



VOICE-QUALITY IN AMATEUR THULLAL ARTISTS BEFORE AND AFTER PERFORMANCE SESSION

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ABSTRACT

The *professional voice user* is an individual whose livelihood depends partially or wholly upon a *certain voice quality*. If voice is damaged within these professionals, it can be detrimental to their careers and how they are perceived by those around them. One among such professional voice user is Thullal folk fore artists. The long and rigorous duration practices of Thullal art form, poses risk of vocal dysfunction among these elite voice users. Hence, the present study was undertaken under this context.

Voice-samples were recorded from 13 amateur Thullal artists and acoustic analysis was carried out using PRAAT software 5.1.37 version. The result of the present study reveals variations in certain acoustic characteristics of voice. The finding is in agreement with study done by William (2003) which states that PVUs are at an increased risk of having voice disorders. The study necessitates the importance to create awareness among such elite voice performers, of voice disorders and facilities available for voice conservation. It also gave an overall view about the voice characteristics of Thullal artists, which would lead to betterment in provision of treatment and counseling strategies.

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INTRODUCTION

“Voice presents an opening window to a person’s personality”. The human voice is extraordinary. It is not only capable of conveying complex thought but also subtle emotion. In an instant it can communicate the terror of a scream or the beauty of a voice. The importance of human voice in modern society cannot be overstated. Voice is the primary instrument through which an individual’s personality is projected and compatriots are influenced (Sataloff, 2006).

Professional voice users constitute an increasing segment of the population and their need for expert care has inspired new interest in understanding the function and dysfunction of the human voice. Professional voice users are individuals whose livelihood depends partially or wholly upon a certain voice quality. They are public speakers and singers, attorneys, politicians, clergy, educators, telephone receptionists and others. If voice is damaged within these professionals, it can be detrimental to their careers and how they are perceived by those around them. One among such professional voice users is Thullal folk fore artists.

According to Vocal Usage Classification System by Koufman and Isaacson (1991), Thullal artists can be considered under LEVEL-1: Elite vocal performers. The vocal needs of such performing artists are great and their extreme anatomic, physiological and therapeutic demands tax clinical and research skills. Among the classical performing arts of Kerala, Thullal is an art-form which is distinct with its simplicity of presentation and its frank outspoken wit and humor (Bhatt, 2006). Thullal presentations generally last for two hours. The dancer sings and dances simultaneously and this entails long periods of rigorous training, agile body and a good communicative voice (Manorma, 2004). The dancer executes vigorous footsteps and rhythmic movement of the body along with singing. The rhythms of the songs are fast-paced and have a high-tempo (Subodh, 2002). Singing along with vigorous body-movements poses an additional strain on voice. Although a vanishing form of art, Thullal is still practiced in rural parts of Kerala. This classical art form has gained popularity because of its simplistic performance and expressive way of presentation.

Human voice is a major component in communication and voices are used to connect with others through speech and songs. Each human voice is unique like a fingerprint and voice use is culture specific-a feature that is best observed in the singing voices of different kinds of music in the world. Since there are voice problems that are unique to Indian climate and

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culture there is a need for new surveys to explore the science of voice in the Indian context. The focus of the present study was mainly based on ottanthullal artists, since this population has not received considerable attention on voice related research previously.

Review of Literature

Voice reflects the health of human mind and body. Voice is a potent, effective and artistic tool for communication. The voice can convey not only sophisticated scholarly concepts, but also fine emotional nuances. The major focus of research in the recent years has primarily been focused on professional voice users, as they constitute a demanding part of the population in voice health care. Stemple, Glaze and Gerdeman (1995) define professional voice users as the group of individuals who, by the very nature of their occupation, are directly dependent on vocal communication for their livelihood. Their voice problems can be labeled occupational voice disorders since the symptoms they suffer from are likely to be caused by the type of work.

Classification of Professional Voice Users

Koufman and Isaacson (1991) suggested a 'vocal usage' classification system which encompasses a wide range of vocal use and is specific and well-defined system comprising of four levels-

Level I: The elite vocal performer – including professional singers and actors, for whom even slight vocal difficulty may cause serious consequences.

Level II: The professional voice user – including clergy, public speakers, lecturers, telephone operators, for whom moderate vocal difficulty would prevent adequate job performance.

Level III: The non-vocal professional – comprising doctors, lawyers, business persons, sales persons, etc. who cannot perform their work properly if suffering from severe dysphonia.

Level IV: Includes factory workers, laborers, clerks, who would not be prevented from doing their work if suffering from vocal difficulties.

