Original Article
http://mjiri.iums.ac.ir
Medical Journal of the Islamic Republic of Iran (MJIRI)

Med J Islam Repub Iran. 2025 (22 Jan);39.14. https://doi.org/10.47176/mjiri.39.14

The Effect of Telepractice Voice Training on the Voice Quality oF Theater Actors with Voice Complaints

Ali Arabi[1], Maryam Tarameshlu[1]*, Roozbeh Behroozmand[2], Hamide Ghaemi[3], Leila Ghelichi[1]

Received: 11 May 2024 Published: 22 Jan 2025

Abstract

Background: Evidence regarding the application of telepractice voice training in theater actors is inconclusive. Our study aimed to investigate changes in acoustic parameters, auditory-perceptual characteristics, and self-reported voice symptoms of theater actors with voice complaints undergoing telepractice voice training.

Methods: Nine theater actors with voice complaints participated in this single-group intervention. In this pre-post study, we observed changes in the participants' voice quality. The participants received twelve online voice training sessions over six weeks. An auditory-perceptual evaluation was performed using the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) profile to analyze the voice, while acoustic parameters were extracted from the recordings using Praat software. In addition, the Vocal Tract Discomfort Scale (VTDS) was administered as a self-report questionnaire. Outcome variables were measured pre-, post, and four weeks after the end of the training. The variables were then subjected to variance analysis with repeated measurements.

Results: Voice training resulted in significant changes in acoustic parameters, such as jitter and HNR. Additionally, over time, significant improvements were observed in auditory-perceptual characteristics, including overall severity, roughness, breathiness, and strain.

Conclusion: Telepractice voice training has the potential to enhance the voice quality of actors who experience voice complaints. However, more specific measures are necessary to fully understand the effectiveness of telepractice voice interventions compared with traditional face-to-face sessions.

Keywords: Voice Training, Telehealth, Voice Quality, Auditory Perception, Speech Acoustics, Occupational Health

Conflicts of Interest: None declared
Funding: This study was supported by grants (number 13646) provided by the Iran University of Medical Sciences (IUMS).

Cite this article as: Arabi A, Tarameshlu M, Behroozmand R, Ghaemi H, Ghelichi L. The Effect of Telepractice Voice Training on the Voice Quality oF Theater Actors with Voice Complaints. *Med J Islam Repub Iran.* 2025 (22 Jan);39:14. https://doi.org/10.47176/mjiri.39.14

Introduction

Theater actors are professional voice users, and voice is a critical component of their artistic lives (1-3). During stage performances, theater actors must be able to control their voices and project them clearly onto the audience. They also need to produce sustained long speeches without becoming hoarse or losing voice and even project their voices too much to reach the back rows of the auditorium (2, 4). All these abilities require a good understanding of vocal functions, breath support, and pitch control; without proper knowledge of these essential elements, vocal abuse can lead to various voice problems (5-7). According to studies by Leyns et al. (2) and D'haeseleer et al. (5), voice problems such as voice fatigue, dysphonia, and poor vocal

Corresponding author: Dr Maryam Tarameshlu, tarameshlu.m@iums.ac.ir

1. Department of Speech and Language Pathology, Rehabilitation Research Center, School of Rehabilitation Sciences, Iran University of Medical Sciences, Tehran, Iran
2. Department of Communication Sciences and Disorders, Arnold School of Public Health, University of South Carolina, Columbia, South Carolina, United States
3. Department of Communicative Sciences and Disorders, Michigan State University, East Lansing, MI, USA

↑What is "already known" in this topic:
Theater actors, a group of professional voice users, often face the risk of voice disorders. While several evidence-based resources on voice training exist, there is a lack of evidence to suggest that telepractice voice training can enhance voice quality for theater actors. This study provides a preliminary insight into the research of telepractice voice intervention for theater performers.

