

Original Research

A Correlation between Some Vocal Acoustic Measures and Voice Handicap Index-10 in Imam Trainees

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Abstract

Background: Imams who lead Islamic worship services daily are at higher risk of developing voice problems. The Imam trainees during the initial stages of training are inclined to exert more effort to deliver the readings with articulatory and acoustic precisions as novice, in order to expand their pitch, loudness range to improve their voice.

Aim of the study: To investigate some acoustic parameters of voice (MFO, MI, MNHR, Jitter% Shimmer%) in Indian Imam trainees and check for any possible association of the acoustic findings with the results of the Voice Handicap Index (VHI-10).

Method: 40 male participants in the age range of 18-23 years enrolled in the religious training program for Imams were recruited for the study. All of them were native speakers of Malayalam language. Self-rating questionnaire, the Voice Handicap Index (VHI-10) was administered on all the participants, followed by audio-recordings of sustained productions of the vowel /a/ in their habitual voice. The voice samples were recorded using PRAAT software in a quiet environment at the training institutes of the participants. Acoustic analysis was done using PRAAT software.

Result: The findings indicated significant differences in mean noise to harmonic ratio (MNHR) between beginners and experienced trainees. Similarly, an increase in the frequency and amplitude perturbation measures, i.e., jitter%, shimmer% were noted, even though statistical significance was absent. Whereas Self-rating questionnaire (VHI-10) did not show any voice trend.

Human beings convey thoughts, information, and feelings through audible meaningful sounds known as voice. Voice is defined as the laryngeal modulation of the pulmonary air stream, which is further modified by the vocal tract configuration [1]. A perceptually normal voice involves the co-ordination between different subsystems - respiratory, phonatory, resonatory, and articulatory systems. The dimensions of voice, such as the pitch, loudness, and quality, are structurally altered by the size, length, tension, and mass of the vocal folds [2]. Furthermore, the functional influences, such as, lifestyle changes, improper diet, and lack of concern on voice usage etc., can contribute to abnormal voice quality. Any individual irrespective of being a professional or non-professional voice user is at great risk for affected voice quality, due to the factors mentioned above [3].

Professional voice users are those who directly depend on vocal communication for their livelihood [3]. Professional voice users are classified into two broad categories-normative and emotive. The former category includes individuals who have more likelihood of issues related to phonotrauma because of

the overuse of voice. They are typically telephone operators, radio and television broadcasters, telemarketers, teachers, and executives. Individuals who often require their voice to encourage or motivate and to engage in an activity are included in the latter category. This category majorly consists of actors, conductors, politicians, instructors, and coaches [4]. Imams most likely fall into the emotive category of voice users. They are a group of professional voice users who lead prayers in the mosques and are considered as scholars in the Islam community. They have a great demand for their voice throughout their career (e.g. training for teaching, public speaking, and building up leadership skills as well as involvement in dialogue venues, seminars, lectures, and different language clubs [5]).

An Imam leads the devotees in congregational prayers in mosques, which are held about five times a day. He has to read the verses of the Holy Quran in a loud voice so that the mass can follow his lead in the mosque. In addition to these vocal demands, few Imams read the Khutbah (lessons usually delivered in mosques every Friday and during rituals). This type of extensive

use of voice, as a professional need throughout their careers, may lead to varying degrees of voice problems in the budding trainees, who are under the tutelage to become scholars. Imams are different from other voice professionals in terms of their vocal and non-vocal habits, vocal load, kind of training they undergo on a daily basis. A study comparing Islamic religious officials (including imams) and other well-known professional voice users (teachers) showed that the Islamic religious officials had significantly lower alcohol use, systemic disease, and vocal loads and significantly higher vocal abuse, vocal misuse, vocal hygiene knowledge, and voice handicap indices compared to teachers [6]. Another Indian study reported some inappropriate vocal and non-vocal habits in imams that included shouting, speaking loudly, speaking fast, throat clearing, consuming more than two cups of coffee per day, and going to bed as soon as after dinner [7] possibly increasing the risk of voice problems in them.

The importance of voice among professional voice users has gained impetus in literature [8]. However, the focus on different groups of religious voice users in the Indian scenario, particularly, Imams have been fewer [9]. Found that one-third of the church priests reported vocal load as the reason for voice problems. The participants of the study reported voice problems and voice issues during their career with a prevalence of 85.6% and 15.9% respectively [10]. Reported that 17.8% of 270 Marthoma church priests in Kerala, India reported voice problems and the authors attributed this to a lack of formal training, allergies, throat clearing, poor vocal hygiene, and history of voice concerns during the training to be the major risk factors for voice problems in church priests.

