Scientific Reports

https://doi.org/10.1038/s41598-026-54600-2

Article in Press

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Received: 2 March 2026

Accepted: 20 May 2026

Published online: 23 May 2026

Cite this article as: Yesilli-Puzella G., Hanbal-İbooğlu E. & Karataylı Özgürsoy S. Effects of vocal hygiene education program delivered via videoconference on acoustic and self-reported voice outcomes in Muslim religious officials in Turkiye. *Sci Rep* (2026). https://doi.org/10.1038/s41598-026-54600-2

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Effects of vocal hygiene education program delivered via videoconference on acoustic and self-reported voice outcomes in Muslim religious officials in Turkiye

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Abstract

This study examined the effects of a vocal hygiene education program delivered via videoconference on voice quality and self-perceived vocal outcomes among Muslim religious officials in Turkiye. The participants were 26 imams, aged between 28 and 51 years. All participants completed a seven-week study procedure, consisting of two structured videoconference-based vocal hygiene sessions and a four-week vocal hygiene implementation period.

Voice-Related Quality of Life (V-RQOL), Voice Handicap Index-10 (VHI-10), Acoustic Voice Quality Index Version 2.06 (AVQIv2), jitter, shimmer, and harmonics-to-noise ratio (HNR) were assessed before and after the program. V-RQOL scores increased from 82.60 ± 19.91 to 89.23 ± 11.61 ($p = 0.006$). VHI-10 scores declined from 9.58 ± 5.24 to 5.96 ± 4.43 ($p < 0.001$), and AVQIv2 scores decreased from 3.12 ± 0.85 to 2.35 ± 0.61 ($p < 0.001$). Jitter, shimmer, and HNR values showed improvement but did not reach statistical significance. These findings suggest that vocal hygiene education delivered via videoconference was associated with favorable changes in self-reported outcomes and AVQIv2 scores, among Muslim religious officials.

Keywords: professional voice; religious officials; voice hygiene; telepractice; acoustic voice analysis; voice-related quality of life

Background

People who use their voice as their primary means of communication in their professional life on a regular, prolonged, and often intense basis are considered professional voice users [1]. For these individuals, vocal performance has a direct impact on the effectiveness of their work. The vocal demands of their job, environmental conditions, and not having proper vocal training or vocal hygiene awareness significantly increase the risk of developing voice disorders among professional voice users [2]. Muslim religious officials, such as imams and muezzins, use their voices in daily prayers (performed five times a day), sermon delivery (khutbah), Qur'anic recitation, and leading religious ceremonies, often in front of large crowds, especially in large mosques. Continuous and intense use of the voice without adequate vocal care may elevate the risk of developing voice disorders, resulting in vocal fatigue, diminished vocal quality, and difficulty in communication.

Despite these extensive vocal demands, Muslim religious officials typically receive minimal formal voice training during their religious

education. A previous study compared the voice hygiene habits and voice training of Christian and Muslim religious officials living in Turkiye and found that Muslim religious officials had a higher rate of voice disorders than Christian religious officials, as well as lower levels of voice training [3]. Similarly, Büyükatalay et al. reported significantly higher vocal abuse-misuse, vocal hygiene knowledge, and voice handicap indices among religious officials compared to teachers [4]. In addition, Islamic religious officials have been reported to exhibit significantly higher rates of reflux complaints and elevated Voice Handicap Index-10 scores in comparison to other professional voice users, with muscle tension dysphonia identified as the most common voice disorder among this group [5]. The occupational voice demands of Muslim religious officials include several phonotraumatic risk factors: prolonged recitation, elevated vocal intensity, melodic recitation, environmental factors such as poor acoustics, and temperature extremes in mosque environments [5]. When combined with inadequate use of vocal hygiene habits, these factors may substantially increase the risk of voice problems. A study conducted on Malayalam-speaking Islamic religious speakers revealed that a significant proportion of professionals experienced voice problems, particularly among those who frequently recite the Adhaan [6].

