrated for good vocal health to occur.

Some items were removed during the exploratory factor analysis, since the

loading factors suggested that there were low correlations for some items related to participants' experiences with vocal problems. This was carried out to improve the factor clarity and reliability of the scale. The items with low factor loadings could still affect vocal outcomes in different situations and populations. In the study, hydration, warm-ups, and eating spicy food were excluded. However, these variables could still be in an indirect relationship that could act either as a moderator or a mediator.

This view was also supported by existing literature, whereby unstructured warm-up exercises were found to contribute to, rather than improve, the subjective effort of vocalisation (Whitling et al., 2023). Thus, the effectiveness of the warm-ups seems to rely less on their implementation as part of the rehearsal schedule and more on how the warm-up activities are carried out and how well the activities meet the principles of voice hygiene. Inconclusive implementation of warm-up activities among the conductors of the choir groups can also account for the disparity, as the conductors can end up placing more emphasis on the musical preparation instead of the voice hygiene and physiologic readiness (Freer, 2022). Another perspective related to voice health indicated that specific and gradual warm-up activities emphasising appropriate support respiration and onset procedures can play a greater role in voice efficiency and prevention of voice fatigue than other factors (McAllen et al., 2025; Van Lierde et al., 2021).

While hydration, a crucial process that helps to maintain viscosity in mucous

tissues, also generally showed little relation to perceived vocal quality when examined through self-report analysis (Sivasankar & Leydon, 2010). Furthermore, Chowdhury et al. (2023) noted that improper eating behaviours, such as the excessive intake of high-fat foods, spicy foods, caffeinated beverages, and highly acidic foods and drinks, may trigger events that contribute to the exacerbation of reflux. This may consequently affect the tissues of the larynx and lead to laryngitis and vocal discomfort.

However, there were strong correlations observed to exist between vocal fatigue and poor practices of vocal hygiene, excessive duration of musical practice, poor acoustic conditions, and peer influence. The findings from the research were consistent with those of Meerschman et al. (2022), who observed that increased levels of vocal load and poor acoustic conditions had a strong association with increased phonation effort. Additionally, poor awareness of vocal hygiene practice remained a concern for amateur choristers and was often linked to the prevalence of vocal symptoms (Sharma et al., 2021). The findings confirmed that existing knowledge on the implications of negligence and environmental factors had more significance than preventive factors on the incidence of vocal fatigue.

Theoretically, the evidence that validated the VRS-CS showed that the multidimensional approach to the risk of vocal health encompassed the interactions of behaviour, environment, and physiology. The findings of the research confirmed that there was more to vocal health than

technique or hygiene-related concerns, and that vocal health could indeed be viewed as a systemically defined set of interactions among various psychological and environmental factors that contributed to an individual's level of vulnerability to the risk of vocal health, as observed by Stemple et al. (2018).

The VRS-CS proved to be an effective screening tool for teachers, clinicians, and researchers to identify early on various potential factors of vocal health. The VRS-CS showed high levels of both reliability and structural validity. As such, it appears to be an important screening instrument in choral educational settings, where systematic monitoring of vocal health has not occurred frequently. The scale could also provide direction for interventions, preventive vocal training, and a basis for evaluation in longitudinal studies concerned with strategies for vocal pedagogy, health, and rehearsals.

In conclusion, the VRS-CS not only provides a validated method of assessing the risk factors of voice handicap for young choral singers but also offers an important contribution towards the further advancement of vocal pedagogy. The comprehensive framework of VRS-CS that includes characteristics of both the Behavioural dimension, as well as the Environmental dimension and Health-related dimension, provides a valuable resource that not only helps early diagnosis of vocal risk but also helps develop strategies towards sustainable vocalisation.

Research Significance

The present study has made a major contribution to the areas of vocal pedagogy, choral education, and voice therapy. The concept of the Vocal Risk Screening for Choristers Scale (VRS-CS) outlined and verified through the study signifies more than a psychometric milestone, as it has established a framework for choral understanding that can promote healthy choral practice for young choristers on a sustainable level. The verification process for the scale has demonstrated that, for many years, choral research has lacked standardised measurement scales, and hence systematic study has not been possible in relation to the risk factors associated with healthy choral practice.