A recent study by Cheng and Woo (2010) utilized another method of classification in the form of a rating scale from 0 (low use) to 5 (elite use). Primary pivotal role has been varied in PVUs in different groups, ranging from teachers to singers, but little attention has been paid to such folkore arts that incorporate a singing style different from that of common classical and carnatic singing styles. Reviewing some studies on professional voice-users:

Western Studies

Russell, Oates and Greenwood (1998) investigated the prevalence of self-reported voice problems in teachers using a mail survey of a simple random sample of 1168 state school teachers (preschool-Grade 12) in South Australia, wherein teachers were asked to report voice problems for the day of the survey, during the current teaching year, and during their careers. The response rate was 75%, with 16% of teachers reporting voice problems on the day of the survey, 20% reporting problems during the current teaching year, and 19% reporting problems at some time during their career. Females

were twice found to be as likely as males to report voice problems. These findings clearly indicated the need for further investigation of the causes of vocal dysfunction in teachers and for the development of educational programs aimed at preventing voice problems in this group of professional voice users.

Rantala, Vilkmann and Bloigu (2002) studied voice changes during a working day in 33 female primary and secondary schoolteachers. Recording was made on first and last lessons during one school day. Estimation of fundamental frequency (F_0), sound pressure level (SPL), the standard deviations of these values (F_0 SD; SPL SD) and F_0 time (vibration time of vocal folds) were made. The most obvious change noted, due to loading was the rise of F_0 that was 9.7 Hz between the first and last lesson ($P = 0.00$). F_0 increased more (12.8. Hz, $P = 0.006$) in the subgroup with few complaints.

Zeine and Waltar (2002) investigated interest and knowledge levels of vocal function and dysfunction among professional voice users. Professional actors and amateur actors indicated the highest levels of interest in gaining further knowledge regarding the role of the speech-language pathologist (SLP) and the voice and vocal hygiene. Professional actors and amateur actors also reported higher perceived knowledge levels than the other groups in these areas. Professional actors answered more knowledge-based questions correctly than amateur actors, acting students, and controls in the areas regarding the role of the SLP and voice and vocal hygiene.

Franco and Andrus (2009) reported common problems seen in professional voice users which included laryngopharyngeal reflux, muscle tension dysphonia, fibrovascular vocal fold lesions (eg, nodules and polyps), cysts, vocal fold scarring, changes in vocal fold mobility, and age-related changes. Microvascular lesions and their associated sequelae of vocal fold hemorrhage and laryngitis due to voice overuse were also reported. Much more common among professional voice users was the negative impact that voice problems had on their ability to work, on their overall sense of well-being, and sometimes on their very sense of self. The article also reviewed the diagnosis and treatment options for these and other problems among professional voice users, describing the relevant roles of medical treatment, voice therapy, and surgery. Emphasis was placed on gaining insight into the "whole" patient so that individualized management plans could be developed.

Van Lierde, Dijckmans, Scheffel and Behlout (2012) determined the presence, frequency, and intensity of pain during speaking in professional voice users and nonvocal professionals and evaluated whether the presence of pain is significantly related with the profile of the professional voice user. To characterize the presence, type, and degree of pain symptoms during speaking, a questionnaire was used. Pain severity was measured by means of a numerical rating scale. Fifty-five percent of the nonvocal professionals and 84% of the professional voice users mentioned the presence of one or more pain symptoms during speaking. Throat pain was mentioned as the most common pain in both the professional and nonvocal professional voice users. The professional voice users showed significantly more throat, neck, shoulder, headache, ear, and back pain. Moreover, the intensity of throat pain was found to be significantly increased in the professional voice users. This study showed evidence that several types of

pain are present with significantly greater frequency in professional voice users and concluded that vocal screening strategies, diagnostic, and treatment protocols should include the assessment of the type and severity of pain.

Singers as Professional voice users

Professional singers are a highly visible and specialized subset of individuals within the population of professional voice-users and present an unusual challenge for speech-language pathologists. Lundy, Roy, Casiano, Xue and Evans (2000), based on comparative study, on acoustic analysis of singing and speaking voice in singing students, concluded that shimmer and noise harmonic ratio were higher in spoken samples.