→What this article adds:
This study suggests that telepractice voice training can improve some acoustic and auditory-perceptual aspects of voice in theater actors with voice complaints.

hygiene are commonly reported by theater actors. These issues can be caused by various factors, including environmental, psychological, and occupational conditions, that increase the risk of voice complaints during stage performances (2, 5, 8, 9). Searl et al. (2019) also reported that 76% of acting students have at least one voice complaint during their artistic performance, with the most common complaints being hoarseness (33%) and pain (15%) (10-12). Moreover, 29.2% of theater actors face difficulties in breathing support during performance, which can lead to excessive voice complaints or dysphonia (7, 8). It is indicated that almost 35% of actors experience voice complaints due to poor vocal hygiene and voice training limitations, and 25.33% of professional theater actors currently working on stage have faced critical voice problems (1, 2, 8). Therefore, providing voice training for theater actors before they encounter voice disorders is necessary.

For a successful performance on stage, theater actors are advised to participate in warm-up and cool-down exercises as well as vocal hygiene that helps them to prepare and protect their voices (6, 13, 14). Koziara and Scherer also highlighted the importance of vocal hygiene instruction for theater actors as an essential aspect of voice training. Their study covered various categories, such as preventing vocal overuse, medical care, vocal hydration, environmental factors, and using proper vocal techniques (15). Moreover, it is recommended that vocal issues in actors be addressedy focusing on voice training and education (9, 16).Training covering voice mechanisms, a vocal warm-up and cool-down exercises, vocal hygiene, and breathing support have been found to be necessary for achieving successful intervention outcomes (2, 6, 9, 13, 14). These techniques are not only required for professional voice users but also for theater actors (6). However, speech-language therapists are hesitant about telepractice voice training methods, particularly in the case of theater actors.

The term "telepractice" has been utilized by the American Speech-Language-Hearing Association (ASHA) to designate a modality of speech-language pathology service delivery via online communication (17, 18). Telepractice for voice rehabilitation involves providing voice care services through the Internet and telecommunication technology (17, 19). Compared with in-person sessions, telepractice offers several advantages. For patients, it enables them to access services across different regions for voice therapy. In addition, it can save the time and financial costs associated with commuting for treatment (18, 19). Recent studies have explored telepractice for evaluation, intervention, and prevention services supporting individuals with voice disorders (18-23). In this regard, Franz et al. investigated the clinical efficacy of voice therapy administered via telepractice to individuals with dysphonia. Their findings indicated that telepractice is a potentially effective method for delivering voice therapy to patients with dysphonia (23). Moreover, the feasibility of telepractice delivery for voice therapy has been confirmed in various adult populations, and its efficacy has been preliminarily revealed (22). Liu et al. conducted online voice training for female teachers. Their program consisted of vocal hygiene education and resonant voice training and was held twice a week for eight sessions. Auditory-perceptual, acoustic, aerodynamic, and self-assessments were conducted before and after the intervention. Their results showed that telepractice voice intervention effectively improved the voice quality of female teachers in this group of professional voice users (24). Despite evidence supporting voice intervention through online sessions for dysphonia, telepractice as a means of delivering voice training for theater actors still needs to be explored. Additionally, there is a lack of literature on telepractice voice training for theater actors, highlighting the need for further research. Therefore, this study aimed to explore the effect of voice training delivered via telepractice on acoustic parameters, auditory-perceptual characteristics, and self-reported voice symptoms in theater actors with voice complaints.

Methods
Study design
This study involved single-group intervention research at three-time points (pre-, post, and follow-up). We measured auditory-perceptual characteristics, acoustic parameters, and self-reported voice symptoms of theater actors with voice complaints.

Participants
This study recruited nine theater actors who regularly performed at the Tehran Theater Hall Complex (TTHC). Five of the actors were male, and four were female. They reported experiencing one or more voice complaints from a list of nine voice symptoms (Hoarseness, Vocal fatigue, Pain, Strain, Aphonia, Breathiness, Monotone, Pitch break, and Tremor) (25). Participants in the study had to be adults (aged 18 to 65), with at least four years of acting experience, without a history of respiratory problems, craniofacial trauma, or head/neck surgery. The exclusion criterion was cold or flu during the study period. Although ten theater actors initially participated, one actress had to leave because of medical reasons.