Given that vocal difficulties experienced by professional voice users can result in major vocational, social, and economic challenges, the shift from a reactive voice care approach to a more proactive strategy is critical. The World Health Organization (WHO) [7] highlights that prevention is not only more cost-effective but, from public health, social, economic, and sustainability perspectives, also more advantageous than depending exclusively on treatment post-injury. It is indicated that even small additional investments in preventive measures can lead to significant financial savings and health improvements. Promoting appropriate voice-use techniques and

increasing awareness of vocal hygiene can aid in the prevention of voice disorders among professional voice users, including religious officials.

The telehealth system is another factor that can enhance prevention strategies. Telehealth has the potential to reduce hospital admissions and provide access to healthcare services across long distances [8]. The COVID-19 pandemic accelerated the development and use of a wide variety of telehealth technologies by health systems, leading to the creation of new virtual health facilities [9,10]. In this context, remote training may be especially advantageous for Muslim religious officials, whose job routine is based on scheduled prayer times, sermon preparation, Qur'anic recitation, and mosque duties, which might make it difficult to regularly access in-person voice care services. Despite the documented vulnerability of Muslim religious officials to voice disorders and the proven efficacy of vocal hygiene training, no previous study has systematically evaluated a structured, vocal hygiene program delivered via videoconference designed for this group. Preventive vocal hygiene training may reach a larger audience via telehealth, encouraging early awareness and appropriate vocal habits, which may potentially reduce the incidence of occupational voice disorders. Additionally, it can lower travel costs, encourage environmentally sustainable healthcare delivery, and give professional users access to expert consultation no matter where they are.

Therefore, this study aimed to assess the effectiveness of a voice hygiene education program delivered via videoconference within a seven-week study protocol, including four-week implementation period on both objective acoustic measures and self-reported voice outcomes in Muslim religious officials in Turkiye. The study compared pre- and post-program self-reported outcomes that involved the Voice-Related Quality of Life Scale (V-RQOL) [11], Voice Handicap Index-10 (VHI-10) [12], together with acoustic measurements including Acoustic Voice Quality Index Version 02.06 (AVQIv2) [13], jitter (%), shimmer (%), and harmonics-to-noise ratio (HNR).

Materials and Methods

This prospective, pre-post educational intervention study was conducted between August 2023 and January 2024 at the Provincial Mufti's Office in Adana, Turkiye. The study received ethical approval from the Cappadocia University Ethics Committee on August 29, 2022 (Decision No: 22.16). All procedures were conducted in accordance with the Declaration of Helsinki. Each subject provided written informed consent.

Participants

This study's participants were Muslim religious officials associated with the Adana Provincial Mufti's Office, actively serving in mosques within the central and district areas of Adana province. The study comprised 26 male volunteers aged between 28 and 51 years, all of whom worked full-time as imams six days per week. During the study period, no participants reported using any medications, and five participants reported current smoking. None of them had physician-diagnosed reflux disease. A priori sample size calculation was done for the primary self reported voice handicap outcome using a paired pre-post comparison model. With a two-tailed alpha of 0.05, a power of 0.80, an estimated mean paired difference of 10 points, and a standard deviation of paired differences of 16, the minimum sample size was determined to be 22 individuals. To allow for any missing data, 26 individuals were recruited.

Consistent with the methodology used in prior research [14], religious officials with a Voice Handicap Index-10 (VHI-10) [12] score of 5 or higher, suggesting the presence of self-perceived voice-related complaints were involved in the study. Additional exclusion criteria included a history and present condition of diagnosed laryngeal pathology, previous laryngeal or head and neck surgery, use of medications known to affect voice production (e.g., corticosteroids, antihistamines, diuretics, antidepressants),

neurological disorders affecting voice production, and prior formal voice therapy experience. No control group was included as this study was designed as an initial educational intervention in Muslim religious officials with restricted availability of participants.