Tang, Boliek, Rieger (2008) examined the physiology of pitch change in terms of laryngeal and respiratory mechanisms in professional singers. Nine female professional singers participated in the study. The preliminary data obtained from this study indicated that the pattern of vocal fold lengthening exhibited by singers might be related to the number of years of training possessed. Furthermore, the data also indicated that stability in one subsystem may result in variability in another, as shown by the interaction between the vocal fold and respiratory patterns. Gonslaves, Amin and Behlau (2010) analyzed voice of rock singers and concluded that rock style is related to greater use of vocal strain.

Prakub (2011) investigated differences in the acoustic measures of fundamental frequency (Fo), jitter, intensity, and shimmer of older amateur singers and nonsingers and whether there were significant correlations between these acoustic measurements and listener judgments of speaker age. Study participants included 30 male and female singers and 30 male and female nonsingers between the ages of 65 and 80 years. Also, 10 speech-language pathology graduate students were recruited as listener participants to estimate the age of speaker participants from recorded vowel sounds. Acoustic measurements were made on sustained vowel production tasks. The author concluded that acoustic and auditory-perceptual features of the aging voice appeared to be factors associated with participation in amateur singing.

Watson, Williams and James (2011) investigated and compared roles of the accessory respiratory muscles in classically trained singers and found that latissimus dorsi played a significant role in maintaining chest expansion in classically trained singers.

Indian Studies

Professional Voice users

Since late 1900's voice analysis of heavy occupational voice users has been on increase in Indian context. Unnikrishnan (1999) acoustically analyzed voice of primary school teachers and college teachers and concluded that primary school teachers were more subjected to abusive voice.

Regishia, Yeshodha (2004) compared and correlated acoustic and aerodynamic parameters of voice across singers and non-singers during different phases of menstrual cycle. Participants included 10 female Carnatic singers and 10 non-singers in the age-range of 20-27 years. Results obtained revealed no difference in acoustic parameters in singers for the two phases of menstrual cycle and decreased vital capacity measures across singers and non-singers. Behra and Savitri (2005)

compared the acoustic and perspective characteristics of voice of 10 professional and 10 prospective teachers and concluded that more abnormalities were seen in professional users, which was attributed to the use of voice over a longer period of time.

Johnsirani and Yeshoda (2007) determined speaker's formant using acoustic analysis in two PVUs-Theatre artists and AIR announcers, compared acoustic and perceptual characteristics and determined perceptual correlates of "good speech" as indicators of expressiveness. Chandran (2009) compared acoustical features in voice of speech-language pathologists in two different situations (routine conversation and speech-language therapy) and found significant differences in mean pitch and F1 in the voice of SLPs during routine conversation and during speech-therapy. Stephen (2009) examined selected acoustic parameters of voice among theologians and compared these to VHI scores. A negative correlation was obtained between VHI scores when compared with Jitter, Shimmer and HNR.

Shah and Sanghi (2010) compared the voice characteristics and Reflux Symptom Index values of individuals working in call-centers and those working as non-professionals and results revealed significant differences in acoustic parameters and RSI values. Raj (2011) compared the acoustic characteristics of radio jockeys before and after broadcast session and results indicated variations in certain acoustic characteristics of voice.

Singers as Professional voice users

The artistic demands of performance separates singers from other voice professionals. In *Ottan Thullal*, the performer sings and dances to the accompanying music rendered by cymbals and drum. This contributes to vocal loading due to additional strain on muscles when used for an extended period of time.

Reviewing some studies on singers

Sheela, Menon (1974) compared vocal parameters of optimum frequency, Fo of vowel /a/, phonation time and pitch range in 30 trained and untrained singers with age range of 19 to 57 years. It was concluded from the study that trained singers use optimum frequency while speaking and possess greater pitch range when compared to untrained singers. Gupta (1984) investigated off-pitch phenomenon in singers. Participants included nine trained singers with ten years training in Karnatic music. Results revealed that of most of the singers go off-pitch at the highest and lowest note above and below the octave range. Magnitude of off-pitch phenomenon was noted more at the lowest note.

Sujatha (1989) differentiated the voice of trained singers from that of untrained singers using acoustic and aerodynamic analysis. Participants in the study included 10 trained and 10 untrained singers in the age range of 19-24 years. The results revealed significant differences with respect to Fo in reading and octave singing. Trained singers were found to exhibit larger Fo between transitions and were found to use lesser number of pauses in between the swaras. Devie, Yeshodha (2003) investigated formant characteristics in Carnatic and Hindustani styles of singing. Participants included 20 singers in each group in the age-range of 21-55 years. Parameters used in the study were formant structure, Fs, bandwidth and intensity of Fs. Difference indicated difference in bandwidth of Fs which was wider in Hindustani style when compared to Carnatic style. Gosh and Yeshodha (2007) investigated temporal and spectral characteristics of speech sounds in

spoken and sung utterances of female trained/untrained singers and nonsingers and concluded that continuous formal/informal vocal training influenced general speech characteristics of singers group. Supraja, Savithri (2007) on basis of survey conducted, revealed that most exercises to improve breath support, vibrato and physical exercises were performed more by Hindustani singers when compared to Carnatic singers. Selvi and Savithri (2008) analyzed glottal parameters and its variation across genders and emotions in carnatic singers and results revealed significant differences across singers ,on comparison with gender and emotions.