Evaluation procedure
Voice evaluations included self-report assessments, auditory-perceptual evaluations, and acoustic measurements. Evaluations were performed pre- (T_0), post (T_1), and four weeks after the end of the voice training (T_2).

a) Self-report evaluation of voice symptoms: The Vocal Tract Discomfort Scale (VTDS) is used to subjectively assess voice problems (26). On a numerical scale ranging from 0 to 48, the experience of vocal tract discomfort is evaluated based on the frequency and severity of symptoms. When the participants completed the questionnaire, points were calculated for the frequency and severity of VTDS.

b) Acoustic evaluation of voice: For acoustic evaluation, voice recording was conducted in an acoustic chamber at the speech laboratory of the IUMS, with noise levels attenuated to 35 dB or below. This was performed using a standard portable handy recorder (Zoom H5-HRC). The sampling frequency of the voice recording was 44.1 kHz with 16-bit precision, and the data were stored in the WAV format on a recorder's memory card. The microphone of the

[DOI: 10.47176/mjiri.39.14]

recorder was positioned 10 cm from the right corner of the mouth at a 45-degree angle (1, 2). Each participant was positioned in a chair with their back straight and instructed to produce sustained phonation of vowel /a/ three times at their conversational pitch and loudness for five seconds. Using Praat Software (Version 6.2.09) (27), and owing to the reduction in the damping effect, the first and last one-second of each voice was eliminated. The acoustic parameters, including the mean F0 (HZ), local shimmer (%), local jitter (%), and Harmonic to Noise Ratio (HNR) (dB), were accurately calculated for each voice file using Praat and the average parameters of each of the three vowels were considered as the final data.

c) Auditory-perceptual evaluation of voice: Auditory-perceptual evaluation was conducted using the Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) profile. It consists of six subscales: overall severity, roughness, breathiness, strain, pitch, and loudness (28). For this profile, there were three levels of voice production: producing sustained vowels /a/ and /i/, reading six sentences, and producing continuous speech for 20 seconds. The grading system uses both quantitative and qualitative methods (using a 100-mm visual scale). Participants were asked to read standard sentences of the validated Persian version of the CAPE-V profile (28). Each participant was asked to sit on a chair with their back straight and produce six standard sentences with natural pitch and loudness. Finally, the voices were rated by a qualified speech-language pathologist with > 15 years of experience in voice analysis.

Voice training procedure

First, the participants attended a remote group meeting in which they learned about the voice-training framework. All voice training sessions were conducted online via an internet network with a minimum bandwidth of 10 Mbps. The system for these sessions used end-to-end encrypted software to ensure security (WhatsApp, https://www.whatsapp.com). Six weeks of telepractice voice training consisted of 12 online sessions, each session lasting about 2 hours, held two times a week. During each session, the participants received instructions on vocal hygiene, breathing exercises, and warm-up and cool-down techniques. A summary of the sessions and contents covered during the six weeks of telepractice voice training for theater actors is provided in Appendix 1.

a) Vocal hygiene: The participants were instructed on the principles of vocal hygiene, anatomy, and physiology of the voice system, as well as the basics of the breathing system (15, 16). They were encouraged to practice vocal hygiene every day, both at home and at work. Video files and PowerPoints were sent regularly to the participants at the end of each session.

b) Breathing exercises: Participants in the study were asked to practice breathing exercises for twenty minutes each day. These exercises included techniques such as breathing pattern awareness, diaphragmatic breathing, and voice-breathing coordination (4, 29). Each participant was asked to perform their own exercises, and the instructor provided visual and verbal feedback through online monitoring at each session. In addition, participants were provided with recorded videos for each session so they could access the techniques during their daily exercises.

c) Warm-up and cool-down techniques: The participants were taught warm-up and cool-down techniques, including trills and humming. In addition, instructional files and videos were shared with the participants (30, 31). All participants were encouraged to perform ten minutes of warm-up and cool-down routines every day. Moreover, they were expected to undertake a ten-minute warm-up before each performance and a ten-minute cool-down afterward.

