VOCAL CHARACTERISTICS OF ULUMA

SYEDA SAMEERA TAJ

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MANASAGANGOTHRI, MYSORE – 570 006

JULY 2020

CERTIFICATE

This is to certify that this dissertation entitled **"VOCAL CHARACTERISTICS OF ULUMA"** is a bonafide work submitted in part fulfilment for the degree of Master of Science (Speech Language Pathology) of the student Registration No: 18SLP039. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other university for the award of any diploma or degree.

Dr. M. Pushpavathi

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CERTIFICATE

This is to certify that this dissertation entitled **"VOCAL CHARACTERISTICS OF ULUMA"** has been prepared under my supervision and guidance. It is also certified that this dissertation has not been submitted earlier to any other university for the award of any diploma or degree.

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July, 2020

DECLARATION

This is to certify that this master's dissertation entitled **"VOCAL CHARACTERISTICS OF ULUMA"** is the result of my own study under the guidance of Dr. R. Rajasudhakar, Reader in Speech Sciences, Department of Speech-language Sciences, All India Institute of Speech and Hearing, Mysore, and has not been submitted earlier to any other university for the award of any diploma or degree.

Mysore **Register No. 18SLP039**

July, 2020

بسم الله الرحمن الرحيم

(In the Name of Allah, the Most Gracious, the Most Merciful)

"saying Bismillah before you do anything helps you keep your intention right. Also reminds you that Allah is watching."

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CHAPTER I

INTRODUCTION

Voice plays a central role in speech and communication. Voice is defined as normal when it has a good quality, with pitch and loudness being appropriate to the individual's age, sex and weight and also when it is produced with no effort, pain, or strain (Senturia and Wilson,1968).

Professional voice users are the people who use their voice for occupational competence for their livelihood whose job responsibilities and employment are highly dependent on effective and efficient use of voice. Individuals who directly depend on their voice for their livelihood are the professional voice users (Stemple,1993). These individuals are expected to be trained in such a way that their vocal skills are up to a professional level, and the training allows them to use their voice effectively in various settings (Koufman and Isaacson,1991).

Koufman and Isaacson (1991) classified professional voice users into four categories depending on their voice use and risk.

- *Level I (Elite vocal performers):* Singers and actors, who are sophisticated voice users fall in this category of voice users, where even a slight voice problem causes serious consequences and affect their adequate job performance.
- *Level II (Professional voice users):* Teachers, lecturers, priests, public speakers, politicians &telephone operators fall in this category of voice users. Their job performance will be affected with a moderate voice problem.

- *Level III (Non-vocal professionals):* Physicians and lawyers fall in this category of voice users. Their job performance will be affected only with severe voice problems.
- *Level IV (Non-vocal/non-professionals):* Homemakers, clerks and labourers fall in this category of voice users. They continue their jobs, even though they experience any kind of dysphonia.

Insight into this classification of professional voice users, one can understand how voice users would be affected in performing their jobs due to deviations in their normal voice, at different levels. Basically, Level I & II voice users are highly dependent on their voice for the adequate performance of their jobs, which would be hindered even with slight changes in their voice. Whereas, voice users who fall under Level III & IV are not much concerned about their voice, they would tend to continue to work, even if moderate to severe voice problems persist. Voice problems would create a fear of loss of job, financial burdens, loss of professional competency in the society and increase the level of frustration that one would undergo at the moment among different levels of voice users.

Uluma

Uluma (plural) and Alimah (singular) are female Islamic scholars in institutions (Madrasa). They fall under Level II category in the classification of professional voice users given by Koufman and Isaacson (1991). For decades, Uluma has been playing a significant role in understanding & interpreting the laws of Islam, creating awareness, and spreading deen (i.e., Religious knowledge in Islam) to the Ummah (Abbasi, 2018). They are certified scholars under the bachelor degree called Alim course of 6 years. This higher education is received from the Madrasa.

The Alim course which is taught at the institute allows students to develop in depth understanding of Islamic history, Islamic laws, Arabic literature, Arabic grammar, Tajweed, Hadith, and Tafseer al-Qur'an. Courses are offered in a traditional environment with students spending approximately six hours per day receiving direct instruction and practices from certified scholars. On completion of Alim course, students (Uluma) will be given permission to practice and teach the Islamic sciences to the younger and older generations of the Muslim community. This official approval to teach is called as Ijazat i.e., Traditional license (Makdisi, 1989). Over a period of time, this practice established a chain of teachers, and pupils who became teachers in their own time and they are proficient in Arabic and Urdu languages (Graham,1993).

Uluma work primarily in the Madrasa which is solely dedicated for educating females with no age limit. The Islamic classes will be conducted by Uluma for six days a week, and the teaching time at institutions begin at eleven am to three pm, Monday-Friday, and on Saturdays, they work from eleven am to one pm. As they focus on the quality of teaching and learning, they form small supervised groups of five to eight students and individual study sessions. This is done in order to provide an opportunity for all the students to interact with Alimah on a one-on-one basis for active learning. Online Arabic classes will also be offered for about two hours per day for five days a week for females, those who are unable to attend Madrasa, due to their ongoing education or for personal reasons. For the beginners at Madrasa, Uluma focuses on Taleem – reading of Hadith and make small groups for learning Qur'an recitation with tajwid (i.e., intoning). They will also have sessions on the basics of Islam and conduct a separate session for learning, reading, and writing of Urdu language. Sometime a while, Uluma focus on teaching the memorization of Qur'an,

after students have learned the recitation. Other topics which they cover up are Islamic characters and Etiquettes, Hadith translation and memorization, Islamic history, essentials of Dua application, learning, and following the Sunnah of Prophet Mohammed (S.A.W), and the Islamic beliefs. Uluma also conducts Arabic classes from 5:30 pm to 7:00 pm for children as young as four years and up to 12 years of age. These classes will be conducted for six days per week. The importance of these classes is to give them the opportunity to learn essentials of Qur'an recitation, memorization of Dua and their applications, basics of namaz (prayers), and procedure of wuzu (ablution). The teaching of Qur'an recitation is individualized, whereas small specialized different age groups are formed for teaching and memorizing Dua's. For many children, these are the only opportunities to learn about Islam after their school hours. On every Friday, Uluma conducts Taleem - Islamic workshop for about 2 hours for women, in which most of the topics are based on Hadith.

Institutional teaching, conducting Islamic classes for children and workshops for women are done without using any amplification system/microphone. In Islam, according to the sharia (Islamic traditional law) a female voice has parda from unknown men i.e. female voice should not be louder when spoken; it should not cross the four walls of a room and should not be heard by unknown men or a stranger outside. Because of this reason, Uluma does not use any amplification while conducting Islamic classes and once they age beyond 50 years and so, automatically they tend to speak very softly with low loudness but continue with their teaching profession without having any concerns about their voice changes. Under such circumstances, their voice use is continuous for about four to six hours per day with less frequent breaks for voice rest. When looked into their teaching profession since

ages, the vocal load placed on their laryngeal system is very high, which acts as a risk factor in them for causing voice related pathologies.

Yasin (2018) conducted a study to investigated the vocal symptoms and characteristics of 30 Imams (age: 20 to 55 years) with minimum working experience of five years and compared with the age and gender-matched 30 normo-phonic males. Voice survey questionnaire was administered on imams and acoustic analysis was carried out on all the participants. From the results of questionnaire, author found that, Imams have experienced voice problems in their carrier and the results of acoustic analysis revealed higher values of frequency perturbation, amplitude perturbation, noise and tremor related acoustic parameters. These findings were attributed to high vocal load due to teaching, poor vocal and non- vocal habits, and limited knowledge about voice care. This is a questionnaire-based study along with an acoustic analysis of voice. Only Imams (male Islamic scholars) were recruited in the study.

Yeshoda, Varghese, Jabeen & Muhumina (2018) conducted a study to investigated the voice characteristics in 10 madrasa teachers in the age range of 41-50 years with 15 years of teaching experience and compared with the age and gender-matched 10 normo-phonic males. Acoustic analysis was carried out and the authors found considerable increase in frequency perturbation (Jitt, RAP) and noise measures (NHR) in madrasa teachers. These findings were attributed to excessive vocal demand. From the study it was concluded that, madrasa teachers are at high risk of developing voice problems.

Jayakumar and Yasin (2019) conducted a questionnaire based study to understand the

Usage of voice in different situation and awareness regarding voice care in Alimah's. From the results of the questionnaire, authors found a higher prevalence rate (70%) of voice problems in students of Alimah course.

Need for the study

The vocal characteristics of different professional voice users have been studied extensively using questionnaires, perceptual analysis, and acoustic analysis. Among the professional voice users, singers and teachers are widely explored. Buyukatalay et al. (2019) reported that Islamic religious officials belong to professional voice users. However, there is paucity of research into the incidence and prevalence of voice disorders among Islamic scholars. A literature survey revealed that there are few studies done on Imams to explore their voice characteristics, vocal symptoms, and voice problems; on the other hand, there is a dearth of research on Uluma in the Indian population. The current study will help to understand and to empirically document the voice characteristics in Uluma, who use their voice throughout the day for a more extended period of time, for many years. Thus, the present study aimed to determine/profile the vocal characteristics of Uluma.

Aim of the study

The study aims to analyze and document the acoustic characteristics of voice in Uluma.

Objectives

1. To estimate the acoustic characteristics of voice in group I (Uluma) and Group II (Normo-phonic females).
2. To compare the following acoustic voice parameters between group I and II
    a. Average Fundamental frequency (MF0)
    b. Standard deviation of F0 (STD)
    c. F0 Tremor frequency (Fftr)
    d. Amplitude Tremor Frequency (Fatr)
    e. Jitter percentage (Jitt)
    f. Relative Average Perturbation (RAP)
    g. Fundamental Frequency Variation (vF0)
    h. Shimmer percentage (Shim)
    i. Amplitude Perturbation Quotient (APQ)
    j. Noise to Harmonic Ratio (NHR)
    k. Voice Turbulence Index (VTI)
    l. F0 – Tremor Intensity Index (FTRI)
    m. Amplitude Tremor Intensity Index (ATRI)
3. To analyze and compare the overall voice quality of both the groups using the Acoustic voice quality index (AVQI)

Chapter II

REVIEW OF LITERATURE

Recent studies on professional voice user's in the international scenario

- **Perceptual analysis of voice in professional voice user's**

Farahat and Mesallam (2016) studied the prevalence of voice disorders in Saudi Imams and analyzed their psychosocial aspects concerning their profession using the Arabic-Voice Handicap Index (A-VHI). Total of 93 imams (age range: 15-64 years; working experience: 5-10 years and above) were recruited in the study from Riyadh city and 82 normo-phonic males (age range: 15-60 years; working in the different profession without any history of voice problems). Participants were subjected to two questionnaires. One was A-VHI, and another was a general voice questionnaire regarding their living habits, work experience, voice-related symptoms, and impact of awareness of voice hygiene on their carrier. The authors reported a significant difference ($p<0.001$) in A-VHI scores between Imams and non-teaching individuals. Sixty-five percent of imams reported voice problems and vocal symptoms such as throat soreness, throat dryness, frequent throat clearing, vocal fatigue, choking, & change in voice quality. The authors concluded that the vocal symptoms were seen in Imams at high prevalence rate, since their profession is vocally demanding. Imams had significantly higher A-VHI scores than control subjects, and fifty-nine percent of Imams in the study were not aware of vocal hygiene. However, some psychosocial aspects (such as living habits, work experience, the impact of voice problems on their carrier, voice-related symptoms & voice hygiene) of Imams profession had no significant impact on their voice quality. This is one of the questionnaire-based study done on imams (male Islamic scholars), and females were not considered in the study.