Devadas, Rajashekhar and Aithal (2009), on the basis of a comparative study between Yakshagana singers and age-matched non-singers, revealed significantly higher fundamental frequency, speaking fundamental frequency and reduced MPD in Yakshagana singers, as compared to the non-singing counterparts. Sweety & Yeshodha (2009) investigated glottal behavior in different vocal registers in singers using some EEG parameters. Participants included 20 female Carnatic professional singers and 20 non-singers. Results revealed differences in Fo and variations in open quotient, speed quotient and closed quotient across registers.

Ranjini and Savithri (2010) compared voice-quality of trained carnatic singers and beginning carnatic singers and found significant differences between the two groups for MPD, habitual frequency and base-note, range of frequencies in phonation, number of vibrato and skewness and kurtosis in singing and speech.

Thullal Art-Form

Thullal is performed with songs and the performer, with his or her dancing pose and gestures expressing the meaning of the verses. The songs are composed keeping in mind the basics of the principles of the treatise, Natyashastra. The origin of Thullal is attributed to Kunjan Nambiar, a veritable genius and one of the foremost poets of Kerala. The songs are written in simple Malayalam language and provide a direct appeal to every day life. This aspect made Thullal very popular. The word 'Thullal' connotes jumping and it is said that in Malayalam, it is a genre of poem. Thullal is classified in three different categories according to the rhythm and metre of the songs. They are Seethankan Thullal, Ottan Thullal, and Parayan Thullal. The costumes and dances of Thullal vary from one kind to another. The songs sung in the Thullal follow the tala and raga along with the use of Chaste Carnatic ragas.

Ottan Thullal has gained most popularity among the three forms of Thullals. This dance form is fastest among the three Thullal dances with a high tempo. In this form, the face of the dancer is painted in the green style Kathakali make-up. Bold red, white and bland are used. A white and red coloured cloth is worn by the performer; extensive use of ornaments made of wood, beads is prevalent in this dance form. A many-headed serpent crown with black cloth is worn by the dancer. Ottamthullal, over the centuries, has a (mostly) single actor, acting and dancing himself. The art form has of late found practitioners from among women too, and is occasionally staged as a group dance form with each artiste representing a character in the storyplay. The art form still retains its satirical touch, and lends the artiste the freedom to improvise, more so on humour. Its incidental satire makes this art form more popular among the common man.

Need for the study

Human voice is a major component in communication and voices are used to connect with others through speech and songs. Each human voice is unique like a fingerprint and voice use is culture specific-a feature that is best observed in the singing voices of different kinds of music in the world. Since there are voice problems that are unique to Indian climate and culture there is a need for new surveys to explore the science of voice in the Indian context. The focus of the present study was mainly based on ottanthullal artists, since this population has not received considerable attention on voice related research previously.

Aim of the study

The aim of the present study is to hypothesize significant differences in the acoustic characteristics of Thullal artists before and after performance sessions.

METHODOLOGY

The study aimed to hypothesize significant differences in the acoustic characteristics of voice of Thullal artists before and after performance sessions.

Subjects

The study group consisted of 13 amateur Thullal artists, 10 females and 3 males, with a mean age of 15 and 17 years respectively. The participants were artists from Kerala Kalamandalam, Deemed University for Arts and Culture, Thrissur.

Participants who were into the field for a minimum of 2 years was included in the study. Subjects who had a history of apparent speech, hearing, respiratory problems, asthma, and other ENT/voice problems were excluded from the study.

Instrument Used

Recording was done using a Smartinfocomm SH03 microphone. Sampling rate of 44100Hz was used. PRAAT software 5.1.37 version was used to extract voice related parameters.

Test Procedure

Subjects were seated comfortably in a quiet surrounding. Voice-samples were recorded before performance and after 2 hours of performance. Prior to recording, subjects were instructed to take a deep breath and phonate vowels, /a/, /i/ and /u/, at a comfortable pitch and loudness level. Three trials were taken for each vowel, and phonatory sample of longest duration was taken for acoustic analysis.