Acoustic and self-reported outcome assessment

Self-reported outcome measures

Participants completed the VHI-10 [12] and V-RQOL [11] at pre- and post-intervention evaluations before the acoustic voice recordings. V-RQOL raw total scores were transformed to the standardized 0-100 scale, with higher scores indicating greater voice-related quality of life [15].

Acoustic recording procedures

For acoustic analysis, voice recordings were obtained from each participant before and after the vocal hygiene education. Voice recordings were taken in a quiet room, ensuring a signal-to-noise ratio (SNR) of more than 30 dB. All the voices were recorded in accordance with the recommendations of Deliyski et al [16,17]. The Audio-Technica AT2005USB (Audio-Technica Corporation) unidirectional microphone was placed at a 45° angle and about 10 cm away from the participant's mouth. Praat [18] software was used to record all of the recordings at a 44.1 kHz sampling rate and 16-bit resolution. Pre and post-intervention recordings were performed under the identical recording conditions (same room, same microphone position, same recording equipment and same ambient settings).

Participants were instructed to maintain the vowel /a/ at a comfortable pitch and loudness for at least 5 seconds. To obtain connected speech samples, they were also asked to read aloud a standardized phrase ("Serüvenim, resimde gördüğünüz doğa harikası şu dağ köyünde başladı") [13].

Traditional acoustic measures

Jitter local (%), shimmer local (%), and harmonics-to-noise ratio (HNR) were measured from the 3 seconds of the midpoint of the sustained /a/ phonation using Praat [18].

Composite acoustic index

The AVQI script version 02.06 [19] was employed in Praat for the computation of AVQIv2. The middle 3 seconds of /a/ phonation and continuous speech sample (“Serüvenim, resimde gördüğünüz doğa harikası şu dağ köyünde başladı”), which is stated in the Turkish validation study of AVQIv2 [13], was used to get the AVQIv2 scores.

Intervention: videoconference-based vocal hygiene education

Each participant had a seven-week study protocol that included baseline evaluation, two structured videoconference sessions delivered two weeks apart, a self-directed application of vocal hygiene recommendations, and post-intervention assessment at week 7. The choice to conduct two sessions was based on prior research on short-format vocal hygiene education programs for professional voice users, such as a one-hour videoconference with evaluation after four weeks [14] and a 2-3-hour program with follow-up assessment after several weeks of training [20]. Each session lasted approximately 40 minutes, and was conducted by the second author, who is a certified speech and language therapist with 5 years of clinical experience in voice disorders and vocal hygiene education. The program was separated into two 40-minute videoconference sessions to minimize participant load and enhance participation. The education was based on vocal hygiene guidelines existing in the literature [21]. The sessions were conducted in accordance with established theories of vocal hygiene and behavioral modification for professional voice users. Educational content included:

Laryngeal anatomy and physiology: During each session, topics like laryngeal anatomy and physiology, how the voice is produced, the structure and function of the vocal folds, and the scientific reasons for implementing a structured voice hygiene program were covered, and both oral explanations and illustrations were used.

Vocal hygiene principles: The standardized vocal hygiene protocol involved the following: avoiding or quitting smoking; avoiding or limiting the intake of caffeine, theine, acidic, and carbonated beverages; avoiding or reducing the consumption of spicy foods; avoiding shouting or prolonged loud speech; minimizing exposure to noisy, hot, or dusty environments; incorporating periodic voice rest throughout the day; avoiding food or beverage intake close to bedtime; managing stress; and avoiding habitual voice misuse behaviors.

Occupational adaptations: Profession-specific recommendations were presented, including the ideal vocal methods for prayer leading, sermon delivery, and Quranic recitation. Environmental modifications and the use of amplification were also recommended. However**,** use of amplification was recommended on an individual basis without systematic implementation or monitoring during the research period.