Statistical analysis

SPSS Statistics for Windows version 18 (SPSS Inc., Chicago, IL, USA) was used to analyze all data. Descriptive statistics of the mean (standard deviation (SD)) were used to describe the characteristics of the participants and outcome variables. Prior to statistical analyses, the Kolmogorov-Smirnov (KS) test was performed to assess whether the quantitative data were normally distributed. Repeated measures ANOVA was used to test the effect of voice training on the outcome measures over time [before the intervention (T_0), post-intervention (T_1), and four weeks after the end of the intervention (T_2)] as the within-subject variable, followed by a Bonferroni adjustment test for multiple comparisons. Statistical significance was defined as a p-value of less than 0.05 ($P < 0.05$).

Results

Nine theater actors (five males, four females) with a mean (SD) work experience of 7.11 (2.36) years were included in this study. The demographic information of the participants is presented in Table 1.

Voice complaint symptoms reported by participants

As reported in Table 2, hoarseness was the most common voice complaint among participants based on voice complaint symptom results, while pitch break (11.1%) and tremor (11.1%) were the least common symptoms.

The self-report of vocal tract discomfort scale

Repeated-measures ANOVA showed a significant reduction in the frequency subscale of the VTDS after the intervention [$P < 0.001$, d = 0.56]. Adjustment for multiple comparisons using Bonferroni correction indicated a significant decrease at T_1 and T_2 compared to T_0 ($P = 0.034$, $P = 0.027$).

Table 1. Demographic characteristics of participants (n=9)

Sex	Mean age (SD)	Number	Percentage	Work experience (SD)
Male	27.2 (1.92)	5	55.60%	6 (1.22)
Female	29.5 (3.87)	4	44.40%	8.5 (2.8)
Total	28.88 (2.99)	9	100%	7.11 (2.36)

[DOI: 10.47176/mjiri.39.14]

Table 2. Voice complaint symptoms reported by participants (n=9)

Voice symptom	Number of participants	Percentage of participan
Hoarseness	9	100
Voice fatigue	8	88.80
Pain	6	66.60
Strain	6	66.60
Aphonia	5	55.50
Breathiness	5	55.50
Monotone	3	33.30
Pitch break	1	11.10
Tremor	1	11.10

The frequency subscale of the VTDS at T_2 was similar to that at T_1 (P = 1.0). Moreover, there was a significant reduction in the VTDS severity subscale after the intervention [P < 0.001, d = 0.66]. Adjustment for multiple comparisons using Bonferroni correction indicated significant changes at T_1 and T_2 compared to T_0 (P = 0.006, P = 0.012). The VTDS severity subscale score at T_2 was similar to that at T_1 (P = 1.000) (Table 3).

Acoustic parameters of voice

The intervention resulted in significant changes in jitter, HNR, and shimmer, as shown by the repeated measures ANOVA. The results revealed significant reductions were observed in the jitter [P = 0.03, d = 0.52], HNR [P = 0.031, d = 0.4], and shimmer [1.07, 8.62] = 5.01, P = 0.020, d = 0.4). Multiple comparison adjustments using Bonferroni indicated significant changes at T_1 and T_2 compared with T_0 for all three measures (P =0.032, P = 0.041, jitter; P = 0.022, P = 0.050 HNR, and P = 0.018, P = 0.034, for shimmer). The shimmer at T_2 was similar to that at T_1 (P = 1.000). Furthermore, no p-values for male F0 (1.000) or female F0 (0.472) were found to be significant (Table 4).

Auditory-perceptual characteristics

The intervention resulted in changes in various CAPE-V characteristics according to the repeated measures ANOVA. Significant decreases in the overall severity subscale score were observed after the intervention [P =0.014, d =0.54]. Adjustment for multiple comparisons using Bonferroni correction indicated significant changes at T_1 and T_2 compared to T_0 (P =0.040, P =0.050). The overall severity at T_2 was similar to that at T_1 (P = 0.311).