PRAAT software 5.1.37 version was used to record voice related parameters. Maximum phonation duration, Fundamental frequency (F0), F1, F2, F3, F4, Jitter(%), Shimmer(dB), Harmonics to noise ratio(dB) was determined and compared between pre- performance and post performance for statistical difference.

Data Analysis

Paired 't' test was used to compare the selected parameters of voice among Thullal artists (before and after performance). For comparison among male subjects, Wilcoxon Signed Ranks Test was used. The results are discussed in the next session.

Table 6 Shows values of acoustic parameters (F0-Fundamental Frequency, HNR-Harmonics to Noise Ratio, F1-first formant, F2-second formant, F3-third formant, F4- fourth formant) and MPD- Maximum Phonation Duration for Vowel /u/ for Pre- performance and Post- after performance of Male Thullal artists

Subject	Age	Fo		Jitter%		Shimmer%		HNR		F1		F2		F3		F4		MPD	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1.	17 yr	114	135	0.428	0.462	0.281	0.294	18.74	24.26	389	390	1158	1159	2604	2607	3867	3879	25	25
2.	17 yr	100	104	0.309	0.435	0.712	0.733	20.61	21.55	312	313	1209	1212	2622	2625	3664	3667	25	20
3.	17 yr	129	134	0.948	0.967	0.738	0.847	10.81	18.55	366	369	1490	1493	2749	2752	3898	3899	20	20
Mean		114	121	0.562	0.621	0.577	0.625	16.72	21.45	356.10	357.9	1286	1288	2658	2660	3810	3815	23.33	21.66
SD		14.38	17.32	0.340	0.300	0.257	0.292	5.20	2.85	39.87	9.342	178.82	245.07	78.79	47.62	126.81	103.98	2.88	2.88
P Value		0.109	NS	0.109	NS	0.109	NS	0.109	NS	0.109	NS	0.109	NS	0.109	NS	0.109	NS	0.317	NS

RESULTS AND DISCUSSIONS

The study aimed to hypothesize significant differences in the acoustic characteristics of Thullal artists before and after performance sessions and results are discussed below-

Results indicated significant differences of (p<0.05) among female artists for sustained phonation of /a/ (MPD, p=0.002), /i/ (MPD, p=0.002), /u/ (MPD, p=0.003) and acoustic parameters, fundamental frequency (F0) (/a/, p=0.007, /i/,p=0.006, /u/, p=0.003), jitter (%) (/a/, p=0.002, /i/, p=0.009, /u/,p=0.001) , shimmer(dB) (/a/, p=0.002, /i/, p=0.006, /u/, p=0.001) and harmonic to noise ratio(dB) (/a/, p=0.002, /i/, p=0.000, /u/, p=0.004) before and after performance sessions. No significant differences were noted for formant frequencies F1, F2, F3, and F4. Differences were also noted in male artists for MPD and acoustic parameters, although not statistically significant, which may be attributed to the small sample size.

The results for acoustic parameters (F0, Jitter, Shimmer, and HNR) and maximum phonation duration in male and female Thullal artists for pre and post performance with Mean, Standard Deviation and p- values are shown below.

Differences were noted in male artists for MPD and acoustic parameters, although not statistically significant, which may be attributed to the smaller sample size. There were no notable differences for formant frequencies before and after-performance.

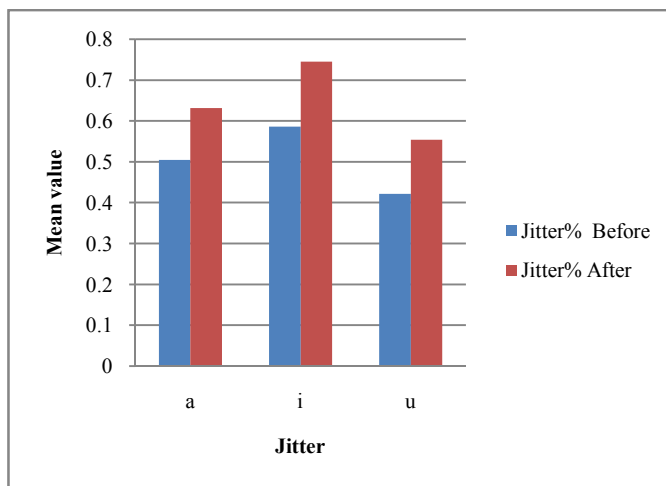


Fig 2 shows the mean values of Jitter % before and after performance of female artists.