Buyukatalay, Z. C et al. (2019) aimed to investigate the vocal usage, vocal pathologies, and the treatment methods used to treat the voice disorders in Islamic religious officials and to compare & contrast the vocal conditions among Islamic religious officials and teachers. In this study, the authors reviewed 85 patients' medical records with voice complaints. They obtained information regarding age, sex, profession, working experience in terms of years, use of tobacco or alcohol, and any positive medical history. Out of eighty five patients, forty two of them were religious officials, and forty three of them were teachers. Among religious officials, thirty nine were males & three were females, whereas five males & thirty eight were females among teachers. The mean age of religious officials and teachers was 42.04 and 12.05 years (age range: 18.0-75.0 years) & 44.05 and 14.05 (age range: 24.0-64.0 years), respectively. Among male religious officials, thirty two of them were Imams, five were Muezzins, and three were Hafiz. Whereas, three female religious officials were Hafiz. Among teachers, twenty were primary school teachers, thirteen were secondary school teachers, and five were preschool teachers. Demographic details and medical history, along with professional work details, were collected from all the patients at the time of admission in the voice center. Reflux Symptom Index (RSI) and Voice Handicap Index (VHI) was given to all the patients to self-administer. They underwent a routine laryngology examination followed by videolaryngostroboscopy using a rigid laryngoscope. Later, Acoustic measurement, MPT, and S/Z ratio was carried out, and the individual results were discussed with each of them before initiating their treatment. After all the diagnostic workout, primary diagnosis was made and the treatment approaches were classified into three groups: medical treatment, surgical treatment, and voice therapy. Authors found that alcohol use, health issues, and the increased vocal load were significantly higher ($P < 0.05$) in teachers than religious

officials. Whereas VHI scores, knowledge of vocal hygiene, and vocal abuse was significantly higher ($P < 0.05$) in religious officials than teachers. Age, working experience, tobacco use, Reflux Symptom Index, & professional voice training background had no statistically significant difference between the groups. Distribution of the diagnoses ($P < 0.005$) was found to have a statistically significant difference between both the groups. The most common treatment method in both the groups was voice therapy, with no statistically significant difference ($P = 0.168$). Weekly working hours of teachers were statistically higher than religious officials. However, the vocal load increases to a greater extent in religious officials during religious occasions such as Ramadan or religious mass gatherings as on every Fridays, during which they work for longer durations without adequate voice rest and hydration. 79.4% of religious officials in this study had knowledge about vocal hygiene. The authors also found a variety of vocal pathologies among the patients, but religious officials had a higher rate of sulcus vocalis than teachers. Fifteen religious officials were diagnosed with sulcus vocalis, whereas eighteen teachers were diagnosed with vocal nodules, and this condition was common among teachers than religious officials. In this study, MTD was the most common primary diagnosis in both the groups. Overall most of the diagnosis was related to organic pathology due to over use of voice. As a result, voice therapy was the common line of treatment. Limitations of this study are, both groups had unequal number of male and female participants, because majority of religious officials were males and teachers were females which in turn can affect the results due to these gender differences. The results of acoustic analysis, S/Z ratio, and MPT are not discussed throughout, though it was carried out on all the patients and in this study the major focus was placed on the diagnosis and treatment methods in both groups.

- **Acoustic analysis of voice in professional voice user's**

Multidimensional voice program (MDVP) analysis

Lin et al. (2016) investigated the relationship between acoustic measurement and self-reported voice disorders among female teachers. A total of eight hundred eighty self-report voice questionnaires (designed by Chen,1988) were issued to primary school teachers in Taipei & the authors received eight hundred fifty six questionnaires in return. During the survey, for one question in the questionnaire, "do you feel you have a voice problem?" Two hundred ninety-seven teachers gave a positive response, and five hundred fifty four teachers gave a negative response—following which a total of eighty teachers were recruited from the schools. Among them, forty teachers reported their voices as normal (NV), and rest forty teachers reported that they have voice disorders (VD). 38.0 years (age range: 24.0-55.0 years) was the mean age of NV group, and 39.1 years (age range: 23.0-55.0 years) was the mean age of VD group. Sustained phonation of vowel /a:/ at a comfortable pitch and loudness level was recorded with a digital recorder. The recorded voice samples were subjected to acoustic analysis using MDVP, model 4400; Kay Elemetrics Corp). The parameters analyzed were (I) jitter percent (Jitt); (II) absolute jitter (Jita); (III) RAP; (IV) PPQ; (V) shimmer in dB (ShdB); (VI) shimmer percent (Shim); (VII) APQ; & (VIII) NHR. The authors reported that all the groups' parameters had a significant difference ($P < 0.001$). The authors found that VD group showed significantly higher amplitude perturbation, pitch perturbation, and NHR values than th NV group. These results were attributed to the overuse of voice in the VD group, which can cause increased stiffness or mass in the cover of vocal folds, because of which the mucosal wave symmetry & amplitude would be reduced. Following which jitter, shimmer and NHR will be

abnormal due to insufficient sub-glottic pressure. In the literature, several studies have found NHR to be the most sensitive parameter to dysphonia severity and self-reported symptoms (Bhuta et al,.1995; Wolfe et al,.1995). In the current study, authors found that self-reported voice problem and NHR was significantly correlated. This finding was attributed to the self-perception of change in voice quality, which is seen as increased NHR value. Shimmer also showed a correlation with self-reported voice disorders. Receiver Operating Curve (ROC) determined the cut-off value of NHR ≥ 0.138 and ShdB $\geq$ 0.470, where the positive predictive value for VD & negative predictive value for NV was high, which was sixty percent and one-hundred percent for voice problems among teachers, NHR and ShdB were possible predictors. Authors assumed that although the NHR and ShdB were high among these teachers, they already had developed muscle tension dysphonia, and they did not give much importance, and this was attributed to straining their voices until the voice problems become severe. The authors concluded that acoustic measurements significantly correlated with self-reported voice disorders in teachers. Specifically, NHR & ShdB are highly sensitive parameters to reflect voice problems in teachers. The study's limitation was that only ten teachers were taken into consideration to test the cut-off point between acoustic measurements and self-reported voice status. Another limitation was although abnormal voices can be detected by acoustic analysis, the underlying vocal pathology remains unknown because of which the authors highlighted the importance of direct laryngoscopy which is needed to visualize the vocal folds to find out the pathology that is causing the change in voice quality, which was not performed in the study.

De Souza et al. (2019) examined the voice characteristics of teachers with dysphonia. The study design was retrospective and cross-sectional, in which a total of

thirty four participants included were divided into two groups. Group I consisted 21 non-laryngeal affection teachers (with normal larynx) with 39.1 years mean age (age range: 24.08 – 61.07 years) and Group II consisted thirteen teachers with laryngeal affections with 39.05 years mean age (age range: 30.01 – 44.08 years), all the participants were diagnosed with vocal pathologies such as vocal nodule or cysts. The participants were instructed to sustain phonation of vowel /a:/ at their comfortable pitch and loudness level for about 6-8 seconds. Voice samples were recorded with Behringer ECM8000 omnidirectional microphone coupled to the digital recorder. Kay Pentax MDVPA (A: Advanced) was utilized for acoustic measurement of the glottic source. The obtained results were compared with the normality standards provided by MDVPA for females (Ribeiro et al., 2014; Cielo et al., 2015). The analyzed parameters were grouped as frequency measurements: fundamental frequency (F0), F0 high (Fhi), F0 low (Flo), standard deviation of F0 (STD), frequency perturbation measurements: absolute jitter (Jita), jitter percent (Jitt), RAP, PPQ, sPPQ, vF0, amplitude perturbation measurements: shimmer in dB, shimmer percent (Shim), APQ, sAPQ, peak-to-peak amplitude variation, noise measurements: NHR, VTI, soft speech index (SPI), voice break measurements: degree of voice breaks and number of voice breaks (NVB), unvoiced segments measurements: number of unvoiced segments (NUV), degree of unvoiced segments, subharmonic segments measurements: degree of subharmonic components (DSH), and number of subharmonic segments (NSH). The authors reported that obtained MDVPA values were not significantly different between the groups. In three conditions (group with laryngeal affections, group without laryngeal affections and total group), means of Jitt, Jita, vF0, PPQ, sPPQ, RAP, shimmer percent, shimmer in dB, sAPQ, APQ, peak-to-peak amplitude variation, & NHR were statistically above the normal value. Also, in three conditions the means of Fhi and

Flo were statistically below the normal value. Obtained STD and SPI values were above normal in a group without laryngeal affections. In the total group, STD, SPI, DSH, NSH & NVB were above normality, signaling the interruption of vocal production, presence of noise, and or instability in the vocal signal. The higher MDVPA values were attributed to frequent incorrect vocal use, leading to fatigue and vocal complaints. In contrast to previous literature, this study did not show significant difference in F0 between with and without laryngeal affection groups. This was justifies saying that difference in vocal folds mass in teachers of both the groups was not sufficient to modify F0 significantly. Further, the Fhi and Flo values were below normal in all the three groups. However, STD value was above normal for without laryngeal affection group which may indicate phonatory instability during the sustentation of F0. Authors concluded that majority of acoustic parameters were above normal in all the participants due to aperiodicity in vocal fold vibrations. Limitations of the study are, fewer participants were considered in Group II. Based on what the participants were labelled as having vocal pathologies is not mentioned in the study, If videolaryngostroboscopy (VLS) was done on all the subjects before recording their voice is unknown.

Acoustic Voice Quality Index (AVQI)

Nunez-Batalla et al. (2017) examined overall dysphonia severity by considering the findings of AVQI (by Maryn et al., 2009). A total of sixty vocally normal and fifty eight patients with dysphonia were recruited. All the participants were instructed to perform two tasks, the first task was to sustain phonation of vowel /e:/ for about 4-5 seconds at their comfortable pitch & loudness level. The second task was to read the phrases of CAPE-V in Spanish (Nunez-Batalla et al.,2015). The recording was done

in a quiet room, and the voice was captured by placing a microphone at 8 cm distance away from the mouth using a digital SONY (ICD PX820) Recorder. Two voice specialists performed auditory-perceptual analysis. The authors placed the voice samples in a random order, and one voice specialist rated all the sustained phonation samples on GRBAS, and the same samples were rated on CAPE-V after seven days. The same task was performed by another voice specialist, separately. To test the reliability of rating, authors had randomly placed all the voice samples without disclosing the patients' diagnosis or if it had normal voices. Acoustic analysis was done using the Praat software & AVQI was calculated by applying a regression formula: AVQI= 9.072 −0.245 × CPPS −0.161 × HNR −0.470 × SL + 6.158 × SLdB−0.071 × Slope −0.170 × Tilt. The authors found that both the groups had a significant difference (P<.000), which implies that AVQI can differentiate between voice with no changes in voice quality and abnormal voice with vocal pathology. The correlation between AVQI and dysphonia severity was r = 0.68 (P<.000), whereas the correlation between B parameter of GRBAS and AVQI was r = 0.68 (P<.000). In connected speech analysis, the obtained AVQI average for sustained vowel was 7.3 with SD 1.07 (range: 5.3 to 9.8), whereas 9.7 was the AVQI average for phrases with SD 0.70 (range: 8.5 to 11.6). Authors carried out AVQI analysis on 20 patients with vocal pathologies (such as polyp, nodules, or cysts) post-surgical treatment, and comparison was made between the pre- and post-operative AVQI scores. Pre-operative obtained AVQI average was 7.8 with SD 0.84 (range:6.0 to 9.6), and post-operative obtained AVQI average was 7.05 with SD 1.12 (range: 5.3 to 9.3). Pre- and post-operative AVQI comparison was found to have a significant difference with lower post-operative values: t(19)=2.47; (P<.023). The authors concluded that AVQI is a multivariant and reasonably valid way of clinically measuring the overall severity

of dysphonia. The pros of the study are, authors considered both normal and vocal pathology groups to find out if AVQI can differentiate between normal and dysphonic voices. Pre- & Post-operative comparison of AVQI scores added more light into the dysphonic condition improvement. The limitations of the study are, age & gender of the participants are not specified. In the discussion, connected speech analysis and its results are not clearly explained in terms of two groups; rather, common values are specified, which is not enough to comprehend.