Moreover, repeated-measures ANOVA showed a significant decrease in roughness after the intervention [P = 0.020, d = 0.51]. Adjustment for multiple comparisons using Bonferroni correction indicated a significant reduction at T_1 and T_2 compared to T_0 (P = 0.041, P = 0.050). The roughness at T_2 was similar to that at T_1 (P = 0.070). We also observed a significant decrease in breathiness after the intervention, P = 0.006, d = 0.62]. Adjustment for multiple comparisons using Bonferroni correction indicated a significant reduction at T_1 and T_2 compared to T_0 (P = 0.021, P = 0.031). Breathiness at T_2 was similar to that at T_1 (P = 0.311).

For strain, a significant decrease was observed after the intervention [P = 0.020, d = 0.53]. Adjustment for multiple comparisons using Bonferroni correction indicated a significant reduction at T_0 and T_1 compared to T_2 (P = 0.050, P = 0.050). The strain at T_0 was similar to that at T_1 (P = 1.131). Furthermore, there were no significant differences in pitch (0.232) or loudness (0.728) (Table 5).

Discussion

In this study, we aim to investigate the effect of voice training delivered via telepractice on the voice quality of theater actors who have voice complaints. Specifically, we measured the changes in acoustic parameters, auditory-perceptual features, and self-report voice assessment in theater

Table 3. Mean (SD) of the VTDS scores reported by participants (n=9)

Subscale	Mean (SD)		
	T_0	T_1	T_2
Severity	16.44 (7.84)	9.33 (4.5)	9.33 (3.96)
Frequency	15.78 (8.52)	9.0 (3.87)	8.56 (3.64)

1st Evaluation= T_0, 2nd Evaluation= T_1, 3rd Evaluation= T_2

Table 4. Mean (SD) of the acoustic parameters in participants (n=9)

Acoustic parameters	Mean (SD)		
	T_2	T_2	T_2
Male F0 (n=5)	129.27 (42.85)	130.78 (28.98)	136.28 (4.49)
Female F0 (n=4)	215.62 (39.51)	226.45 (13.26)	224.65 (16.19)
Jitter	0.371 (0.114)	0.252 (0.106)	0.238 (0.086)
Shimmer	3.104 (1.575)	1.813 (0.815)	2.173 (0.775)
HNR*	22.66 (2.89)	25.81 (2.51)	24.93 (2.59)

1st Evaluation= T_0, 2nd Evaluation= T_1, 3rd Evaluation= T_2,
*HNR= harmonic-to-noise ratio

Table 5. Mean (SD) of CAPE-V scores in participants (n=9)

CAPE-V subscale	Mean (SD)		
	T_0	T_1	T_2
Overall severity	35.0 (22.6)	12.22 (8.7)	10.0 (9.35)
Roughness	33.33 (22.63)	13.88 (8.2)	10.0 (9.35)
Breathiness	21.94 (16.66)	5.0 (5.59)	2.77 (3.63)
Strain	26.66 (17.98)	13.33 (11.98)	8.33 (12.5)
Pitch	7.77 (13.78)	3.33 (4.33)	1.11 (2.2)
Loudness	3.88 (6.98)	3.33 (4.33)	2.22 (3.63)

1st Evaluation= T_0, 2nd Evaluation= T_1, 3rd Evaluation= T_2

[DOI: 10.47176/mjiri.39.14]

actors' voices who participated in telepractice voice training. Previous research into theater actors has followed a face-to-face method in voice training (6, 8, 9).

The self-report of vocal tract discomfort scale

In this study, we observed a significant reduction in both frequency and severity sub-scales of the VTDS among theater actors. The high level of the VTD subscales in the pre-intervention phase was also similar to the study by Pecorari et al. (2022), in which the high VTDS score was attributed to the massive use of the voice during professional activity and the high vocal demand imposed by the performance (8). The vocal abuse behaviors, such as shouting or improper vocal techniques, increase vocal tract discomfort (VTDS) scores in various populations (6, 14). However, telepractice voice training focused on vocal hygiene, voice education, and breathing exercises was promising for improving VTD scores.