The mean Jitter for vowels, /a/ , /i/ and /u/ before performance were 0.5046% , 0.586% and 0.4212% respectively and after performance 0.6312% , 0.7454% and 0.5539%.High-significant values were obtained for vowel /i/ as compared to /a/ and /u/.

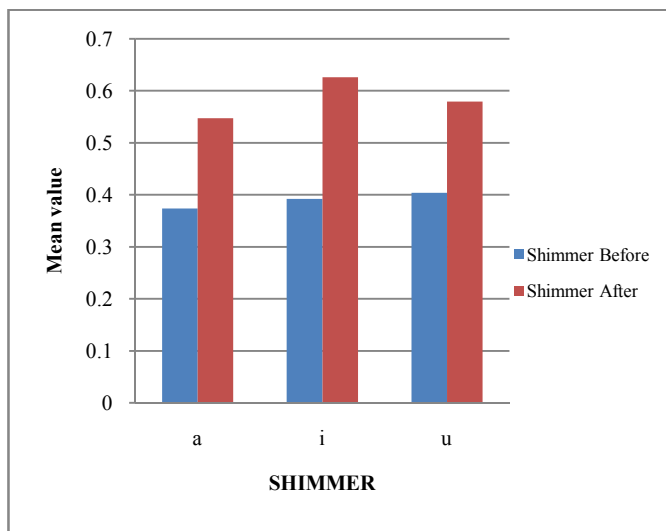


Fig 3 shows the mean values of Shimmer dB before and after performance of female artists.

The mean Shimmer (dB) for vowels , /a/ , /i/ and /u/ before performance were 0.374 ,0.392 0.404 respectively and after performance 0.547 , 0.626 and 0.579.High-significant values were obtained for vowel /i/ as compared to /a/ and /u/.

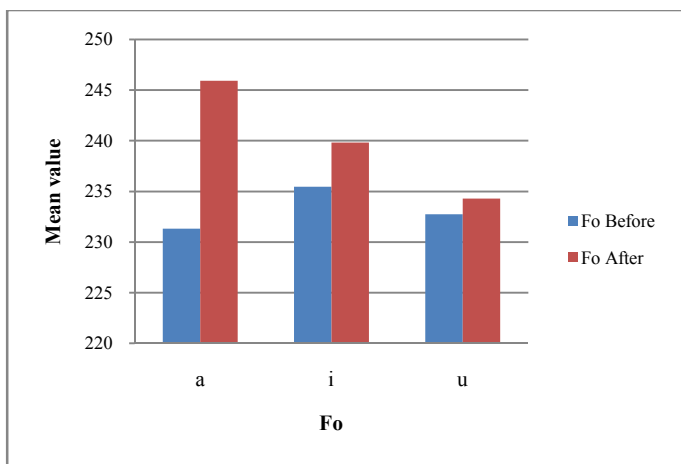


Fig 1 shows the mean values of Fo before and after performance of female artists.

The mean Fo for vowels, /a/ , /i/ and /u/ before performance were 231Hz , 235 Hz and 232Hz respectively and after performance 245Hz , 239Hz and 234Hz.High-significant values were obtained for vowel /a/ as compared to that of /i/ and /u/.

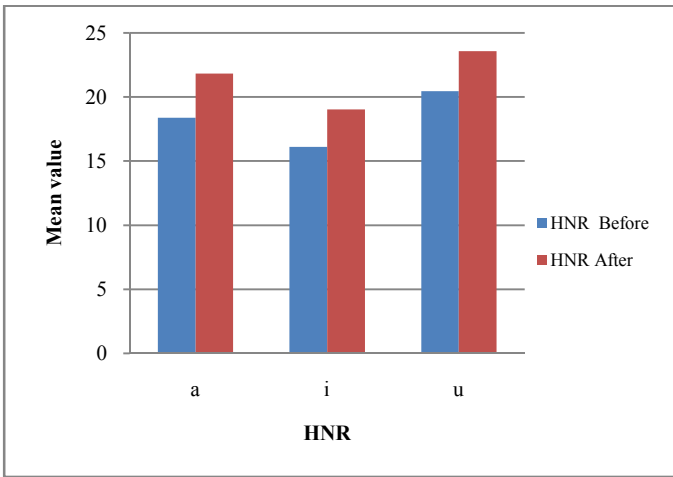


Fig 4 shows the mean values of HNR dB before and after performance of female artists

The mean HNR (dB) for vowels, /a/ , /i/ and /u/ before performance were 18.38 ,16.11 and 20.44 respectively and after performance 21.82, 19.03 and 23.56.High-significant values were obtained for vowel /u/ as compared to /a/ and /i/.