As AVQI involves the use of concatenated samples of continuous speech and phonation simultaneously, there was a need to identify whether AVQI was stable across languages. For this purpose, studies on several languages such as Dutch, English, Japanese, Lithuanian, German, Korean, Spanish, and French were carried out by several researchers, and the results are summarized in table 2.1.

Table 2.1

Summary of AVQI score across different languages reported in the literature

Authors	Language	AVQI cut-off score
Maryn et al., (2010)	Dutch	2.95
Maryn et al., (2014)	English	3.25
Maryn et al., (2014)	French	3.07
Hosokawa et al., (2017)	Japanese	3.15
Uloza et al., (2017)	Lithuanian	2.97
Delgado et al., (2018)	Spanish	2.28
Kim et al., (2018)	Korean	3.33
Latoszek et al., (2020)	German	1.85

Recent studies on professional voice user's in the national scenario

- **Perceptual analysis of voice in professional voice user's**

Jayakumar and Yasin (2019) conducted a study to investigated the voice use at different situations and knowledge of vocal hygiene among Alimah's. A total of 155 UG female students (range: 21.0 – 24.0 years) of Alimah course were recruited. All the participants were in their final year (8^{th} semester). The authors developed a self-reporting questionnaire which was divided into the following sections: Prevalence and general health, communication, and voice usage in daily situations, lifestyle and emotional impact, and knowledge about voice and voice care. Five experienced SLP's validated the content of the questionnaire. The participants were instructed to read carefully and rate a total of 40 questions on a 5-point rating scale. Where '0' indicates 'never', and '4' indicates 'always'. Authors found that under the first section, prevalence and general health, during the course time, 70% of students had experienced voice problems. Almost always 11% of them reported voice problems, while 13% reported they are still having voice problems. 78% of students reported anxiety, mental tension, and stress. Therefore, in Alimah's voice problems and general health issues were highly prevalent. Results of the second section, i.e., communication and voice usage in daily situations showed that mean hours of voice usage was 10.5 hours. The voice was used majorly during daily recitation of Quran and 79% of them recited loudly. 84% of students fluctuate their voice during Quran recitation and 69% did not take voice rest and continued recitation, even during throat infection. Therefore, these results indicate excessive and inappropriate vocal usage at the time of throat infection. Results of the third section, i.e., lifestyle and emotional impact, revealed that more than 50% of Alimah's were involved in poor vocal hygiene

practices such as speaking loudly, frequent consumption of tea/coffee and spicy food, irregular eating habits and inappropriate sleeping timing. Further, 57% of students reported gastrointestinal problems. Concerning the emotional impacts of their voice or speaking difficulty, 48% of students reported feeling frustrated at the time of voice problems, and 33% reported negative feedback from listeners. In the last section, i.e., knowledge of voice and voice care, 83% of students reported voice changes with age; 57 % of them agreed that voice rest during throat infection could prevent them from developing voice problems. 82% of them believed that voice problems are common among Alimah, and 48% of them were interested in receiving voice care in the future. 61% of them reported no training or voice care was provided. 14% reported adequate hydration, 15% reported avoiding loud talks or shouting, and 17% reported by avoiding consumption of extreme hot or cold food items, measures can be taken to prevent voice problems. The authors found that Alimah's had limited knowledge of voice care, due to which they had high prevalence rate of voice problems i.e., 70%. Hence, there is necessity of creating awareness among this population regarding voice use and its care. This is a questionnaire-based study on Alimah students (female Islamic scholars), and no objective voice analysis was done to find out their vocal characteristics.

- **Acoustic analysis of voice in professional voice user's**

Multidimensional voice program (MDVP) analysis

Yasin (2018) investigated the vocal symptoms and characteristics of thirty Imams in the age range of 20-55 years with minimum working experience of five years and compared with the age and gender-matched thirty normo-phonic males. Voice survey questionnaire was administered only on Imams, and sustained phonation of vowel /a:/

was recorded using an Olympus (LS-100) recorder for both the groups. Acoustic analysis of this voice sample was done using MDVP software. In the voice survey questionnaire, the author reported that the amount of vocal load was too high in the Imam group due to leading prayers, preaching, and teaching religious lessons to children. Imams had poor vocal and non-vocal habits such as shouting, speaking loudly with a fast rate of speech, frequent throat clearing, and drinking coffee more than twice daily. From the questionnaire, they had some positive habits such as drinking more than 1 liter of water/day, and proper voice rest was taken after longer duration speeches. On the other hand, the author found that the acoustic parameters such as RAP, Jitt, Shim, vF0, STD, VTI, NHR, FTRI were high in the Imam group than non-teaching individuals. The author inferred the increased values of acoustic voice parameters to the instability of voice in Imams due to prolonged voice usage. Therefore, from the results of the questionnaire, the Imam group had experienced voice problems in their carrier. The cause was attributed to the vocal loading that they were subjected to, poor vocal and non- vocal habits, and limited knowledge about the voice care. This is a questionnaire-based study along with an acoustic analysis of voice. Only imams (male Islamic scholars) were recruited in the study.

Yeshoda, Varghese, Jabeen & Muhumina (2018) investigated the voice characteristics in madrasa teachers in terms of frequency perturbation and noise measures. A total of 20 participants was considered in the study (ten madrasa teachers with 15 years of teaching experience, voice usage was a minimum of 2-3 hours/day for six days/week and ten non-teachers in the age range: 41-50 years). Participants were instructed to Sustained phonation of vowel /a:/ for about 5 – 6 seconds at a comfortable pitch and loudness level and the samples were recorded using a portable digital sony recorder ICD UX81F. The middle three seconds steady portion of the

phonation sample was analyzed using the MDVP software of CSL Model 4500. Acoustic voice parameters such as jitter percent (Jitt), Relative Average Perturbation (RAP), and Noise to Harmonic Ratio (NHR) was extracted. The authors reported that there is a considerable increase in Mean jitt, RAP, and NHR among madrasa teachers than non-teachers, which can be due to excessive demands in their voice without taking adequate voice rest. It was concluded that madrasa teachers are at high risk of experiencing voice disorders. Limitations of the study are less number of samples were taken, and the reason for considering only three acoustic voice parameters for analysis is not mentioned.

Acoustic Voice Quality Index (AVQI)

Benoy (2018) aimed to develop the normative reference data for AVQI and to validate AVQI with perceptual measures using the GRBAS scale for normo-phonic and dysphonic individuals in Indian context. A total of one hundred twenty participants (age range: 20-50 years) were recruited and divided into three groups. Group-I included fifty normo-phonic individuals (mean age: 33.06 ± 9.38) who were native Malayalam speakers. Fifty normo-phonic individuals (mean age: 34.28 ± 9.63) who were native Kannada speakers were in Group-II. Group-III consisted twenty individuals with mild to moderate dysphonia (mean age: 33.4 ± 9.29). Participants were asked to perform two tasks, the first task was to sustain phonation of vowel /a:/ for about five to six seconds and the second task was to read eight sentences from standardized Kannada and Malayalam passage (Savithri and Jayaram, 2005), out of which the middle three sentences were considered for analysis. Olympus LS 100 digital voice recorder was used for recording Voice/speech. AVQI analysis was done in Praat software by using a Praat script given by Maryn and Wernik (2015). Further,

all the voice samples were subjected to perceptual evaluation using the GRBAS scale by five experienced speech-language pathologists. The author reported the mean AVQI was found to be 3.03 (± 0.32) in normo-phonic individuals and 4.79 (± 0.97) in individuals with dysphonia. 2.29 - 3.76 was the AVQI range obtained for normo-phonic individuals and 3.37 - 6.26 for individuals with dysphonia. The independent sample t-test showed no significant difference in age and language in all three groups. Results of perceptual evaluation revealed, as the 'G' rating increased, the AVQI values were more variable in individuals with dysphonia, and the less variability of AVQI values were found for normo-phonic individuals. The spearmen's rank-order correlation revealed poor to moderate AVQI correlation with GRBAS in normo-phonic individuals. However, grade, roughness, and breathiness demonstrated a significant good correlation with AVQI values. Asthenia and strain were found to have a significant moderate correlation with AVQI values in individuals with dysphonia. The author concluded that for Indian languages, i.e., Kannada and Malayalam, the mean AVQI value was 3.03 (± 0.32) and 3.00 (± 0.45). The AVQI value for normo-phonic individuals may range between 2.39 to 3.67. Any voice sample for which the AVQI value obtained is above this range is regarded as dysphonic. The study's limitation is that small sample size was considered in the dysphonic group (n = 20), and the participants were not professional voice users.

Pebbili et al. (2019) conducted a study to document document the AVQI across the degrees of perceptual dysphonia severity and to verify the AVQI sensitivity to detect different dysphonia severity. The authors reviewed the data of one hundred seventy patients with the complaint of voice problems. On the first visit, these patients were diagnosed according to the protocol of voice clinic & detailed evaluation was carried out, which included perceptual evaluation of voice using CAPE-V, Acoustic

analyses using MDVP software, MPD & S/Z ratio and vediostroboscopy. The voice pathologist and the Otolaryngologist together made the differential diagnosis based on the results of vediostroboscopy. Out of one hundred seventy patients data, only seventy one patients' data were retained as these many had both sustained phonation and reading passage recordings. Group-I consisted seventy one patients with eighteen females and fifty three males in the age range of 12.0 - 82.0 years (mean age: 41.0 years), and nineteen normo-phonic individuals with ten females and nine males (mean age: 24.0 years) were included in Group-II. The voice recording was done in Praat software using a dynamic microphone SM48. The voice samples were recorded at 44.1 kHz sampling frequency and 16-bit resolution. Participants phonated vowel /a:/ for more than four seconds and read the Kannada passage (Savithri and Jayaram, 2005). For AVQI analyses, 3 seconds middle portion of sustain phonation and the second sentence of passage was considered. The samples were renamed as 'cs' and 'sv' as per the pre-requisites to run the AVQI algorithm. Voice samples were perceptually analyzed using GRBAS by three speech-language pathologists (SLP). The consensus of at least two SLP's was considered for determining the dysphonia severity. After which, the perceptual evaluation and AVQI scores were compared. Praat software (6.0.40 V) was used to obtain AVQI value using the Praat script given by Maryn and Wernik (2015). The overall grade score of GRBAS was divided into normal, slight, moderate, and severe categories. Under which, 19 voice samples were in normal category, 34 in slight category, 27 in moderate category and 10 severe category. Good inter-judge agreement for overall grade with value 0.6 to 0.7 was obtained. Statistical analysis showed a positive correlation between the grade (G) of perceptual dysphonia severity and the AVQI ($\rho = 0.67$; $P < 0.001$). The ROC statistics revealed that the AVQI could discriminate the normal versus slight, slight versus moderate, and

moderate versus severe groups with cut-off scores 2.72 (Sensitivity = 52%; Specificity = 73%), 4.00 (Sensitivity = 66%; Specificity = 88%), and 6.25 (Sensitivity = 66%; Specificity = 96%), respectively. Thus, the authors reported that AVQI can be used to distinguish different degree of dysphonia. The number of participants across the subcategories of dysphonia are not equally distributed and there is a difference in the mean age across groups which can be considered as the limitation of the study.