Acoustic parameters of voice

After providing telepractice voice training, we observed a significant decrease in jitter and shimmer among theater actors, along with an improvement in the harmonic-to-noise ratio (HNR). This improvement is believed to be the result of focusing on vocal hygiene, breathing exercises, and the use of warm-up and cool-down voice methods. It is noteworthy that the positive changes in mean jitter and mean HNR were maintained at both the post- and follow-up points four weeks later. These findings suggest that improvements can be sustained over time. Moreover, no significant changes were found for F0 in participants. This might be because actors usually use a similar F0 range across performing conditions and gender, where they perform a wide range of F0 between 75.38 and 530.33 Hz (32).

Auditory-perceptual characteristics of voice

Following telepractice voice training, participants were observed to experience significant reductions in strain, roughness, and breathiness indexes of CAPE-V. These findings were consistent with the results of a previous study by Sezin et al. (9). Their study indicated that incorporating online monitoring of breathing exercises, as well as daily vocal warm-up and cool-down routines, have a positive impact on reducing vocal strain, breathiness, and roughness (24, 33). In addition, our study showed a significant decrease in the overall severity index of CAPE-V, which suggests that comprehensive vocal hygiene practices can have a positive impact on voice quality. The results of a study conducted by Rangarathnam et al. also delivered similar findings to our results (16). However, there was no significant change in the mean pitch and loudness of CAPE-V across the three assessment periods, which confirms the findings of Sezin et al. (9). This finding suggests that telepractice voice training for theater actors may need to be conducted for a longer duration to make substantial changes to CAPE-V pitch and loudness values.

Limitation

The main limitation of this study was its small sample size. Future studies should include a larger sample size and a control group to obtain more comprehensive results. Additionally, this study did not measure stroboscopic parameters or physiological measurements of the voice, which could have been helpful in investigating the effects of the interventions. Therefore, future studies could use multidimensional assessments to measure the effectiveness of voice training via telepractice and compare it with in-person voice training for theater actors.

Conclusion

The findings of this study highlight the value of telepractice voice training for theater actors with voice complaints as accessible preventive care. According to these findings, voice training methods, such as vocal hygiene, education, breathing exercises, and warm-up and cool-down exercises, can be implemented via a telepractice model of care for theater actors with voice complaints.

Authors' Contributions

All authors contributed to the study's conception and design. The AA contributed to data collection, interpretation of data, and writing of the manuscript; the MT contributed to the writing of the manuscript, interpretation of data, and statistical analysis, L.GH contributed to the analysis and first draft of the manuscript, the H.GH and RB contributed with study conception and the first draft of the manuscript. All authors read and approved the final manuscript.

Ethical Considerations

The Research Ethics Board of Iran University of Medical Sciences approbated the ethical code for this research (IR.IUMS.REC.1397.839). All participants were informed of the research purpose and procedure, and written informed consent was obtained prior to participation in the study.

Acknowledgment

The authors thank the theater actors who participated in this study.

Conflict of Interests

The authors declare that they have no competing interests.

References

1. D'haeseleer E, Meerschman I, Claeys S, Leyns C, Daelman J, Van Lierde K. Vocal Quality in Theater Actors. J Voice. 2017 Jul 1;31(4):510.e7-510.e14.
2. D'haeseleer E, Quintyn F, Kissel I, Papeleu T, Meerschman I, Claeys S, et al. Vocal Quality, Symptoms, and Habits in Musical Theater Actors. J Voice. 2022 Mar;36(2):292.e1-292.e9.
3. Bourne T, Kenny D. Vocal qualities in music theater voice: perceptions of expert pedagogues. J Voice. 2016;30(1):128-e1.
4. Sliiden T, Beck S, MacDonald I. An evaluation of the breathing strategies and maximum phonation time in musical theater performers during controlled performance tasks. J Voice. 2017;31(2):253-e1.
5. Leyns C, Daelman J, Meerschman I, Claeys S, Van Lierde K, D'haeseleer E. Vocal Quality After a Performance in Actors Compared to Dancers. J Voice. 2022 Jan;36(1):141.e19-141.e31.
6. Fritz R, Porcaro CK, Gollery T. Effectiveness of Vocal Training Techniques in School-Aged Drama Students. J Voice. 2023 Dec.
7. Ferrari EP, Simões-Zenari M, Master S, Nemr K. Risk of dysphonia and