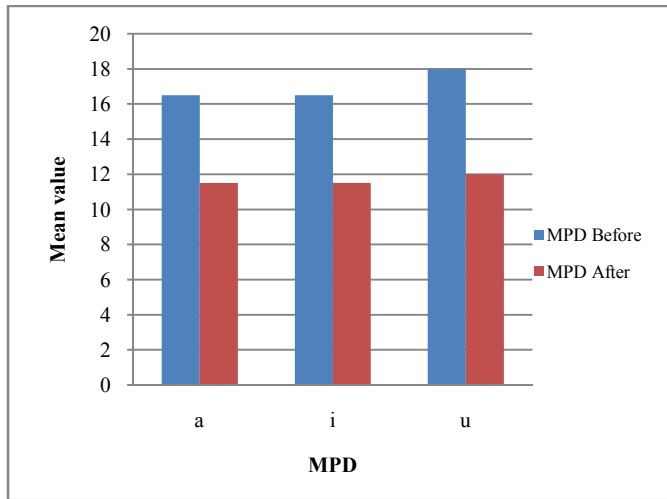


Fig 5 shows the mean values of MPD before and after performance of female artists.

The mean MPD (sec) for vowels, /a/ , /i/ and /u/ before performance were 16.5 ,16.5 and 18 respectively and after performance 11.5 , 11.5 and 12.High-significant values were obtained for vowel /u/ as compared to /a/ and /i/.

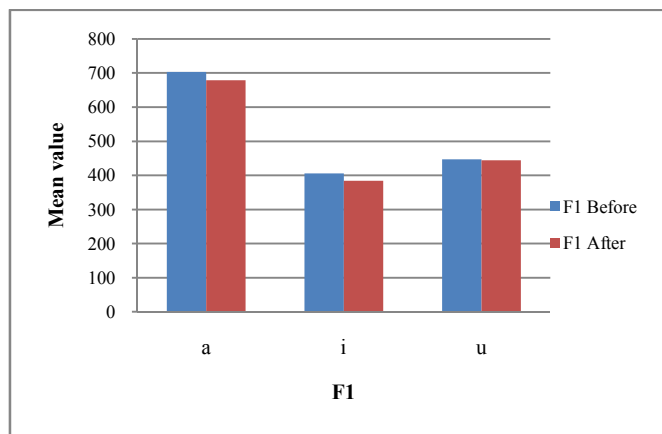


Fig 6 shows the mean values of F1 before and after performance of female artists.

The mean formant (F1) for vowels, /a/ , /i/ and /u/ before performance were 702.8Hz ,405.7Hz and 447.2 Hz respectively and after performance 679.1Hz, 384.4Hz and 444.3Hz. On comparison no significant score was seen before and after performance.

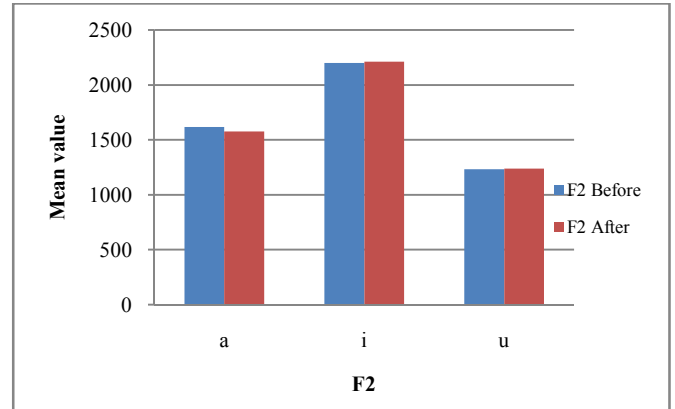


Fig 7 shows the mean values of F2 before and after performance of female artists.

The mean formant (F2) for vowels, /a/ , /i/ and /u/ before performance were 1615.9Hz, 2198.6Hz, 1233.19 Hz respectively and after performance 1575.3Hz, 2211.1Hz and 1238.6 Hz. On comparison, no significant score was seen before and after performance.