The relevance and significance of VRS-CS reside in the capacity of the study to integrate pedagogical, behavioural, and clinical paradigms. It attempted to offer a comprehensive theoretical foundation for vocal well-being on account of the capacity of the model to define the notion of vocal health risk based on the encounter that takes place at the levels of behaviours, physiology, and environment. The outstanding psychometric qualities of VRS-CS offer an important indication that it possesses stability and thus the capacity of the research to act as a benchmark for future comparison. In addition to the methodological aspect of the research, it also contributes to the emerging literature that proposes a preventive approach in relation to voice care. The significance of risk analysis towards vocal health not only

includes the aspect of consequences of voice misuse and strain, but also the perspective of searching for patterns within educational contexts.

Research Limitations

However, there are certain limitations that need to be understood when analysing the outcomes derived from this research. The first limitation is the use of self-reporting, whereby the study could be prone to certain types of bias, such as social desirability, accuracy of recall, and so forth, and individuals may have responded to the study questions in accordance with expected behaviour related to their vocal use patterns.

Second, the study did not use objective clinical measurements, for example, laryngoscopy, to confirm the participants' vocal fold health. The results, therefore, were based on perceived rather than objectively validated vocal health conditions.

Third, while the participants came from 17 provinces across mainland China, the study population was limited by its participants' age range, consisting only of adolescents and young vocalists from secondary educational institutions and universities. Despite its well-defined demographics, the results do not apply to populations different from the original study group, not only in geography, culture, and language, but also in learning settings and health services.

Finally, the analysis employed a cross-sectional study design, which made it rather difficult to establish whether causal links existed among the various identified factors.

For instance, long-term research designs should be used to determine the influence of factors such as behavioural, environmental, and physiological variables that affect the vocal outcomes of choristers.

CONCLUSION

The reliability and validity of the VRS-CS were assessed critically within the research. The findings provide evidence of the usefulness of the VRS-CS as a valid scale used in evaluating contributory factors that influence voice difficulties in choristers. The reliability and validity indices were found to produce highly significant results, making the VRS-CS scale highly dependable for use in research, educational, and professional settings. Collectively, it can be agreed that the results form a solid basis for future research and health efforts by concerned parties to protect and improve the vocal well-being of choristers.

Ethical Considerations

The study protocol was reviewed and approved by the Ethics Committee of Universiti Putra Malaysia (JKEUPM). All research procedures complied with the institutional ethical standards for studies involving human participants.

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APPENDIX

Validation format for data collection instruments

Title of the instrument for validation: “The Vocal Risk Screening for Choristers Scale (VRS-CS-39) Questionnaire among Chinese Younger Choristers”

Dear Experts,

We beseech your expert opinion in how relevant each item is being measured. The instructions are provided below to guide you in your analysis. Please use the following rating scale and rate each item as objective as possible in your review.

Instruction: This instrument is used for the EXPERT EVALUATOR to assess the relevance and effectiveness of the instrument that is validating. You must place the punctuation that you consider appropriate to the different statements according to the following scale:

1. Not Relevant 2. Somewhat Relevant 3. Quite Relevant 4. High Relevant

Questionnaire Item The Vocal Risk Screening for Choristers Scale (VRS-CS)	Scale			
	1 (Not Relevant)	2 (Somewhat Relevant)	3 (Quite Relevant)	4 (High Relevant)
Have you had formal musical training before? If yes, how long? 你之前有接受过多久的专业声乐训练?				
How long have you participated in choral singing? 你参加合唱团的日常排练共多久?				
Which part do you sing? 你在合唱团中担任的声部是?				
1. I would like to eat within three hours before bedtime. 我会在睡觉前三小时吃东西。				
2. I prefer to eat spicy food. 我喜欢吃辣的食物。				
3. I prefer to eat oil food. 我喜欢吃油炸食品。				
4. I prefer to eat ice cream or have cold drinks. 我喜欢吃冰激淋或喝冰饮料。				
5. I prefer to eat too hot food or drink hot water or soup. 我常吃很热的食物或者喝烫水。				
6. I can drink at least 1000-1500mL of water every day. 我每天至少能保证摄入1000-1500mL的水。				
7. I can sleep well at night. 我的睡眠质量很好。				
8. I usually have excessive talking every day. 我每天会说很多的话。				
9. I usually clear throat or cough. 我会经常清嗓子或者咳嗽。				
10. I usually scream, yell or holler. 我会尖叫或者大声吼叫。				

11. I usually whisper. 我会窃窃私语或者小声哼歌。				
12. I have to talk during throat infection. 嗓子发炎期间我不得不讲很多话。				
13. I have to talk in noise situations. 我不得不在很吵闹的环境下讲话。				
14. I have poor postures when speaking or singing (Hunched back). 当我说话或者歌唱的时候, 我的体态不好。(比如: 低头, 含胸, 驼背, 坐着唱)				
15. I usually sing without warming up. 我在歌唱前没有进行开嗓练习。				
16. I am out of break when singing. 唱歌时我的气息总是不够。				
17. I do not experience emotional stress or frequent feelings of sadness and depression. 我没有情绪上的压力或时常感到沮丧和抑郁。				
18. I have experienced acid reflux (The backflow of stomach contents, including acid, into the throat or mouth, causing a sour or bitter taste). 我有经历过胃酸返流(胃内容物(胃酸)回流到喉咙或口腔中, 导致酸味或苦味)。				
19. I have heart burn (A burning sensation in the chest, often after eating or when lying down). 我有经历过烧心或者消化不良(胸部烧灼感, 通常在进食后或躺下时出现)。				
20. I have nasal/inhalant allergies. 我有鼻炎或者吸入式的过敏症状。				
21. I have upper respiratory tract infection (URTI). 我经历过上呼吸道感染。				
22. I have the flu or a cold. 我患了流感或感冒。				
23. I have some voice treatments. 我接受过一些嗓音的治疗。				
24. I have consulted an ENT (ear, nose and throat) specialist. 我有去寻求过耳鼻喉科医生的帮助。				
25. I usually have practiced singing each day more than 2 hours except choral rehearsals. 我每天练歌超过两小时。				
26. I have participated in choral rehearsals for more than 2 hours every time. 我每次在合唱团的排练时间超过两个小时。				
27. Perform vocal warm up at the beginning of choral singing. 在合唱团排练时, 会先进行集体练声。				
28. Perform cool down at the end of choral singing. 在合唱团排练结束时, 会进行声音的放松训练。				
29. I feel difficult about selected repertoires. 感觉合唱团排练的曲目超出了我的歌唱水平。				
30. Choral conductors can clearly instruct the choral rehearsal. 我可以清晰的明白和理解合唱指挥的指示。				

31. Choral conductors have mentioned vocal hygiene during rehearsals. 合唱指挥有普及过声音健康方面的常识。				
32. I can get useful vocal techniques during choral rehearsals. 在合唱排练期间，我能够学到有效的发声技巧。				
33. The rehearsal room has soundproofing to prevent external noise from interfering with rehearsals. 排练厅有隔音设备能有效防止外部的噪音干扰。				
34. The rehearsal room is dusty. 排练厅布满灰尘。				
35. I have enough time to take a rest after the rehearsal. 我有充足的时间去休息自己的嗓子。				
36. I usually feel that my voice quality is good. 我觉得自己的声音质量很好。				
37. I am easily disturbed by other choristers when I am singing. 在合唱过程中，我容易受到其他合唱团员的干扰。				
38. I would like to compete with other choristers during choral rehearsals. 排练过程中，我喜欢和其他合唱团员相互竞争（比如飙高音）。				
39. I usually overuse my voice during choral singing with peers. 和同伴一起合唱时，总会不可避免的过度用嗓。				

Please write out the **risk factors** that were not mentioned and **comments**:

请写出上面没有提到过的风险因素和意见：

Name: _____

APPENDIX

The Vocal Risk Screening for Choristers Scale (VRS-CS-20)

The following statements are used by many people to describe their vocal habits, lifestyle, and other external factors that may affect vocal health. Over the past THREE months, based on your actual situation, please check the frequency of the following circumstances by marking the appropriate response.