Vishali (2019) aimed to determine the AVQI in native Tamil speaking normo-phonic adults with an objective to establish normative data. A total of one hundred thirty six participants were recruited in the study and were divided into three groups. Group-I consisted sixty-four normo-phonic individuals with thirty two females and thirty two males (range: 20-35 years). Group-II consisted fifty-seven normo-phonic individuals with twenty nine females and twenty eight males (range: 36-50 years). Group-III consisted fifteen normo-phonic individuals with five females and ten males (range of 20-50 years). Group-I and II was considered as a control group, and Group-III was considered as a clinical group. Participants were asked to perform two tasks, the first task was to sustain phonation of vowel /a:/ for about five to six seconds, and the second task was to read nine sentences from standardized Tamil passage (Savithri and Jayaram, 2005), out of which the middle three sentences were considered for analysis. Voice/speech recording was carried out in Praat software (6.0.28 V) using Sennheiser CX 275 earphones with a microphone connected to the Lenovo laptop. AVQI analysis was done in Praat software by using Maryn and Wernik (2015) algorithm. The author reported that the mean AVQI for Tamil speakers was found to be 2.76 (± 0.76) and there was no significant effect of age on AVQI measure. In terms of gender differences, there was significant difference found i.e., males had higher AVQI values (2.92) than females (2.58). These findings showed that AVQI is sensitive

to gender-related changes and not age-related changes in vocal fold anatomy and physiology. On comparison of AVQI between normo-phonics and dysphonic, the mean AVQI value was higher in dysphonic (3.99) than normo-phonics (2.79). The author concluded that this study would provide a norm reference data of AVQI values in Tamil speakers, and the higher values in the dysphonic group indicate that AVQI is sensitive in identifying dysphonic voice. The study's limitations include the severity of dysphonia is not mentioned, and the sample size of dysphonic group was relatively lesser compared to normo-phonic group.

Ambulatory Phonation Monitor (APM)

Jabeen (2019) investigated the vocal load characteristics in Imams by continuous monitoring of phonatory behaviors for five hours using Ambulatory Phonation Monitor (APM) instrument. A total of five participants (range: 29-48 years) with minimum of 5 years teaching experience were recruited. The APM instrument's accelerometer was adhered to on the throat with plastic tape, and five hours of data was collected from around 7:00 am - 1:00 pm. Then, the data from the accelerometer was transferred to the PC for analysis. The APM's measured parameters were phonation time, percentage phonation time, F0 mode, F0 average, average amplitude, cycle dose, and total distance dose for about five hours (started during madrasa teaching time). The author found that phonation time, percentage phonation time, F0 mode, cycle dose, and total distance dose values were higher for four Imams out of five. The author compared this results with other four studies from the literature (Boudreaux et al., 2011 studied voice problems in persons with Parkinson disorder and non-Parkinson disorder using APM; Cantarella et al., 2014 studied the APM in 92 call center operators; Buckley et al., 2015 studied the occupational vocal health of elite sports coaches using APM). In comparison with the above four studies, three

parameters that were high in Imams were percentage phonation time, F0 mode, and average amplitude. The author concluded that, this study clearly showed that Imams have high vocal load due to duties done by them. The reason for the high vocal load was attributed to Imam's age, marital status, years of experience, vocal and non-vocal behaviors, classroom setting, and a number of students in the classroom and additional job. Limitations of the study are age-matched control group was not included, only five Imams were considered, and data was not collected separately for madrasa teaching and additional working time.

With the background information about the voice usage and vocal loading in a different type of professional voice users (including the Islamic scholars who teach Qur'an and spiritual related aspects at Madrasa), it is known that in recent years the international and national research has emphasized on voice quality of Imams. However, there are countable studies on Uluma, as it is one of the difficult population for research purposes due to some of the Islamic principles. Therefore the present study is planned to investigate the vocal characteristics in Uluma. The additional highlight in the current study is AVQI analysis, which is one of the recently developed methods to quantify overall dysphonia's severity involving both sustained phonation and connected speech (Maryn et al., 2010). The national studies have come up with reference data for AVQI in three languages, i.e., Kannada, Malayalam, and Tamil. The current study will explore the AVQI cut-off score for Urdu language, which is an Indo-Aryan language, and it is one of the 22nd constitutionally recognized official languages in India with 62,772,631 Urdu speakers according to Government of India census, 2011.

Chapter III

METHOD

3.1 Research Design

In the present study, a standard group comparison research design was utilized to investigate the objectives.

3.2 Participants

A total of 80 female participants in the age range of 25-45 years volunteered in the study. Participants were divided into two groups, Group I included 40 Uluma with a mean age of 32.72 years, and Group II included 40 normo-phonic females with a mean age of 32.60 years. Participants in Group II were age and gender-matched with those in Group I. All the participants were female native Urdu speakers, and they were recruited from Bangalore city, Karnataka.

3.2.1 Inclusion criteria

- Participants with a minimum of three years of experience in teaching were considered in Group I
- Participants who were non-teaching professionals and with no singing or loud speaking habits were considered in Group II
- Participants with normal speech (including voice), language, hearing, vision, communication, and with intact cognition were included in Group I and II.
- Participants with no signs and symptoms of upper respiratory tract infection at the time of the recording were included in Group I and II.

3.2.2 Exclusion criteria

- Any participant with a history of voice problems, exposure to smoking/ alcohol consumption/ chemical fumes or any trauma/ accident/ surgery to the laryngeal system, or history of exposure to medication, irrespective of medical conditions such as GERD/LPR, diabetes or hypertension were excluded.
- Participants in Group I who reported the use of an amplification device during the teaching hours were excluded.
- Based on the revised consensus of BMI guidelines for Indians, participants whose BMI was not within the normal range (i.e., 18.5 – 22.9 kg / m^2) were excluded (Gropper et al., 2009).

3.3 Material

The participants of both groups were given two tasks to perform. Task 1 was to sustain phonation of vowel /a:/ for 5 to 6 seconds at their comfortable pitch and loudness level, and task 2 was to read a Urdu passage, taken from NCERT, 10^{th} Grade, Urdu text book: Gulzar-e-Urdu. The passage included a total of seven sentences, which contained 49 syllables (see Appendix - I).

3.4 Instrumentation

Standard high definition microphone was used to record the phonation and reading samples of Uluma and normo-phonic females. Multi-Dimensional Voice Program (MDVP) of the Computerized Speech Lab (model 4305; Kay Elemetrics, USA) was used to analyze the phonation samples. MDVP provides a total of 33 parameters, which can be classified under eight major categories: fundamental frequency information, short and long term frequency perturbation, short and long term amplitude perturbation, voice break related, sub-harmonic related, voice

irregularity related, noise related and tremor related measures. In the present study, only the following parameters were extracted to compare voice characteristics between the two groups:

a. Average Fundamental frequency (MF0) – Average value of all obtained period to period F0 values.
b. Standard deviation of Fundamental frequency (STD) – Variation of F0 within the analysed voice sample.
c. F0 Tremor frequency (Fftr) – It is the frequency of the lowest frequency modulation component.
d. Amplitude Tremor Frequency (Fatr) – Frequency tremor amplitude index average ratio of the frequency.
e. Jitter percentage (Jitt) – Relative evaluation of period to period (very short term) variability of pitch within the analysed speech sample.
f. Relative Average Perturbation (RAP) - Relative evaluation of period to period (very short term) variability of pitch within the analysed speech sample with smoothening factor of 3 periods.
g. Fundamental Frequency Variation (vF0) – Variations of the f0.
h. Shimmer percentage (Shim) - Relative evaluation of period to period (very short term) variability of peak to peak amplitude within the analysed voice sample.
i. Amplitude Perturbation Quotient (APQ) - Relative evaluation of period to period (very short term) variability of peak to peak amplitude within the analysed voice sample with smoothening factor of 11 periods.

j. Noise to Harmonic Ratio (NHR) – Average ratio of harmonic energy in the range of 1500-4500 Hz to harmonic energy in the range of 70-4500 Hz.

k. Voice Turbulence Index (VTI) – A ratio of spectral in-harmonic high-frequency energy in the range 1800-5800 Hz to spectral harmonic energy in the range of 70-4500 Hz.

l. F0 Tremor Intensity Index (FTRI) – Average ratio of frequency magnitude of the lowest frequency modulation to total frequency modulation.

m. Amplitude Tremor Intensity Index (ATRI) – Average ratio of the amplitude of the most intense low amplitude modulating component to the total amplitude of the analyzed voice sample.

Following this, the phonation and reading samples were subjected to AVQI analysis (Version 02.03) using AVQI script in PRAAT software (v.6.0 by Boersma & Weenink, 2015) in Dell Inspiron 15 3000 laptop.

3.6 Procedure

3.6.1 Ethical consideration

The aim and objectives of the study were informed, and it was clearly explained to all the participants. Their safety and confidentiality were assured, and written consent was taken before subjecting them into the study.

3.6.2 Data Recording

The recording was carried out in a quiet room before the teaching hours in the morning. The participants were made to sit comfortably, and microphone distance was maintained at 10 cm away from the mouth to avoid the breathing noise. The recording was done on PRAAT software (v.6.0) using the settings monochannel with 44 kHz sampling frequency and 16-bit resolution. For the first task, participants were instructed to take a deep inspiration followed by phonation of vowel /a:/ for about 5 to 6 seconds at their comfortable pitch and loudness level. Three trials were recorded, and the best one was considered for analysis. In the second task, participants were asked to read total of seven sentences from Urdu passage at their comfortable loudness level. The phonation and the reading samples were recorded and saved in '.wav.' format.

3.7 Data Analysis

The phonation samples were subjected to MDVP analysis to extract the 13 acoustic parameters. Following this, the saved .wav phonation and reading samples were renamed as 'sv' and 'cs,' respectively, for convenient AVQI analysis. These samples were analyzed to extract the AVQI value in Praat software (v.6.0) by using the AVQI script given by Maryn et al. (2010). To calculate an AVQI score, a weighted combination of six acoustic time domain [i.e., shimmer local, shimmer local dB and HNR], frequency domain (i.e., general slope of the spectrum and tilt of the regression line through the spectrum) and quefrency domain [i.e., smoothed cepstral peak prominences (CPPs)] parameters are modeled in a linear regression formula. i.e.,

AVQI=2.571*[3.295-0.111*CPPS-0.073*HNR-0.213*SL+2.789*ShdB-0.032*Slope+ 0.077*Tilt]. Moreover, AVQI results were obtained on a scale of 0-10.