[DOI: 10.47176/mjiri.39.14]

voice quality in performing arts students. Codas. 2023;35(4).
8. Pecorari A, Yamasaki R, Badaro F, Borrego MC, Behlau M. Perceived vocal complaint and self-assessment of the vocal problem impact in professional theater actors. Audiology-Communication Research. 2022;27.
9. Sezin RK, Özcebe E, Aydinli FE, Köse A, Günaydin RÖ. Investigation of the Effectiveness of a Holistic Vocal Training Program Designed to Preserve Theatre Students' Vocal Health and Increase Their Vocal Performances; A Prospective Research Study. J Voice. 2020;34(2):302-e21.
10. Searl J, Dargin T, Bailey E, Lansing E. Voice and Lifestyle Behaviors of Student Actors: Impact of History Gathering Method on Self-Reported Data. J Voice. 2021;35(2):233-246
11. De Saram PO, Wijesinghe T, Toner MA. Impact of Self-reporting Voice Symptoms on Occupational and Social Life among Stage Drama Actors and Their Knowledge on Vocal Hygiene Techniques, Habits and Treatment Options. 2015.
12. Devadas U, Hegde M, Maruthy S. Prevalence and Risk Factors of Self-reported Voice Problems Among Yakshagana Artists. J Voice. 2019;33(1):124.e35-124.e47.
13. Seton M, Maxwell I, Szabó M. Warming up/cooling down: managing the transition on and off stage. Theatre Dance Perform Train. 2019 Jan 2;10(1):127–41.
14. Panoutsos C. The absence of the cool-down for actors following a theatre performance; the discussion is on-going but the gap remains. Theatre Dance Perform Train. 2021 Oct 2;12(4):554–74.
15. Koziara AM, Scherer DR. Vocal Hygiene for Musical Theatre Performers [Internet]. Bowling Green State University; 2019. Available from: https://scholarworks.bgsu.edu/honorsprojects/553
16. Rangarathnam B, Paramby T, McCullough GH. "Prologues to a bad voice": effect of vocal hygiene knowledge and training on voice quality following stage performance. J Voice. 2018;32(3):300–6.
17. Mallipeddi N V., Mehrotra A, Van Stan JH. Telepractice in the Treatment of Speech and Voice Disorders: What Could the Future Look Like? Perspect ASHA Spec Interest Groups. 2023 Apr 5;8(2):418–23.
18. Gong X, Han Y, Wang Y, Huang Z. The Effects of Telerehabilitation in Patients with Voice Disorders: A Systematic Review and Meta-Analysis. J Voice. 2024;4:S0892-1997(24)00180-2.
19. Myers B, Hary E, Ellerston J, Barkmeier-Kraemer JM. Telepractice Considerations for Evaluation and Treatment of Voice Disorders: Tailoring to Specific Populations. Am J Speech Lang Pathol. 2022 Mar 10;31(2):678–88.
20. Ward EC, Wall LR, Burns CL, Cartmill B, Hill AJ. Application of telepractice for head and neck cancer management: a review of speech language pathology service models. Curr Opin Otolaryngol Head Neck Surg. 2017;25(3):169–74.
21. Fu S, Theodoros DG, Ward EC. Delivery of intensive voice therapy for vocal fold nodules via telepractice: A pilot feasibility and efficacy study. J Voice. 2015;29(6):696–706.
22. Weidner K, Lowman J. Telepractice for adult speech-language pathology services: a systematic review. Perspect. ASHA Spec Interest Groups. 2020;5(1):326–38.
23. Franz L, Da Canal A, Tuon M, Defilippi R, Biscaro A, Pasian M, et al. Clinical effectiveness of telerehabilitation in voice therapy programs for dysphonia. Am J Otolaryngol. 2024 May;45(3):104255.
24. Liu H, Hao G, Chen S, Ouyoung L, Liu Y, Li J, et al. Effectiveness and Feasibility of Telepractice on Voice Therapy for Female Teachers in Elementary Schools with Self-Reported Voice Disorders. J Voice. 2024 Jan;38(1):244.e1-244.e13.
25. Safaeyan S, Jenabi MS, Kamali M, Roudbari M, Amiri-Shavaki Y. Vocal complaints and risk factors in practitioners of speech-language pathology. Koomesh. 2018;20(4):650–6.
26. Torabi H, Khoddami SM, Ansari NN, Dabirmoghaddam P. The Vocal Tract Discomfort Scale: Validity and Reliability of the Persian Version in the Assessment of Patients With Muscle Tension Dysphonia. J Voice. 2016 Nov;30(6):711–6.
27. Boersma P, Weenink D. Praat: doing phonetics by computer [Computer program]. http://www.praat.org/; 2024.
28. Salary Majd N, Maryam Khoddami S, Drinnan M, Kamali M, Amiri-Shavaki Y, Fallahian N. Validity and rater reliability of Persian version of the Consensus Auditory Perceptual Evaluation of Voice. Audiology. 2014;23(3):65–74.
29. Desjardins M, Bonilha HS. The Impact of Respiratory Exercises on Voice Outcomes: A Systematic Review of the Literature. J Voice. 2020 Jul;34(4):1–39.
30. Ragan K. The efficacy of vocal cool-down exercises. J Sing. 2018;74(5):521–6.
31. Mezzedimi C, Spinosi MC, Massaro T, Ferretti F, Cambi J. Singing voice: acoustic parameters after vocal warm-up and cool-down. Logoped Phoniatr Vocol. 2020 Apr 2;45(2):57–65.
32. Melton J, Bradford Z, Lee J. Acoustic Characteristics of Vocal Sounds Used by Professional Actors Performing Classical Material Without Microphones in Outdoor Theatre. J Voice. 2022 Sep;36(5):733.e23-733.e29.
33. Ribeiro VV, Frigo LF, Bastilha GR, Cielo CA. Vocal warm-up and cool-down: systematic review. Rev CEFAC. 2016;18:1456–65.