Studies done using acoustic voice measures are on the rise gaining impetus in the recent past [11]. Investigated variations in acoustic measures across different tasks (chanting, reading and monologue) in 14 temple priests. A significantly lowest and highest minimum and maximum frequencies respectively with a resultant wider range and SDF0 were noted for monologue compared to reading task. Reading was more expressive owing to increased vF_0 and Chanting showed a significant high Mean Frequency leading the authors to speculate Chanting was more vocally loading due to increased vocal fold tension and the ensuing strain [12].

Conducted a cross-sectional study on 34 Imams before and after Ramadan (the ninth month in Islamic calendar and holy month of fasting). 17 Imams served as the control group, and the remaining 17 were part of the experimental group. The former group had a mean age of 42.08 ± 35.61 , and the latter group had a mean age of 41.47 ± 36.25 . Voice hygiene guidelines were provided to the participants in the experimental group. Voice Handicap Index (VHI) was administered on all the participants, and Multi-Dimensional Voice Program (MDVP) was used to extract the acoustic parameters of their voice namely, fundamental frequency (F_0), relative average perturbation (RAP), shimmer (Shim), noise to harmonic ratio (NHR) and voice turbulence index (VTI). The results revealed that the experimental group that received the vocal hygiene guidelines fared better on acoustic measures and VHI compared to the participants in the control group [13].

Administered the Arabic Voice Handicap Index-10 (A-VHI-10) and a general voice questionnaire on 93 Imams and 82 control subjects. The findings suggested that about 65 % of Imams reported voice-related problems and the A-VHI-10 scores were significantly different between Imams and the control group. Further [14], investigated the jitter percent (jitter %), relative average perturbation (RAP) and noise-to-harmonic ratio (NHR) in ten Indian Madrasah teachers (teachers of Islamic schools) and compared the same with the age matched non teachers using the phonation of vowel /a/. They reported a significant increase in all the three measured parameters in Madrasah teachers as against non-teachers.

Most researchers have agreed that the amount of inharmonic energy (noise) that is present in an individual's voice is a significant parameter of voice quality. For instance [15], suggested a correlation between Noise to Harmonic Ratio (NHR) and breathiness, while [16] established a significant correlation between perceptually rated roughness of voice and NHR.

The analysis of an individual's speech is vital for the detection of speech pathology [17- 20]. Various techniques have been carried out to evaluate the voice quality of an individual. One among them is the auditory perceptual analysis; however, this lacks a conclusive consensus due to varying levels of expertise involved in its protocol. Other methods like the use of self-rating scales and the objective voice analysis have largely been focused upon in the recent past. Self-assessment questionnaires such as Voice Handicap Index, Voice Related Quality of Life, have been the widely used tools. With reference to the objective acoustic analysis, measures such as jitter and shimmer have been proven to be useful in the description of vocal characteristics. Jitter is defined as the parameter of frequency variation from cycle to cycle, and shimmer relates to the amplitude variation of the sound wave. The jitter is affected majorly by the lack of control during vocal fold vibration, and shimmer is altered with a reduction in glottal resistance and mass lesions on vocal folds [21].

There are studies carried out on professional voice users including trained imams. The studies on imams focused on understanding prevalence of voice problems and comparison of presence or absence of voice problems in imams compared to other professional voice user groups or voice characteristics before and after festive seasons using acoustic measures. Imams also indulge in regular voice use over extended periods of time for professional needs, it is necessary to garner shreds of evidence on their voice using qualitative and quantitative measures. Hence, an attempt is made to understand the nature of vocal demands, voice usage, and some acoustic voice characteristics during the period of training in such a group of professional voice user.

This study had the specific objectives of investigating some acoustic parameters of voice (MF_0 , MI, MNHR, Jitter% Shimmer %) in Indian Imam Trainees and compare the acoustic findings with the results of the Voice Handicap Index (VHI-10) for any possible association.