3.8 Statistical Analysis

The obtained MDVP and AVQI parameters were tabulated and subjected to statistical analysis in Statistical Package for the Social Sciences (SPSS) software (Version 21.0). Descriptive statistics was carried out to calculate the mean, median, and standard deviation for both the groups. Shapiro Wilk test was done to test the normality. As the obtained data was non-normalized, a non-parametric analysis was performed. That is, the Mann-Whitney U test was employed for between-group comparisons for the measured parameters.

Chapter IV

RESULTS

The aim of the present study is to investigate the vocal characteristics of Uluma. The study included two groups; Group I (Uluma, N=40) and Group II (normo-phonic females, N=40). The recorded voice samples were subjected to acoustic analysis using the MDVP module of CSL and AVQI. The raw data was fed into SPSS software (Version 21.0) for statistical analysis.

Results of test of Normality

Shapiro-Wilk test was carried out to check the Normality of acoustic data, and the results indicated non-normal distribution ($p \leq 0.05$) for the following parameters: MF0, STD, Fftr, Fatr, Jitt, RAP, vF0, Shim, APQ, NHR, VTI, FTRI, ATRI, and AVQI. Therefore, a non-parametric test for two independent group comparisons was applied for the data.

The results of the present study are discussed under the following subheadings;

1. Acoustic voice characteristics of Uluma (Group I) and Normo-phonic females (Group II)
2. Comparison of acoustic voice characteristics between groups
3. Comparison of AVQI value between groups

1. Acoustic voice characteristics of Uluma (Group I) and Normo-phonic females (Group II)

The mean, standard deviation (SD) and median values for both the groups were obtained through descriptive statistical analysis. These values are tabulated in

table 4.1. The mean values of acoustic parameters: STD, Fatr, Jitt, RAP, vF0, Shim, APQ, and NHR are higher in Group I than Group II. The median values of all the acoustic parameters except MF0, Fftr, and VTI are found to be higher in Group I than Group II.

Table 4.1

Mean, Standard Deviation (SD) and Median of acoustic voice parameters in Group I and Group II

Parameters	Group I			Group II		
	Mean	SD	Median	Mean	SD	Median
MF0 (Hz)	218.18	21.25	217.50	224.90	25.69	230.50
STD (Hz)	2.37	0.57	2.34	2.01	0.63	1.88
Fftr (Hz)	2.77	1.14	2.48	3.32	0.98	3.08
Fatr (Hz)	2.97	1.20	2.90	2.95	0.87	2.67
Jitt(%)	0.72	0.33	0.65	0.55	0.24	0.52
RAP (%)	0.67	0.45	0.54	0.34	0.87	0.31
vF0 (%)	1.47	0.59	1.39	0.90	0.30	0.87
Shim (%)	3.23	1.15	3.07	2.69	1.07	2.57
APQ (%)	2.45	0.66	2.43	2.11	0.66	1.99
NHR	0.13	0.02	0.13	0.12	0.02	0.12
VTI	0.04	0.01	0.04	0.08	0.14	0.05
FTRI (%)	0.78	0.16	0.46	0.62	1.40	0.30
ATRI (%)	2.85	1.55	2.65	3.12	1.69	2.39

Abbreviations: MF0, Average Fundamental Frequency; STD, Standard Deviation of F0; Fftr, F0 Tremor Frequency; Fatr, Amplitude Tremor Frequency; Jitt (%), Jitter Percent; RAP, Relative Average Perturbation; vF0, Fundamental Frequency Variation; Shim (%), Shimmer Percent; APQ, Amplitude Perturbation Quotient; NHR, Noise to Harmonic Ratio; VTI, Voice Turbulence Index; FTRI, F0 Tremor Intensity Index; ATRI, Amplitude Tremor Intensity Index.

2. Comparison of acoustic voice characteristics between groups

The data was further subjected to the Mann-Whitney U test to check if the obtained mean values of MDVP parameters were statistically significant difference between groups. The mean ranks of this non-parametric test were considered for comparing the obtained means because each of the parameters had a different shape of skewness in both groups. Mean Ranks of acoustic voice parameters for Group I and Group II are depicted in table 4.2. The |z| and *p* values for Group I and Group II are depicted in table 4.3.

Table 4.2

Mean Ranks of Mann-Whitney U test for parameters in Group I and Group II

Parameters	Group I	Group II
	Mean Ranks	
MF0 (Hz)	37.16	43.84
STD (Hz)	47.48	33.53
Fftr (Hz)	32.04	48.96
Fatr (Hz)	40.01	40.99
Jitt (%)	46.70	34.30
RAP (%)	51.40	29.60
vF0 (%)	53.29	27.71
Shim (%)	45.46	35.54
APQ(%)	46.66	34.34
NHR	46.84	34.16
VTI	36.70	44.30

FTRI (%)	49.70	31.30
ATRI (%)	40.35	40.65

Table 4.3

Results of Mann Whitney U test for between-group comparison

Parameters	|z| value	*Sig. p* value
MF0 (Hz)	1.28	0.19
STD (Hz)	2.68	0.007**
Fftr (Hz)	3.25	0.001**
Fatr (Hz)	0.18	0.851
Jitt (%)	2.38	0.017*
RAP (%)	4.19	0.000**
vF0 (%)	4.92	0.000**
Shim (%)	1.91	0.056
APQ (%)	2.37	0.018*
NHR	2.50	0.012*
VTI	1.48	0.13
FTRI (%)	3.54	0.000**
ATRI (%)	0.05	0.94

*indicates significance at 0.05 level

**indicates significance at 0.01 level

a. MF0 (Hz)

Higher mean rank score in Group II is obtained compared to Group I on Mann-Whitney U test. Similarly, the mean and median of MF0 (Hz) were also higher in

Group-II. However, there is no statistically significant difference between the groups at 0.05 level of significance (|z|= 1.28 and p = 0.199).

b. STD (Hz)

Higher mean rank score was obtained in Group-I compared to Group-II on Mann-Whitney U test. The analysis revealed a significant difference between the groups, where the mean as well as median of STD (Hz) were significantly higher in Group-I than Group-II at 0.05 level of significance (|z| = 2.68 and p = 0.007).

c. Fftr (Hz)

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-II compared to Group-I. The analysis revealed a significant difference between the groups, where the mean and median of Fftr (Hz) were significantly higher in Group-II than Group-I at 0.05 level of significance (|z| = 3.25 and p = 0.001).

d. Fatr (Hz)

Results of the Mann-Whitney U test revealed the mean rank score for Fatr (Hz) was higher in Group-II compared to Group-I. However, the difference between groups was not statistically significant at 0.05 level of significance (|z| = 0.18 and p = 0.85).

e. Jitt (%)

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-I compared to Group-II. The analysis revealed a significant difference between groups, where the mean and median of Jitt (%) was significantly higher in Group-I than Group-II at 0.05 level of significance (|z| = 2.38 and p = 0.017).

f. *RAP (%)*

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-I compared to Group-II. The results of the test revealed a significant difference between groups, where the RAP (%) was significantly higher in Group-I than Group-II at 0.05 level of significance (|z| = 4.19 and p = 0.000).

g. vF0 (%)

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-I compared to Group-II. The results of the test revealed a significant difference between groups, where the vF0 (%) was significantly higher in Group-I than Group-II at 0.05 level of significance (|z| = 4.92 and p = 0.000).

h. Shim (%)

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-I compared to Group-II. Similarly, the mean and median of Shim (%) values were also higher in Group-I than Group-II. The results of the test revealed a significant difference between groups, where the Shim (%) was significantly higher in Group-I than Group-II at 0.05 level of significance (|z| = 1.91 and p = 0.056).

i. APQ (%)

Results of the Mann-Whitney U test revealed mean rank score for APQ (%) was higher in Group-I compared to Group-II. The analysis revealed a significant difference between groups, where the mean and median values of APQ (%) were significantly higher in Group-I than Group-II at 0.05 level of significance (|z| =2.37 and p = 0.018).

j. NHR

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-I compared to Group-II for NHR. The analysis revealed a significant difference between groups, where the NHR was significantly higher in Group-I than Group-II at 0.05 level of significance ($|z| = 2.50$ and $p = 0.012$).

k. VTI

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-II compared to Group-I. Similarly, the mean and median value of VTI were higher in Group-II than Group-I. However, the difference between groups was not statistically significant at 0.05 level ($|z| = 1.48$ and $p = 0.13$).

l. FTRI (%)

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-I compared to Group-II for FTRI (%). Similarly, the mean and median value of FTRI (%) were higher in Group-I than Group-II. The analysis revealed a significant difference between groups, where the FTRI (%) was significantly higher in Group-I than Group-II at 0.05 level of significance ($|z| = 3.54$ and $p = 0.000$).

m. ATRI (%)

Results of the Mann-Whitney U test revealed a higher mean rank score in Group-II compared to Group-I for ATRI (%). However, the difference between groups was not statistically significant at 0.05 level of significance ($|z| = 0.05$ and $p = 0.95$).

Mann-Whitney U test revealed a statistically significant difference between two groups in the following acoustic voice parameters; STD, Fftr, Jitt, RAP, vF0, Shim, APQ, NHR, FTRI. From the above, only Fftr parameter was significantly higher in

Group-II and rest of the parameters are significantly higher in Group-I. Whereas MF0, Fatr, VTI, and ATRI had no statistically significant difference between the groups.

3. Comparison of AVQI value between groups

The Mean, SD, and Median of AVQI value are higher in Group-I than Group-II; the AVQI values for both the groups are tabulated in table 4.4.

Table 4.4

Mean, SD and Median of AVQI value in Group-I and Group-II

Parameters	Group-I			Group-II		
	Mean	SD	Median	Mean	SD	Median
AVQI	3.26	0.91	3.18	2.49	0.67	2.46

The Mann-Whitney U test revealed a higher mean rank score in Group-I than in Group-II, as depicted in table 4.5. The |z| and *p* values for Group-I and Group-II are depicted in table 4.6. The results indicated a significant difference between groups, where the AVQI value was significantly higher in Group-I compared to Group-II at 0.05 level of significance (|z| = 3.84 and $p = 0.000$).

Table 4.5

Mean Rank of Mann-Whitney U test for AVQI value in Group-I and Group-II

Parameter	Group-I	Group-II
	Mean Rank	
AVQI	50.50	30.50

Table 4.6

Results of Mann Whitney U test for between-group comparison

parameter	|z| value	*Sig. p* value
AVQI	3.84	0.000**

*indicates significance at 0.05 level

**indicates significance at 0.01 level

CHAPTER V

DISCUSSION

The present study aimed to analyze and document the acoustic characteristics of voice in Uluma. The first objective was to estimate the acoustic characteristic of voice in Group I (Uluma) and Group II (normo-phonic females). Second objective was to compare the acoustic characteristics between Group I and Group II. Third objective was to analyze and compare the overall voice quality of both groups using AVQI.

Islamic religious officials account for significant group of voice professionals and higher rate of sulcus vocalis was found in them (Buyukatalay et al., 2019). High Prevalence rate of voice and general health issues were high in Islamic scholars and students of Alimah course (Farahat & Mesallam, 2016; Jayakumar & Yasin, 2019). Madrasa teachers are at high risk of developing voice problems due to excessive demands on their voice and high vocal load because of longer periods of teaching (Yasin, 2017; Yeshoda et al., 2018 and Jabeen, 2019).