Individualized vocal hygiene plan: Each participant received a personalized vocal hygiene education adapted to their lifestyle, vocal demands, and phonotraumatic behaviors. The vocal hygiene program was individualized based on the predominant occupational voice-use patterns and self-reported vocal abuse behaviors reported by the participants. The recommendations were defined with priorities according to the main features of the voice load of the individual. For example, participants who reported extended use of loud voice during sermon delivery or Qur’anic recitation received further counseling on reduction of excessive vocal intensity and suggestions of periodic voice rest. Moreover, participants demonstrating

frequent throat clearing or inadequate hydration habits received targeted vocal hygiene recommendations.

Compliance and follow-up: Participants were instructed to start implementing vocal hygiene suggestions after the first session. The second session was used to review and reinforce the vocal hygiene recommendations and individualize the program. After the second session, participants were asked to continue applying their vocal hygiene plan till the post intervention assessment. Weekly check-in calls or messages were used to monitor compliance following the first session and continued until the post-intervention evaluation. These calls or messages were used to monitor ongoing use of vocal hygiene suggestions, and answer questions. However, no standardized measure of adherence or numerical record of compliance was recorded. Following this period, all subjective (VHI-10, V-RQOL) and objective (acoustic parameters) measures were re-evaluated under the same conditions to assess any changes after the intervention. A detailed data collection timeline is given below:

Data collection timeline

Baseline (week 0): Pre-program assessment with VHI-10, V-RQOL, and acoustic analysis

Week 1: First videoconference session; delivery of the full set of vocal hygiene suggestions; participants were asked to start using the suggestions following this session

Week 3: Second videoconference session; review and reinforcement of vocal hygiene suggestions; participants were asked to continue with the vocal hygiene suggestions

Week 4-7: Independent application of vocal hygiene plan

Week 7: Post-program assessment with VHI-10, V-RQOL, and acoustic analysis

Statistical analysis

The IBM SPSS Statistics version 26.0 software package (IBM Corp., Armonk, NY, USA) was utilized for statistical analysis. Descriptive statistics were computed for all participants' scores on the VHI-10, V-RQOL, and acoustic analysis parameters (AVQIv2, jitter, shimmer, and HNR), including frequency, percentage, mean, standard deviation, median, minimum, and maximum values. The Shapiro–Wilk test was utilized to assess the normality of the distribution for all continuous variables. For variables exhibiting a normal distribution, comparisons between pre- and post-intervention were performed using the paired-samples t-test. For variables that did not adhere to a normal distribution, comparisons were conducted using the Wilcoxon signed-rank test. All statistical analyses were conducted within a 95% confidence interval, and a p-value of less than 0.05 ($p < 0.05$) was accepted as statistically significant.

Results

Participant characteristics

A total of 26 male Muslim religious officials participated in the study. All participants were working full-time as imams actively serving in mosques within the Adana province. The presence of self-perceived voice problems was confirmed by baseline VHI-10 scores, which ranged from 5 to 27 (mean = 9.58 ± 5.24). No adverse outcomes were reported during the research period.

Self-reported and acoustic outcomes

Self-reported and acoustic outcomes before and after vocal hygiene education are presented in Table 1. V-RQOL scores increased significantly after the training from 82.60 ± 19.91 to 89.23 ± 11.61 ($p = 0.006$), indicating better voice related quality of life. VHI-10 scores decreased from 9.58 ± 5.24 to 5.96 ± 4.43, with a statistically significant difference ($p = 0.0003$).

AVQIv2 scores decreased significantly from 3.12 ± 0.85 to 2.35 ± 0.61 after vocal hygiene education ($p < 0.001$). After the education, jitter local (%) and shimmer local (%) decreased, while HNR increased; however, these pre-post changes were not statistically significant.

[Place Table 1 about here]

Discussion

This study represents the initial evidence that a planned, videoconference-based vocal hygiene program was associated with improvements in patient-reported outcomes and objective acoustic voice quality in Muslim religious officials. The significant increases in V-RQOL, and significant decreases in VHI-10, and AVQIv2 following the remote intervention suggest potential clinical value of tele-voice education for this occupational group.