METHOD

Participants

40 adult males in the age range of 18-23 years, enrolled for Islamic religious training at the Ma 'din Academy for Islamic studies were the participants of the study. All the participants were native speakers of Malayalam language and had bilingual proficiency in English language. The participants were divided into five groups (that is, 8 participants in each group) based on their academic program, the novice forming the Group I and those in their final year of the program (fifth year) formed the participants of Group V. Participants with histories of infections related ear, nose, throat and general health concerns such as pulmonary diseases and voice disorders/difficulties were excluded from the study. Demographic details of the participants, that is, age, voice use and vocal demand (hours per week), vocal hygiene, medical history (diseases, allergies, use of medication and previous surgeries if any) and information regarding tobacco/alcohol usage were obtained from the participants of the study [Table 1].

Task

The Voice Handicap Index-10 (VHI-10) questionnaire was administered to all the participants. The VHI-10 is an index of an individual's voice handicap and it contains ten items. Five point rating scale (0-4) is used to score each item of the self-evaluation questionnaire. Higher scores indicate the presence of voice problems [22]. Firstly, the participants were instructed to complete the questionnaire. Then they were instructed to sustain phonation of the vowel /a/ at their comfortable pitch and loudness for at least 5 seconds. A total of three trials of phonation were elicited from each participant and the segment with the lowest jitter was selected to analyse each participant's best sample. This was done in order to minimize artifact-interference from background noise or aperiodic voicing at onsets and offsets.

Procedure

The objectives of the study with the assurance of confidentiality were explained to all the participants. Voluntary participation of the subjects was ensured after obtaining the written consent. The recordings were carried out individually in a relatively quiet environment in the academy premises. The participants were seated comfortably and the second author recorded the voice

Table 1: Demographic detail of the participants

Characteristics	Details
Mean age	20 years
Tobacco/Alcohol use	Nil
Allergy/Systemic disease	Nil
Vocal abuse-misuse	About 25 % of the participants reported frequent throat clearing and speaking in loud voice
Vocal load (hours/week)	6-8 hours voice usage per day
Knowledge of vocal hygiene	All the participants reported no prior knowledge of the vocal hygiene practices

samples directly on to the PRAAT software (version 5.3.64) loaded on Asus X541U laptop through Sennheiser PC 8 Over-Ear USB VOIP Headphone with an adjustable microphone. The microphone to mouth distance was maintained at 10 centimetres and the angle was maintained at 45-90 degree during the audio recording of the data.

Analysis

The responses of the participants from the VHI-10 were tabulated and documented as mean scores. The recorded audio samples of phonation's were analyzed using the PRAAT software with a sampling frequency of 44100 Hz. Mean pitch (MF0), mean intensity (MI), mean noise to harmonics ratio (MNHR), Jitter% (local) and Shimmer% (local) were extracted. The acoustic data and responses of the questionnaires were subjected to the Statistical Package tool for the Social Sciences (SPSS) software version 17 for the descriptive statistics. The details are shown in the subsequent paragraphs.

RESULTS

The obtained data were analyzed in terms of self-rated and quantitative measures of voice.

Analysis of the self-rated questionnaire responses

Table 2 shows the median values of VHI-10. Tables shows no specific trend of VHI-10 and RSI scores across the groups.

Analysis of the acoustic parameters

The median value of the acoustic parameters analyzed from the voice samples of all the participants are provided in Table 3.

Group II had the highest MF0 and lowest was noted in Group III. MNHR increased from group I-V and jitter% from I-IV. The MI and shimmer% dipped from groups I to III. Group I constituted participants that had enrolled into the training program and Group V had participants in their final grades. Most variations were noted for groups IV and V disconcerting any trend in the acoustic parameters across the groups.

Table 2: The median VHI-10 scores of the participants

Group	Median VHI-10 Score
I	3.50
II	3.00
III	11.00
IV	4.00
V	2.00

Table 3: Median (M) of the acoustic parameters for the participants

Group	MF0 M	MI M	MNHR M	Jitter% M	Shimmer% M
I	122.80	80.96	0.05	0.67	6.18
II	124.83	79.14	0.11	0.71	5.58
III	115.69	77.79	0.11	0.81	5.94
IV	123.95	80.66	0.13	0.87	5.40
V	118.29	77.61	0.15	0.81	8.95

The Shapiro Wilks test of normality revealed the non-normal distribution of the data ($p < 0.05$). Hence, a non-parametric test, Kruskal Wallis test was carried out for group comparisons. The results revealed overall non-significant difference across the groups ($p > 0.05$). Further, Mann-Whitney U test was carried out to compare the acoustic parameters between the groups and the results suggested a significant difference ($p < 0.05$; $z = -1.81$) in the MNHR between Groups I and V. None of the other measured acoustic parameters showed significant differences in participants across the groups. The mean VHI-10 yielded no significant difference across and between the groups ($p > 0.05$) on Kruskal Wallis and Mann Whitney U tests.