In the present study, on comparison of acoustic parameters between Uluma and normo-phonic females, the results showed that there is a significant difference in STD, Fftr, Jitt, Shim, RAP, vF0, APQ, NHR and FTRI between the groups. The parameters those are observed to be significant can be categorized into five domains, Frequency related measures (STD); Frequency perturbation measures (Jitt, vF0, RAP); Amplitude perturbation measures (Shim, APQ); Noise related measures (NHR) and Tremor related measures (Fftr, FTRI).

5.1 Frequency related measures

The female voice is naturally high in pitch, with F0 ranging from 150 – 250 Hz (Putnoki, Hara, Oliveira, et al., 2010; Behlau, Azevedo, Pontes, & Conceito, 2013; Cielo, Ribeiro, & Bastilha, 2015), which means that the high frequency may strain the mucosa more during the motion and create greater impact forces over a small area of tissue. In addition female vocal folds are thinner and they are more vulnerable to voice disorders (Preciado, Calzada, & Preciado, 2005; Williams, 2013). Females have relatively less Hyaluronic acid (HA) in the most superficial layer, but more HA towards the vocalis muscle than males (Butler, Hammond, &Gray, 2001). Relatively less HA in the most superficial layer may suggest less protection from vibratory trauma and this explains why females are more prone to phono-traumatic lesions than males. Dehqan and Scherer (2013) attributed the decrease in MF0 to more massive vocal folds, due to excessive voice usage. If the vocal fold stiffens then the vibratory patters will be altered and decrease in the frequency would be equivalent to decrease in the tissue stress (Titze, 2011). Fundamental frequency range will be reduced due to the presence of glottal insufficiency, and variations in pitch and loudness will be restricted. Individuals with dysphonia tries to compensate with more vocal effort along with increased respiratory effort in order to maintain the normal voice quality (Zhnag, 2017). In the present study, reduced MF0 in Uluma can be attributed to excessive voice use because of which there is alteration in the vicious cycle of vocal fold vibration. Also, the absence of amplification and improper hydration during teaching can lead to increased vocal load on the laryngeal system and the vocal folds may undergo fatigue. As hyaluronic acid is less in the vocal folds cover of females, therefore Uluma being

female population, they can be susceptible to develop phono-traumatic lesions due to excessive voice use during teaching.

STD indicates the phonatory stability during the sustentation of F0 (Beber & Cielo, 2010). Yasin (2018) reported a significant increase in STD in Imams than non-teaching individuals; De souza et al., (2019) reported STD was statistically above the normal value in teachers with dysphonia; and Ribeiro and Cielo, (2014) found a significantly higher STD in female teachers. Cielo, Portalete, Ribeiro, et al. (2016) found a significantly higher STD in teachers with voice complaints. The researchers attributed these findings to decrease of the phonation system's control with presence of aperiodicity in the vocal signal due to overuse of voice.

Similarly, in the present study, obtained STD is significantly higher in Uluma compared to normo-phonic females, which indicates the presence of aperiodicity in the vocal signal due to irregular vibration of mucosal layer of the vocal folds. This finding is in agreement with the previous researches (Ribeiro & Cielo, 2014; Cielo, Portalete, Ribeiro, et al., 2016; Yasin, 2018; De souza et al., 2019).

5.2 Frequency perturbation measures

Present study found higher jitter value in Group I (Uluma) compared to Group II. Jitter measurements assess small irregularities of glottic pulses during speech (Titze, 1995). Higher value in the jitter measurements among Group I (Uluma) can be attributed to vocal fold vibration irregularities; control difficulties at phonatory or respiratory level; mass and or tension resulting in hoarse or breathy voice quality (Ribeiro & Cielo, 2014; Cielo et al., 2016).

According to Zyskia et al. (1984) RAP values indicate poor voice quality and vary for different pathological conditions. In the present study, RAP is found to be significantly higher in Uluma than normo-phonics females. This finding is in line with studies in the literature. Yasin (2018) reported a significantly higher RAP in Imams than non-teaching individuals; Yeshoda et al. (2018) reported a considerable increase in mean RAP in madrasa teachers than non-teachers; and De Souza et al., (2019) reported mean RAP was statistically above normal value in teachers with and without laryngeal affections.

Jitt and vF0 are significantly higher in Uluma than normo-phonic females. The increased values in Uluma indicates aperiodicity in the vocal signal due to instability in the vocal fold vibration, suggesting the presence of hoarseness (Beber & Cielo, 2010) and or harshness in the voice (Maryn et al., 2013). The current finding is in agreement with results of Dehqan and Scherer, (2013); Yasin, (2018); Yeshoda et al. (2018) and De Souza et al. (2019). Researchers have attributed the increase in frequency perturbation measures to vocal abuse, leading to vocal fatigue without taking adequate voice rest. Similarly, in Uluma the vocal fatigue is high due to continuous voice usage, which is approximately four – six hours per day, with less frequent breaks and improper hydration during the teaching hours. These behaviors in Uluma can lead to changes in voice quality over a period of time.

5.3 Amplitude perturbation measures

Shimmer is a measure of cycle to cycle variation in the amplitude of the acoustic signal, which is expressed as the average difference between the amplitudes of consecutive periods (Ferrand, 2001; Colton, Casper, & Leo, 2011). Shimmer reflects the state of pulmonary support during phonation and conversational speech.

Increase in Shimmer indicates instability in amplitude due to inadequate breath support and vocal function. (Baken & Orlikoff, 2000; Ferrand, 2001).

In the current study, shimmer percent is found to be significantly higher in Uluma than normo-phonic females. This finding is in line with the study done by Dehqan & Scherer (2013) who reported significantly higher shimmer values in female teachers than their corresponding control group; Lin et al. (2016) reported a higher mean Shim in teachers with voice complaints than teachers with normal voices; Yasin (2018) reported a significantly higher mean Shim in Imams than non-teaching individuals; Yeshoda et al. (2018) reported a considerable increase in mean Shim in madrasa teachers than non-teachers; De Souza et al. (2019) reported a higher Shim in teachers with and without laryngeal affections). Researchers attributed the increase in Shimmer % due to excessive voice use and vocal fatigue causing lowered muscle tonus and impaired neuro-motor control of the larynx.

The significantly higher values of Shimmer % in Uluma can be attributed to slumped body posture during the teaching hours, as they sit on the floor with anterior positioning of the head, while straining their neck and shoulder muscles and this in turn effect the normal respiratory patterns. The lateral expansion of ribs and downward descent of diaphragm takes place during normal inspiration. When the body is in this slumped position, all the intercostal and abdominal muscles will be in shortened position, which will impact the lung volume for inspiration by restricting the movements of ribs and the diaphragm. In this condition, the airflow will be compromised and the sub-glottal pressure is not adequate enough resulting in vocal folds vibration irregularities, because of which the phonation stability would be lost with intensity variations in the vocal signal and to compensate this physiological

changes, more effort will be placed on the laryngeal system to maintain same level of precision in activity and Uluma adjust their voices more dynamically (in terms of F0 and intensity). This could result in vocal fatigue and difficulty in projecting the voice. These changes at anatomical and physiological levels can lead to perception of breathiness in Uluma. The current findings support the findings of Kooijman et al. (2005) study who reported that combination of muscular hypertonicity and deviant body posture influence higher scores on VHI. Also, inappropriate vocal and non-vocal habits (shouting, speaking loudly in presence of background noise, smoking) and presence of gastro-oesophageal reflux are the probable risk factors for developing voice problems (Morrison & Rammage, 1993).

In the present study, APQ was found to be significantly higher in Uluma than normo-phonic females, and this indicates instability in the amplitude of vocal fold vibration suggesting the presence of Breathiness (Beber & Cielo, 2010; Ribeiro &Cielo, 2014) or reduction in the contact surface of vocal folds (Finger, Cielo, and Schwarz, 2009).

5.4 Noise related measures

NHR represents the proportion of acoustic energy that is considered noise and that is harmonic (Ferrand, 2001; Jotz, Cervantes, Abrahao, & Settanni, 2002). NHR is the parameter most sensitive to severity of dysphonia and self-reported symptoms (Bhuta, Patrick, and Garnett., 2004; Zhang & Jiang, 2008). NHR ≥ 0.13 is the possible indicator of voice problems in teachers (Lin et al., 2016).

In the present study, NHR is found to be significantly higher in Uluma than normo-phonic females. This indicates the presence of aperiodic energy and little

harmonic component in the vocal signal of Uluma (Christmann et al., 2017). The current finding is in agreement with studies in the literature (Lin et al., 2016; Yasin, 2018; Yeshoda et al., 2018; De Souza et al.,2019). The researchers attributed the higher NHR to the overuse of voice in the voice disordered group which can be due to increased stiffness or mass in the cover of vocal folds, resulting to their inflammation. And there is a possibility of decrease in the symmetry and amplitude of mucosal wave, where in the sub-glottic pressure would be insufficient to maintain the regular vocal folds vibratory pattern, and the resulting turbulent airflow can produce altered NHR.

A similar finding was observed in Uluma, wherein the higher NHR can be caused due to excessive voice use, and vocal load placed on the laryngeal system is very high because they do not use any amplification while teaching. Another possible reason can be, during the recording of phonation samples, Uluma phonated softly compared to normo-phonic females, and there could be a possibility of incomplete glottal closure due to soft phonation. Another contributing factor can be the presence of posterior glottal gap in females. On videolaryngoscopic assessment in females with normal voice, the predominant glottal configuration found was presence of Y posterior chink (Tarazani, Khoddami, Jalaie, Moghadam, & Akbari 2010). Similar finding was reported by Cielo, Schwarz, Finger, Lima and Christmann (2019) who conducted a cross sectional study on 56 females with no voice complaints, in the age range of 20-30 years. On videolaryngoscopy, significant occurrence of posterior glottal gap, and normal vocal folds vibration reported. A study conducted by Schneider and Bigenzahn, (2003) on 520 young normo-phonic females (age: 12-41 years) reported incomplete closure in 76.2% of all the participants during soft phonation on videostroboscopic examination, and the authors concluded that posterior glottal gap is

a potential risk factor for developing functional voice disorders as the results of compensatory muscle hypertension, muscle misuse, and maladaptive behavior. Similarly, Sodersten and Lindestad (1990) reported increased perception of breathiness in females due to presence of posterior triangular chink. In the present study, as the target population was females, it is known from the literature that gap is a frequent characteristic found in women due to the typical glottic proportion of the female larynx. So whenever there is vocal misuse/overuse in female vocal cords which leads to vocal fatigue and increase in glottal gap with higher NHR.

5.5 Tremor related measures

FTRI is found to be significantly higher in Uluma than normo-phonic females. This indicates high aperiodicity in the vocal signal. The present results supports the findings of Yasin, 2018; Munoz, Mendoza, Fresneda, Carballo, & Lopez, 2003.

Fftr is found to be significantly lower in Uluma than normo-phonic females. This finding is contrary to Yasin's (2018) findings. The differences in findings present with the present study to the earlier study is due to selection of participants, task used, instrument employed and number of participants. Present study focused on Ulumas, whereas Yasin (2018) study focused on Imams (male Islamic scholars). Also, lesser number of Ulumas participated in the study could be another reason for different findings.