Appendix 1. Summary of the sessions and contents covered during six weeks of telepractice voice training for theater actors

Week	Sessions / Duration	Content	Example
1	2/ 4 hours	• Introduction to voice-training framework • Anatomy and physiology of voice • Vocal hygiene principles and basics of the voice and breathing system	Introduction to laryngeal and voice system. Explanation of diaphragmatic breathing and discussion on voice function. Engagement in interactive activities and discussions regarding anatomy and physiology of voice as well as breathing system.
2	2/ 4 hours	• Continued vocal hygiene practice • Breathing exercises: breathing pattern awareness, diaphragmatic breathing	Practicing diaphragmatic breathing exercises with visual feedback. Focusing on proper breathing patterns and its coordination with vocalization. Personalized feedback on breathing technique. Discussions on the importance of breath support for vocal projection in the stage performance.
3	2/ 4 hours	• Emphasis on vocal hygiene practice • Breathing exercises refinement and feedback	Refinement of breathing techniques with personalized feedback. Discussion on vocal care routines, including hydration and avoiding vocal strain.
4	2/ 4 hours	• Vocal hygiene reinforcement • Warm-up techniques: trills and humming	Demonstration of trills and humming exercises with audiovisual and tactile feedback. Practicing warm-up exercises incorporating trills and humming to gently warm up vocal muscles. Individualized coaching on vocal warm-up techniques.
5	2/ 4 hours	• Continued vocal hygiene practice • Warm-up and cool-down techniques consolidation	Practicing cool-down techniques such as lip trills. Engagement in group warm-up and cool-down exercises. Integrating warm-up and cool-down exercises into daily practice.
6	2/ 4 hours	• Final vocal hygiene review • Practice of warm-up and cool-down routines • Review of breathing exercises	Review of vocal hygiene practices, rehearsal of warm-up and cool-down routines, as well as breathing exercises. Individualized feedback and sharing experiences and challenges.

[DOI: 10.47176/mjiri.39.14]