The significant increase in V-RQOL scores after receiving videoconference-based vocal hygiene education suggests better voice-related quality of life. This is especially crucial for religious officials, whose spiritual leadership responsibilities and professional efficacy greatly rely on verbal communication. Previous studies showed similar results, reporting that V-RQOL scores of imams were significantly improved following a vocal training program [22]. Similarly, the significant decrease in mean VHI-10 scores following the vocal hygiene program indicates a reduction in self-perceived voice handicap. This finding is consistent with earlier research indicating that a structured voice training program was associated with improved VHI outcomes of religious officials [22]. Likewise, a study conducted with imams during Ramadan found that participants who received voice hygiene advice before Ramadan had significantly enhanced post-Ramadan acoustic parameters and VHI scores compared with controls [23]. Although the intervention design and delivery method differed from the current study, it provides useful insights because it addressed vocal hygiene advice in the same professional group. The current study reinforces existing data by evaluating vocal hygiene education program delivered via videoconference in

the same professional group and showing reduced self-perceived voice handicap. Similar results have been noted for other professional voice users, participating vocal hygiene or voice education programs. Voice education program was associated with significantly improved VHI scores in teachers [24], and in student teachers a vocal hygiene program was shown to prevent worsening of VHI scores during a period of higher occupational use [25]. Although the method and professional groups varied across these studies, their outcomes are comparable with the present results, which show that VHI-10 scores reduced following the voice hygiene program.

The significant decrease in AVQIv2 stands as the most clinically important finding of the current study. AVQIv2 is a validated, multiparametric acoustic index that displays improved sensitivity to treatment-related changes compared to individual acoustic parameters [26,27]. The decrease in AVQIv2 scores, with post-intervention values falling below the Turkish dysphonic cutoff (2.98) [13], suggests an improvement in voice quality. Jitter, shimmer, and HNR values showed numerical improvement but did not reach statistical significance. These results might be attributed to the limited sensitivity of perturbation and noise-related measurements to behavioral interventions compared with composite indices such as AVQIv2. This disparity aligns with earlier studies showing that, in the absence of direct voice therapy procedures, indirect interventions (vocal hygiene training) may not significantly change vocal fold vibratory characteristics [28]. However, the significant decrease in AVQIv2 suggests a favorable change in the acoustic voice quality, an may reflect the sensitivity of AVQI as an acoustic measure that can detect subtle intervention-related alterations in professional voice users [26,27].

In this research, the training model via videoconference was selected for delivering vocal hygiene education, that might facilitate access voice care for professional voice users, in line with previous studies that have suggested that telepractice-based voice interventions may yield beneficial outcomes comparable to those reported for conventional in-person programs [20,29].

There have been dramatic changes in healthcare, starting with the COVID-19 pandemic, which increased the use of telehealth [30]. Previous research on telepractice-based voice therapy services have demonstrated positive outcomes for different dysphonia types, indicating significant improvements in voice parameters, with high patient satisfaction levels [31–35]. Similar to this research, a study in which teachers received voice hygiene training via videoconferencing was associated with positive changes in vocal behaviors [14]. These findings give additional support for the practice of remote delivery in voice care. Approaches such as vocal hygiene training, that do not require direct physical contact with the patient and rely primarily on patient education may be suitable for remote delivery.

From the clinical point of view, our findings suggest potential benefits of implementing vocal hygiene training into routine care for professional voice users, particularly those in high-risk occupations such as religious officials. The remote delivery format may also provide a flexible option to conduct vocal hygiene training when in-person access is limited. From a public health perspective, these findings point out the need for primary prevention strategies for occupational voice problems.