Lin et al. (2016) reported that individuals with laryngeal pathologies have higher muscle tension and inappropriate body posture. According to Nguyen, Kenny, Tran, and Livesey (2009), the patients disregarded the muscle tension dysphonia (MTD) as it starts gradually over a period of time, and the pain in throat and/or

irritation/ discomfort subsides when the voice is given adequate rest. In the same way, Uluma did not report any voice problems in their carrier and they strongly disagreed with the fact of developing voice problems due to overuse of voice/ vocal fatigue because of teaching. Few of the Uluma reported throat infections which lead to voice changes and this could be because of climate changes or common cold/ cough. During which they are unable to speak loudly and they face difficulty in varying F0 and intensity during Quran recitation or preaching. But these problems would subside after a period of 3-4 days and they do not pay attention to such voice changes, as it is temporary and they continue teaching without taking voice rest. While recording the voice of Uluma, examiner observed subjectively and perceptually strain in voice and they were unable to sustain phonation beyond 7-8 seconds, instability in phonation along with variations in the intensity and breathy component by the end of phonation was observed. But they did not agree with the fact that developing voice problems due to straining their voice by placing more vocal demands on the laryngeal system without following the vocal hygiene tips / guidelines for voice care in the future. Tarazani, Khoddami, Jalaie, Moghadam, and Akbari (2013) reported acoustic parameters (F0, shimmer, jitter and NHR) were significantly higher in females with MTD than normo-phonic individuals. It would therefore be reasonable to assume that a number of Uluma in this study (those with higher STD, RAP, vF0, APQ, Shimmer, Jitter, &NHR) may have been unaware that they were suffering from the onset of MTD. When these individuals continue stressing their voices, the vocal problems might become severe. At this point, it is imperative to create awareness among Uluma regarding voice problems and to increase their knowledge on voice care or vocal hygiene tips to prevent further deterioration of the voice.

Acoustic voice quality index (AVQI)

In the previous decades, acoustic measures of voice have progressively received attention in which the numerical output of acoustic analysis is derived from sustained vowel samples. There are several reasons for sustained phonation to have gained importance in measuring the quality of voice. First, sustained vowel represents stable phonation, whereas continuous speech involves dynamic changes at glottal as well as supra-glottal level. Second, unlike continuous speech, the sustained phonation does not have unvoiced segments, prosodic variations in F0 and amplitude. Third, sustained phonation does not influence the speech rate, stress and phonetic context. Fourth, sustained phonation is produced with less effort, and it is more commonly utilized for acoustic analysis than continuous speech. Sustained phonation is also language independent, as it does not influence by language, dialect, cultural background and the region (Parsa and Jamieson, 2001; Maryn et al., 2010).

In the assessment of the quality of voice, continuous speech and sustained phonation should be considered as it is "Ecologically valid" (i.e., one that is truly representative of daily speech and voice use pattern). The symptoms of dysphonia would be observed only during conversational speech and not in sustained phonation alone (Yiu, Worral, Longland, and Mitchell, 2000). AVQI is first of its kind to incorporate continuous speech and sustained phonation for acoustic analysis. It was developed by Maryn et al. (2010) to quantify dysphonia severity.

AVQI in Urdu Language

In the present study, the mean AVQI obtained for native Urdu speakers between the age range of 25 – 45 years was 2.49 (± 0.67). This finding is in line with

earlier studies reported in Indian literature i.e., 3.03 in Kannada and 3.00 in Malayalam (Benoy, 2017); 2.76 in Tamil (Vishali, 2019). The result is also in concordance with the AVQI values computed in many other western languages, 2.95 in Dutch (Maryn et al., 2010); 3.25 in English (Maryn et al., 2014); 3.07 in French (Maryn et al., 2014); 2.43 in Dutch (Barsties et al., 2015); 2.35 in Finnish (Kankare et al., 2015); 3.15 in Japanese (Hosokawa et al., 2017); 2.97 in Lithuanian (Uloza et al.,2017); 2.28 in Spanish (Hernandez et al., 2018); 3.33 in Korean (Kim et al., 2018); 2.87 in Finnish (Kankare et al., 2020); and 1.85 in German (Latoszek et al., 2019).

The variations in the AVQI values across urdu and other three Indian languages can be attributed to the differences in the selection of participants, instrumentation, ambient noise level of the room, linguistic differences, phonetic variations, and the cultural backgrounds (Vishali,2019). Maryn et al. (2014) compared AVQI value across four different languages i.e., English, German, French and Dutch and the authors reported that there was no significant difference across four different language speakers on AVQI values. Also, In the present study, the number of participants were lesser (40 normo-phonic individuals) with a narrow age range (i.e., 25 – 45 years) compared to the other studies. The results of the present study augment the evidence that AVQI does not vary with respect to language.

Comparison of AVQI between Group-I (Uluma) and Group-II (Normo-phonic females)

AVQI is a sensitive tool with high diagnostic accuracy to distinguish normal and dysphonic voices (Maryn at al., 2010; Uloza et al., 2018). The present study compared the mean AVQI between Uluma and normo-phonic females. The mean AVQI was found to be higher in Uluma (3.26) than normo-phonic females (2.49) with

a significant difference between both the groups (p = 0.000), which implies that AVQI can differentiate normal versus slight to severe dysphonia (Pebbili et al., 2019). Thus the findings of the present study are in concordance with the findings of Maryn et al.(2010); Barsties and Maryn (2015); Uloza et al.(2017); Pebbili et al., (2019) and Vishali, (2019).

The higher AVQI value in Uluma than normo-phonic females can be attributed to excessive vocal usage with frequent F0 and amplitude variations, inadequate breaks, improper hydration, altered diet and poor knowledge about voice care practices.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of the present study is to investigate the vocal characteristics of Uluma. The study included two groups; Group I (Uluma, N=40) and Group II (normo-phonic females, N=40) in the age range of 25-45 years. All the participants were female native Urdu speakers and they were recruited from Bangalore city, Karnataka.

All the participants were instructed to perform two tasks. First task was to phonate vowel /a:/ at their comfortable pitch and loudness and the second task was to read seven sentences from a Urdu passage. The recorded voice samples were subjected to acoustic analysis using Multi-Dimensional Voice Program (MDVP) of the Computerized Speech Lab and Acoustic voice quality index (AVQI) analysis.

Total of 13 parameters of MDVP were categorized under five domains, such as Frequency related measures (MF0, STD); Frequency perturbation measures (Jitt, vF0, RAP); Amplitude perturbation measures (Shim, APQ); Noise related measures (NHR, VTI) and Tremor related measures (Fftr, Fatr, FTRI, ATRI). The values of all these 13 parameters were extracted for Uluma and normo-phonic females.

On comparison of these 13 acoustic parameters of MDVP between Uluma and normo-phonic females showed a significant difference in STD, Fftr, Jitt, Shim, RAP, vF0, APQ, NHR and FTRI. The results of acoustic analysis clearly showed that elevated frequency, perturbation, noise, and tremor related measures in Uluma and this can be attributed to excessive voice use because of which there would be alteration in the vicious cycle of vocal fold vibration. Also, frequent changes in F0 and amplitude, the absence of amplification, infrequent breaks, body posture, and

improper hydration during teaching can lead to increased vocal load on the laryngeal system. Further, the vocal folds may undergo fatigue leading to decrease in the phonation system's control with presence of aperiodicity in the vocal signal which results in the perception of breathiness or hoarseness.

AVQI analysis was carried out on Uluma and normo-phonic females. Mean AVQI was obtained for both the groups and comparison was done. The results showed higher AVQI value in Uluma, which can be attributed to excessive voice use in Uluma.

To conclude, the higher acoustic parameters and AVQI values in the current study hints that Uluma are at high risk of developing voice problems in future, if they continue to strain their voice without following vocal hygiene and voice care guidelines.

Implication of the study

- The outcome of the present study enlightens the understanding of voice quality of Uluma.
- This study would raise the awareness and prevent voice problems among Uluma.
- AVQI is found to be a clinically sensitive tool for measuring overall voice quality and document subtle voice changes because of vocal over use.
- The results of the present study would serve as a baseline in planning therapeutic management of Uluma with voice disorders.

Limitation of the study

- ❖ Perceptual analysis of voice and laryngeal examination was not performed.
- ❖ Information about vocal and non-vocal habits/practices in detail was not collected from Uluma group.

Future directions

- ✓ Future studies can focus on acoustic analysis of voice in Uluma based on different years of teaching experience.
- ✓ Studies can also compare vocal characteristics of Uluma in Pre and post teaching condition.
- ✓ To consider Laryngeal and aerodynamic evaluation in Uluma.
- ✓ Norm reference AVQI data can be developed for native Urdu speakers in different age groups.

REFERENCES

Abbasi, M. Z. (2018). Co-existence of Sharīʿa and the Modern State: A Historical Perspective from South Asia. *Yearbook of Islamic and Middle Eastern Law Online*, *19*(1), 161-187.

De Souza A.J., Daniela da Silva G.C., Gabriele R.B., Mara Keli Christmann., FabrıcioScapini., & Carla A.P. (2019). Acoustic Measurements Of The Glottic Source Of Female Teachers With Dysphonia. *Journal of Voice, 22*(3).275-279.

Baken, R.J, & Orlikoff, R.F.(2000). Clinical Measurement of Speech and Voice (2nd ed). San Diego, CA: Singular Publishing Group

Barsties, B., & Maryn, Y. (2015). The improvement of internal consistency of the Acoustic Voice Quality Index. *American Journal of Otolaryngology*, *36*(5), 647-656.

Beber, B. C., & Cielo, C. A. (2010). Acoustic measurements of the glottal source of normal male voices. *Pró-FonoRevista de AtualizaçãoCientífica*, *22*(3), 299-304.

Behlau, M., Azevedo, R., & Pontes, P. (2013). Conceito de voz normal e classificação das disfonias. *Voz: o livro do especialista*, *1*, 53-84.

Benoy, J.J. (2018). Acoustic voice quality index (AVQI) and perceptual measures in Indian languages. An Unpublished Masters' Dissertation, Submitted to University of Mysore, Mysore.

Bhuta, T., Patrick, L., & Garnett, J. D. (2004). Perceptual evaluation of voice quality and its correlation with acoustic measurements. *Journal of Voice*, *18*(3), 299-304.

Butler, J. E., Hammond, T. H., & Gray, S. D. (2001). Gender related differences of hyaluronic acid distribution in the human vocal fold. *The Laryngoscope*, *111*(5), 907-911.

Büyükatalay, Z. C., Gökmen, M. F., Yıldırım, S., &Dursun, G. (2019). Voice Disorders in Islamic Religious Officials: Is It Any Different Than Those of the Teachers, Another Well-Known Professional Voice Users?. *Journal of Voice : official journal of the Voice Foundation*, S0892-1997(18)30444-2.

Cielo, C. A., Ribeiro, V. V., Bastilha, G. R., & Schilling, N. D. O. (2015). Qualidade de vidaemvoz, avaliaçãoperceptivoauditiva e análiseacústica da voz de professoras com queixasvocais. *Audiology-Communication Research*, *20*(2), 130-140.