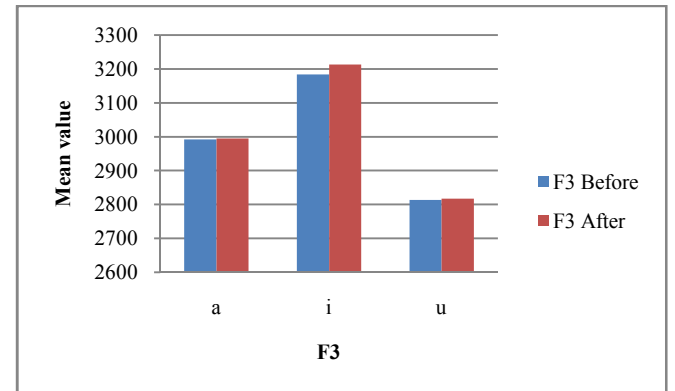


Fig 8 shows the mean values of F3 before and after performance of female artists.

The mean formant (F3) for vowels , /a/ , /i/ and /u/ before performance were 2991.6Hz , 3183.7Hz , 2813.0Hz respectively and after performance 2994.4Hz , 3213.2Hz and 2817.0 Hz.On comparison , no significant score was seen before and after performance.

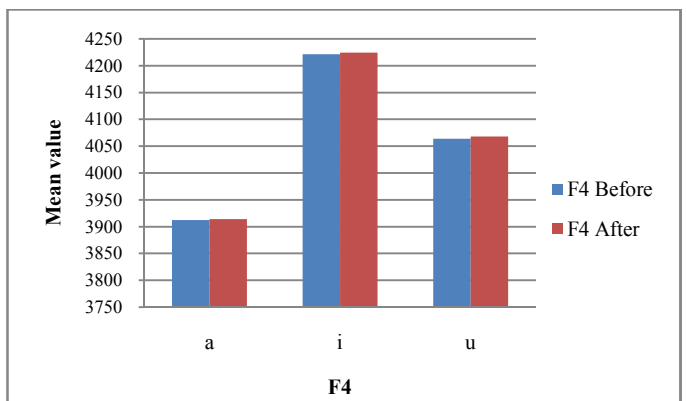


Fig 9 shows the mean values of F4 before and after performance of female artists.

The mean F3 of vowels, /a/ , /i/ and /u/ before performance were 3912.31Hz, 4221.20Hz , 4064.08Hz respectively and after performance 3914.31Hz , 4224.207Hz and 4068.169Hz. On comparison, no significant score was seen before and after performance.

DISCUSSION

The results of the above study reveals that Thullal artists are confronted by strong performance related stressors. Prolonged and continuous performances for long duration leads to hampering of the vocal-quality. Josephine and Jennifer (1994) reported that voice-projection and pitch-range were most affected when vocally fatigued, among actors and singers, due to high performance demands and high pitch volume levels. The results of the present study reveal variations in certain acoustic characteristics of voice. The finding is in agreement with the study done by William (2003) which states that PVUs are at an increased risk of having voice disorders.

SUMMARY AND CONCLUSION

The present study aimed at hypothesizing that there will be significant differences in the acoustic characteristics of voice of Thullal artists before and after performance. 13 Thullal artists, 10 females and 3 males with a mean age of 15 and 17 years respectively, participated in the study. The participants had a minimum of 2 years experience in the field.

PRAAT software 5.1.37 version was used to record voice related parameters. Task given was sustained phonation of vowels /a/, /i/ and /u/. Maximum phonation duration, Fundamental frequency (F0), F1, F2, F3, F4, Jitter(%), Shimmer(dB), Harmonics to noise ratio(dB) was determined and compared between pre- performance and post performance for statistical difference.

Significant differences were noted in acoustic characteristics of F0 , Jitter(%), Shimmer(dB), Harmonics to noise ratio(dB) in female Thullal artists. Maximum phonation duration was found to be decreased after performance. No significant differences were noted in the formant frequencies. In male Thullal artists differences were noted in the acoustic characteristics the results were not statistically significant, which may be attributed to the smaller sample size. Here too, differences were not noted in the formant frequencies.

Adequate care and preservation of voice quality is necessary among Thullal artists. Most Thullal artists leave this practiced form of art, as vocal dysfunction and voice-disorders hamper the voice quality. It is necessary to create awareness among such elite voice performers about voice disorders and facilities available for voice conservation. The above study gives an overall view about the voice characteristics of Thullal artists, which may lead to betterment in provision of treatment and counseling strategies.

Limitation of the study

1. A large sample size would have yielded more reliable result
2. Only vowels were included in the study

Future direction

1. Study can be replicated on older Thullal artists
2. Also study can be conducted incorporating more number of parameters

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