下列的叙述是许多人用来描述他们的用嗓习惯，生活方式以及其他外部可能会影响声音健康的因素，在过去的三个月内，根据您自身的真实情况，请选出以下情况的频繁程度。

1=Never从不 2=Occasionally偶尔 3=Sometimes有时 4=Often经常 5=Always总是

How many years of professional vocal training have you received? (years) 你接受过多久的专业声乐训练？（单位：年）					
How long have you been a member of the choir? (years) 你加入合唱团多久了？（单位：年）					
What vocal part do you sing in the choir 你在合唱团中担任的声部是：	Soprano 女高音	Alto 女中音	Tenor 男高音	Bass 男低音	
Risk Factors 风险因素	Frequency 频繁程度				
	1. Never 从不	2. Occasionally 偶尔	3. Sometimes 偶尔	4. Often 经常	5. Always 总是
Q1. I would like to eat within three hours before bedtime. 我会在睡觉前三小时吃东西。	1	2	3	4	5
Q3. I enjoy fried food. 我喜欢吃油炸食品。	1	2	3	4	5
Q4. I like to eat ice cream or drink cold beverages. 我喜欢吃冰激淋或喝冰饮料。	1	2	3	4	5
Q10. I usually scream, yell, or holler. 我会尖叫或者大声吼叫。	1	2	3	4	5
Q12. I have to talk a lot when my throat is inflamed. 嗓子发炎期间我不得不讲很多话。	1	2	3	4	5
Q13. I have to speak in very noisy environments. 我不得不在很吵闹的环境下讲话。	1	2	3	4	5
Q20. I have nasal/inhalant allergies. 我有鼻炎或者吸入式的过敏症状。	1	2	3	4	5
Q21. I have upper respiratory tract infection (URTI). 我经历过上呼吸道感染。	1	2	3	4	5
Q23. I have some voice treatments. 我接受过一些嗓音的治疗。	1	2	3	4	5

Q24. I have consulted an ENT (ear, nose and throat) specialist. 我有去寻求过耳鼻喉科医生的帮助。	1	2	3	4	5
Q30. Choral conductors can clearly instruct the choral rehearsal. 我可以清晰的明白和理解合唱指挥的指示。	1	2	3	4	5
Q31. Choral conductors have mentioned vocal hygiene during rehearsals. 合唱指挥有普及过声音健康方面的常识。	1	2	3	4	5
Q32. I can get useful vocal techniques during choral rehearsals. 在合唱排练期间，我能够学到有效的发声技巧。	1	2	3	4	5
Q33. The rehearsal room has soundproofing to prevent external noise from interfering with rehearsals. 排练厅有隔音设备能有效防止外部的噪音干扰。	1	2	3	4	5
Q34. The rehearsal room is dusty. 排练厅布满灰尘。	1	2	3	4	5
Q35. I have enough time to take a rest after the rehearsal. 我有充足的时间去休息自己的嗓子。	1	2	3	4	5
Q36. I usually feel that my voice quality is good. 我觉得自己的声音质量很好。	1	2	3	4	5
Q37. I am easily disturbed by other choristers when I am singing. 在合唱过程中，我容易受到其他合唱团员的干扰。	1	2	3	4	5
Q38. I would like to compete with other choristers during choral rehearsals. 排练过程中，我喜欢和其他合唱团员相互竞争（比如飙高音）。	1	2	3	4	5
Q39. I usually overuse my voice during choral singing with peers. 在和同伴一起合唱时，总会不可避免的过度用嗓。	1	2	3	4	5