DISCUSSION

VHI-10 revealed non-statistical significant difference between groups. The median scores were least for Group II and no trend in VHI-10 responses could be observed across the groups. These findings provide insights that the self-evaluation scales may not depict the vocal changes across the groups which could be observed in measured acoustic parameters (MF0, MI, MNHR, Jitter%, Shimmer %). This might have been due to the facts that the changes in voice of the participants could have been minimum, ignorance about the normal voice characteristics, psycho-social factors as they are away from home and families, and or anxiety/bias in accepting the voice issues because of threat to career prospects.

The results of the acoustic parameters revealed a significant difference only in mean MNHR between Groups I and V. MNHR indicates the amount of aperiodicity in the voice and hence is considered as an indicator of quality alterations in voice. A correlation was reported between breathiness and NHR [15] and further between roughness of voice and NHR [16]. Hence, it may be speculated that quality was deviant in Group V more so because Shimmer% was also higher in them.

The Jitter% of Group IV was maximum. In the five-year training period, a comparatively rigorous training practice would typically be initiated from the fourth year as reported by the participants. The increased Jitter% may point to an increased vocal load during the fourth-year of training. This could be a sign of the need for Imams to exert more effort to deliver the articulatory and acoustic precisions while reading the verses from the Quran. The tiredness of throat will be reflected by increase in jitter value [23].

Group I consisting of the novice trainees showed an increased median average intensity. The reduced median average intensity over the years of training (Group II to Group III) was likely to be the consequence of vocal fatigue and the gradual increase in vocal load in the initial years (across the first three-years of training period). Whereas the other acoustic measures such as MNHR and Shimmer% were found to be highest for Group V indicating that these participants had lowest vocal quality as lower value indicate higher vocal quality [24]. This is probably due to they use continues loud voice for speaking and or reading for longer duration in presence of background noise and mostly without the

aid of any amplification systems (except during major rituals) signifying vocal load. The fact that no proper guidance on voice use and no voice conservation strategies in place during training could likely have led to these results and were in contrast to the results of the cross-sectional study on Hindu temple purohiths [25] wherein an increased mean jitter and shimmer were reported and the MNHR mean values were reduced when compared to controls. They speculated the reduced MNHR to be because of the heterogeneity in participants, the methods of training they underwent and years of experience the participants had as Hindu purohiths. [26] Brought out the short term benefits of sensitization programs in creating awareness and safe-guarding voice from the beginning stages of one's career in the training-to-be-professionals based on a voice conservation sensitization program on nursing trainees.

CONCLUSION

Among the acoustic parameters, MNHR could delineate the voice of the novice and the to-be-professional Imams along with frequency and amplitude perturbation measures, i.e., jitter% and shimmer% respectively. This indicates that vocal demand progresses from novice to the final year of training and the vocal load does not follow a trend. A preliminary study that considered the training-to-be Imams as participants and attempted to understand the vocal habits and vocal demands during the training stage. Hence, circumspection is essential in generalization of the results of the present study owing to small sample size and the audio-recordings not being carried out in a sound-proof/sound-treated room owing to lack of availability of such facilities at the venues of the participants. Further studies conducted on larger number of participants that represent different stages/levels of training programs will help garnering more evidence on the voice characteristics, professional vocal demands and load. The occupational voice load is likely to increase once the participants begin their jobs officially as Imams. A systematic protocol for creating awareness and guidelines may be developed as a future goal for the less-focused professional voice users who are working as religious officials, such as Imams, priests in church and temples. Such studies would aid in improving the voice related quality of life of these individuals consequent to adaptation of proper vocal hygiene for conservation of good voice. Studies in these lines would help the professional voice users in maintaining the balance between occupational vocal demand and self-guided voice care.

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Ethics declarations

The study conformed to the Ethical Guidelines for Bio-Behavioral Research Projects Involving Human Subjects at AIISH by the AIISH ETHICS COMMITTEE (AEC).

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