Limitations

This study has several limitations. First, this study did not have a control group. Future controlled research is suggested to confirm these preliminary findings. In addition, the results' generalizability may be adversely affected by the small sample size and restriction to participants from only one city. The sample size calculation was based on the self-reported outcome. Therefore, a small sample size might have limited the capacity to identify statistically significant changes in some acoustic parameters, such as jitter, shimmer and HNR. Second, smoking status was recorded descriptively, but no subgroup analysis was conducted due to the limited number of smokers. Third, participant adherence to the vocal hygiene education program was evaluated by weekly check-in calls and texts but was not objectively measured with established compliance metrics. Fourth, the

follow-up period was limited, therefore this does not provide evidence on the long-term influence of the vocal hygiene program on voice quality. The current findings represent just immediate post-intervention outcomes and future research with longer follow-up periods are needed to better understand the long-term maintenance of vocal behaviors and voice outcomes. Although self-reported and acoustic measures were included, laryngoscopic examination was not included. Future studies are suggested to include more participants, and supplemental evaluation methods such as laryngeal imaging techniques.

Conclusion

The results of this study revealed that voice hygiene education provided via videoconference was associated with favorable changes in self-reported and acoustic outcomes. Following the education, there was a significant increase in V-RQOL scores, and decrease in VHI-10, and AVQIv2 scores. These results suggest the potential utility of structured vocal hygiene education for religious officials who may be vulnerable to high occupational voice demands. Remote delivery may be an alternative for vocal hygiene training when in person access is limited.

Declarations

Funding

The authors state that this study did not receive any external grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare no conflict of interest.

Data availability

Data supporting the study’s findings are available from the corresponding author upon reasonable request. Due to institutional and ethical constraints, the data is not available to the public.

Transparency statement

A large language model (ChatGPT, OpenAI) was used solely for language editing and clarity. No data analysis or interpretation was performed using artificial intelligence tools.

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Author contributions

G.Y.P. conceptualized and designed the study, supervised data collection, performed data analysis, and drafted the manuscript. E.H.İ. conducted the intervention, collected the data, and contributed to data interpretation. S.K.Ö. contributed to clinical oversight, interpretation of findings, and manuscript revision. All authors reviewed and approved the final manuscript.

Table 1. Self-reported and acoustic outcomes before and after vocal hygiene education

Outcome	Pre-test Mean ± SD	Pre-test Median (IQR)	Pre-test Min–Max	Post-test Mean ± SD	Post-test Median (IQR)	Post-test Min–Max	Test used	Test statistic	p value
V-RQOL, 0–100 score	82.60 ± 19.91	91.25 (15.00)	27.50 – 100.00	89.23 ± 11.61	93.75 (11.25)	50.00 – 100.00	Wilcoxon signed-rank test	Z = 2.724	0.006
VHI-10	9.58 ± 5.24	7.00 (6.00)	5–27	5.96 ± 4.43	5.00 (8.00)	0–17	Wilcoxon signed	Z = – 3.640	0.0003

							-rank test		
AVQIv2	3.12 ± 0.85	3.12 (1.22)	1.64–4.81	2.35 ± 0.61	2.37 (1.00)	1.36–3.71	Paired-samples t-test	t = 5.608	<0.001
Jitter local (%)	0.453 ± 0.34	0.356 (0.281)	0.176–1.756	0.368 ± 0.23	0.287 (0.209)	0.190–1.286	Wilcoxon signed-rank test	Z = –0.343	0.732
Shimmer local (%)	2.65 ± 1.50	2.42 (1.61)	0.959–7.333	2.19 ± 1.22	1.80 (0.85)	0.985–5.680	Wilcoxon signed-rank test	Z = –1.029	0.304
HNR	19.92 ± 3.96	20.16 (5.24)	11.285–28.688	21.07 ± 3.51	22.04 (6.08)	12.421–25.185	Wilcoxon signed-rank test	Z = 1.486	0.137

V-RQOL: Voice-Related Quality of Life; VHI-10: Voice Handicap Index-10; AVQIv2: Acoustic Voice Quality Index Version 02.06; HNR: harmonics-to-noise ratio; SD: standard deviation; IQR: interquartile range. V-RQOL raw total scores were transformed to a standardized 0–100 scale, with higher scores indicating better voice-related quality of life.