Cielo, C.A., Portalete, C.R., Ribeiro, V.V., et al. (2016). Occupational, general health and vocal profile of teachers of Santa Maria city. *Rev CEFAC.51(18), 635–648.*

Cielo, C. A., Schwarz, K., Finger, L. S., Lima, J. M., & Christmann, M. K. (2019). Glottal closure in women with no voice complaints or laryngeal disorders. *International archives of otorhinolaryngology*, *23*(04), e384-e388.

Christmann, M. K., Gonçalves, B. F. T., Lima, J. P. M., Scapini, F., Bastilha, G. R., & Cielo, C. A. (2017). Controlled and randomized clinical trial of

intensive short-term voice therapy with finger kazzo technique in teachers. *Audiology-Communication Research*, *22*, e1791.

Colton RH, Casper JK, Leonard R.(2011). Understanding Voice Problems. (4thed). Baltimore: Lippincott Williams & Wilkins

Dehqan, A., & Scherer, R. C. (2013). Acoustic analysis of voice: Iranian teachers. *Journal of Voice*, *27*(5), 655-e17.

Farahat, M., & Mesallam, T. A. (2016). Psychosocial Assessment of Voice Problems among Saudi Imams. *Journal of Advances in Medicine and Medical Research*, 11(12), 1-7

Ferrand CT. (2001). Speech Science: An Integrated Approach to Theory and Clinical Practice. Needham Heights, MA: Allyn& Bacon

Finger, L. S., Cielo, C. A., & Schwarz, K. (2009). Acoustic vocal measures in women without voice complaints and with normal larynxes. *Brazilian journal of otorhinolaryngology*, *75*(3), 432-440.

Graham, W. A. (1993). Traditionalism in Islam: An essay in interpretation. *The Journal of Interdisciplinary History*, *23*(3), 495-522.

Hernandez, D. J., Gómez, L., N. M., Jiménez, A., Izquierdo, L. M., Barsties v., & Latoszek, B. (2018). Validation of the acoustic voice quality index version 03.01 and the acoustic breathiness index in the Spanish language. *Annals of Otology, Rhinology & Laryngology*, *127*(5), 317-326.

Hosokawa, K., Barsties, B., Iwahashi, T., Iwahashi, M., Kato, C., Iwaki, S., ... & Ogawa, M. (2017). Validation of the acoustic voice quality index in the Japanese language. *Journal of Voice*, *31*(2), 260-e1.

Jabeen, F. (2019). Vocal Load Characteristics in Imams Using Ambulatory PhonationMonitor. An UnpublishedMasters' Dissertation, Submitted to University of Mysore, Mysore.

Jayakumar, T., and H. Yasin. (in press). "A Preliminary Exploration of Vocal Usage in Prospective Professional Voice Users (PPVUs): Students of the Alimah Course." *Journal of Voice* (2019).

Jotz, G. P., Cervantes, O., Abrahão, M., Settanni, F. A. P., & de Angelis, E. C. (2002). Noise-to-harmonics ratio as an acoustic measure of voice disorders in boys. *Journal of Voice*, *16*(1), 28-31.

Kankare, E., Barsties, B., Maryn, Y., Ilomäki, I., Laukkanen, A. M., Tyrmi, J., ... &Vilpas, S. (2015). A preliminary study of the Acoustic Voice Quality Index in Finnish speaking population. In *PAN EUROPEAN VOICE CONFERENCE ABSTRACT BOOK* (p. 218).

Kankare, E., Barsties V. Latoszek, B., Maryn, Y., Asikainen, M., Rorarius, E., Vilpas, S., ... & Laukkanen, A. M. (2020). The acoustic voice quality index version 02.02in the Finnish-speaking population. *Logopedics Phoniatrics Vocology*, *45*(2), 49-56.

Kim, G. H., Lee, Y. W., Bae, I. H., Park, H. J., Wang, S. G., & Kwon, S. B. (2019). Validation of the acoustic voice quality index in the Korean language. *Journal of Voice*, *33*(6), 948-e1.

Kooijman, P. G., De Jong, F. I. C. R. S., Oudes, M. J., Huinck, W., Van Acht, H., & Graamans, K. (2005). Muscular tension and body posture in relation to

voice handicap and voice quality in teachers with persistent voice complaints. *Folia phoniatrica et logopaedica*, *57*(3), 134-147.

Koufman, J. A., & Isaacson, G. (1991). The spectrum of vocal dysfunction. *Otolaryngologic Clinics of North America*, *24*(5), 985.

Latoszek, B. B. V., Ulozaitė-Stanienė, N., Maryn, Y., Petrauskas, T., &Uloza, V. (2019). The influence of gender and age on the acoustic voice quality index and dysphonia severity index: a normative study. *Journal of Voice*, *33*(3), 340-345.

Lin, F. C., Chen, S. H., Chen, S. C., Wang, C. T., & Kuo, Y. C. (2016). Correlation between acoustic measurements and self-reported voice disorders among female teachers. *Journal of Voice*, *30*(4), 460-465.

Makdisi, G. (1989). Scholasticism and humanism in classical Islam and the Christian West. *Journal of the American Oriental Society*, *109*(2), 175-182.

Maryn, Y., De Bodt, M., & Roy, N. (2010). The Acoustic Voice Quality Index: toward improved treatment outcomes assessment in voice disorders. *Journal of Communication Disorders*, *43*(3), 161-174.

Maryn, Y., De Bodt, M., Barsties, B., & Roy, N. (2014). The value of the Acoustic Voice Quality Index as a measure of dysphonia severity in subjects speaking different languages. *European Archives of Oto-Rhino-Laryngology*, *271*(6), 1609-1619.

Morrison, M. D., & Rammage, L. A. (1993). Muscle misuse voice disorders: description and classification. *Acta oto-laryngologica*, *113*(3), 428-434.

Munoz, J., Mendoza, E., Fresneda, M. D., Carballo, G., & Lopez, P. (2003). Acoustic and perceptual indicators of normal and pathological voice. *Folia Phoniatrica et logopaedica*, *55*(2), 102-114.

Nguyen, D. D., Kenny, D. T., Tran, N. D., & Livesey, J. R. (2009). Muscle tension dysphonia in Vietnamese female teachers. *Journal of Voice*, *23*(2), 195-208.

Parsa, V., & Jamieson, D. G. (2001). Acoustic discrimination of pathological voice. *Journal of Speech, Language, and Hearing Research*, *44(2),* 327-339.

Pebbili, G. K., Shabnam, S., Pushpavathi, M., Rashmi, J., Sankar, R. G., Nethra, R., ... & Shashish, G. (in press). Diagnostic Accuracy of Acoustic Voice Quality Index Version 02.03 in Discriminating across the Perceptual Degrees of Dysphonia Severity in Kannada Language. *Journal of Voice* (2019).

Preciado, J., Pérez, C., Calzada, M., & Preciado, P. (2005). Function vocal examination and acoustic analysis of 905 teaching staff of La Rioja, Spain. *Acta otorrinolaringológicaespañola*, *56*(6), 261-272.

Putnoki, D. D. S., Hara, F., Oliveira, G., &Behlau, M. (2010). Voice-related quality of life: the impact of a dysphonia according to gender, age and occupational use of voice. *Revista da SociedadeBrasileira de Fonoaudiologia*, *15*(4), 485-490.

Ribeiro, V. V., & Cielo, C. A. (2014). Vocal acoustic and auditory-perceptual measures, vocal complaints and professional characteristics of teachers

from the city of Santa Maria (Rio Grande do Sul), Brazil. *Audiology-Communication Research*, *19*(4), 387-398.

Senturia, B. H., & Wilson, F. B. (1968). Otorhinolaryngic Findings in Children with Voice Deviations: Preliminary Report. *Annals of Otology, Rhinology & Laryngology*, *77*(6), 1027-1041.

Södersten, M., & Lindestad, P. Å. (1990). Glottal closure and perceived breathiness during phonation in normally speaking subjects. *Journal of Speech, Language, and Hearing Research*, *33*(3), 601-611.

Schneider, B., & Bigenzahn, W. (2003). Influence of glottal closure configuration on vocal efficacy in young normal-speaking women. *Journal of Voice*, *17*(4), 468-480.

Stemple, J. C. (1993). Voice Therapy, Clinical Studies. St. Louis, MO: Mosby-Year book.

Tarazani, M., Khoddami, S. M., Jalaie, S., Moghadam, S. T., & Akbari, M. (2011). The correlation between voice handicap index and specific acoustic measures in patients with muscle tension dysphonia. *Thrita*, *2*(3), 24-28.

Titze, I.R. (1995) Workshop on acoustic analysis. Summary statement. Iowa City: National Centre for Voice and Speech, USA.

Titze, I.R. (2011). Vocal fold mass is not a useful quantity for describing F0 in vocalization. *Journal of Speech, Language, and Hearing Research*. *54(2),* 520-522.

Uloza, V., Petrauskas, T., Padervinskis, E., Ulozaitė, N., Barsties, B., & Maryn, Y. (2017). Validation of the acoustic voice quality index in the Lithuanian language. *Journal of Voice*, *31*(2), 257-e1.

Vishali (2019). Acoustic voice quality index (AVQI) in Tamil language. An Unpublished Masters' Dissertation, Submitted to University of Mysore, Mysore.

Wikipedia contributors. (2020, June 19). Ulama. In *Wikipedia, The Free Encyclopedia*. Retrieved 07:03, July 2, 2020, from https://en.wikipedia.org/w/index.php?title=Ulama&oldid=963378303

Yasin, H. (2018). Vocal Symptoms and Voice Characteristics of Imams. An Unpublished Masters' Dissertation, Submitted to University of Mysore, Mysore.

Yeshoda, K., Varghese, R. T., Jabeen, F., &Muhumina, K. M. (2018). Vocal Characteristics in Indian Madrasah Teachers. *International Journal of Social and Economic Research*, *8*(2), 133-138.

Yiu, E., Worrall, L., Longland, J., & Mitchell, C. (2000). Analysing vocal quality of connected speech using Kay's computerized speech lab: a preliminary finding. *Clinical Linguistics & Phonetics*, *14*(4), 295-305.

Yumoto E, Sasaki Y, Okamura H.(1984). Harmonics-to-noise ratio and psychophysical measurement of the degree of hoarseness. *Journal of Speech Hearing, 27(2),* 2-6.

Zhang, Y., & Jiang, J. J. (2008). Acoustic analyses of sustained and running voices from patients with laryngeal pathologies. *Journal of Voice*, *22*(1), 1-9.

Zhang, Z. (2019). Compensation strategies in voice production with glottal insufficiency. *Journal of Voice, 33*(1), 96-102.

Zyski, B. J., Bull, G. L., McDonald, W. E., & Johns, M. E. (1984). Perturbation analysis of normal and pathologic larynges. *Folia Phoniatrica, 36*(4), 190–198.

APPENDIX - I

غزل

غزل 'عربی کا لفظ ہے-اس کے معنی ہي محبوب سے باتین کرنا عورتون سے باتین کرنا-وہ شاعر جسے غزل کہتے ہین اس مین بنیادی طورپر عشقیہ باتین کی جاتی ہین-لیکن آہستہ آہستہ غزل مین دوسرے مضامین بھی داقل ہو تے گے ہین اورآج یہ کہا جا سکتا ہی کہ غزل مین تقریبا ہر طرح کی باتین کی جا سکتی ہین-یہی وجہ ہے کہ غزل آردوکی سب سے مقبول صنفی سخن ہے