COMPARISON OF ACOUSTIC CHARACTERISTICS OF KONKANI CHOIR SINGERS AND NON-SINGERS

Voice presents an opening window to a person's personality. Voice is the primary instrument through which most of the people project their personality and influence their environment. The production of human voice includes complex series of events in the peripheral phonatory organs which are controlled by the central nervous system (Sataloff,2006).

Voice problems are typically characterized by pain or discomfort when speaking, as well as difficulty controlling pitch, loudness, or quality of voice. As you exhale, air flows gently through your throat, across your open vocal cords, and moves out through mouth and nose. It primarily affects one's ability to speak normally. The voice may quiver, sound strained and hoarse. When speaking, an individual may experience pain or a lump in the throat.

An individual who relies on their voice in order to carry out their job is regarded as professional voice users. Professional voice users are singers, teachers, actors, broadcasters, coaches (Lions voice clinic,2003). The most common vocal symptoms seen in professional voice users are Muscle tension dysphonia, vocal fold lesions (e.g., nodules and polyps), cysts, vocal fold scarring, changes in vocal fold mobility, and age-related users (Franco and Andrus, 2007).

The vocal fatigue conditions and vocal nodules are common among various voice users such as singers, teachers and drill sergeants (Hogikyan, Appel, Guinn and Haxer, 1999).

Individuals must maintain a healthy lifestyle and follow a proper diet in order to take care of their voice. It includes staying hydrated and using your voice appropriately.

In order to identify the pathology and provide the best intervention, various means of analysis of voice are developed by different researchers, such as acoustic analysis, aerodynamic analysis, psychoacoustic evaluation etc. Acoustic analysis of voice is the most popular and non-invasive vocal assessment method which is used extensively in dealing with voice of professional voice users and others for voice diagnosis, therapy and research. By analyzing vowel sounds, it helps us to understand fundamental frequency (F0), intensity and the filter characteristics (formant frequencies, jitter, shimmer etc). Parameters of voice production includes pitch, MPD, maximum to minimum intensity at various pitches, jitter, noise and resonance. The various acoustic parameters most commonly used in acoustic analysis of voice are fundamental frequency, jitter, shimmer and harmonic to noise ratio (HNR) and noise to harmonic ration (NHR).

Fundamental frequency is the number of cycles produced by vocal folds per second. It is the result of interactions among the vocal fold length, mass and tension during speech (Morris and Brown, 1996). Average adult male will have a fundamental frequency of 100-160 Hz and adult female from 220-290 Hz. During sustained vibration, vocal folds exhibit slight variation of frequency from cycle to cycle. This phenomenon is called as jitter. Patients with pathologies often have jitter percentage greater than 1 or 2%. Shimmer is the cycle-to-cycle variation in the amplitude (component) of fundamental frequency. It measures and describes the voice quality. Patients with pathologies have a shimmer greater than 3%. Harmonic to noise ratio (HNR) characterizes the relationship between two components of acoustic wave of a sustained vowel; the periodic components and non-periodic components of speech sounds. Noise to harmonic ratio (NHR) and HNR measures are inversely proportional values that assess the presence of noise in a voice signal. They are directly related with voice quality.

According to Stemple, Glaze, Gerdeman and Klaben (1995), vocal professionals by the very nature of their occupations are more likely to experience voice problems and laryngeal pathologies than the general population. The demand on an individual's vocal system depends on the kind of occupation one is engaged in. Vocal professionals, especially those in the speaking profession require certain qualities in their speech to be successful in their profession such as good pitch range, rhythm, melody, fluency, phrasing, emphasis, modulation & good expiratory breath to sustain speech.

Choir singing is an important traditional form of worship in India. It is mostly performed in religious settings, schools, and communities by a group of untrained who learn to sing through observation and feedback from other singers. To match a singing group, significant variations in frequency and intensity are required, which puts more strain on the respiratory and phonatory systems and requires coordination between two subsystems. These variations in frequency and intensity may go beyond optimal capacity, causing damage to speech subsystems resulting in voice disorders.

Ravi, Shabnam, George and Saraswathi (2015) did a study on the acoustic characteristics of choir singers by comparing 20 choir singers (10 males and10 females) and 20 non-singers (10 males and 10 females) in the age range of 20-30. The voice samples were recorded and analyzed using the PRAAT software and results showed that female groups showed higher F0 in singers than non-singers, higher jitter, shimmer and NHR values for non-singers compared to singers. Acoustic analysis of male groups revealed higher F0 in singers than non-singers, higher shimmer and NHR values for non-singers than singers. And aerodynamic analysis for male and female groups revealed higher vital capacity, forced vital capacity, and slow vital capacity in singers than non-singers

Ravell and Simberg (2020) investigated the prevalence of vocally harmful behaviors in 350 english choir singers. The results showed that choir singers with vocally demanding profession reported several frequently occurring symptoms with significant relation with number of other health related risk factors. Overall voice knowledge among choir singers is limited.

There are few or very limited studies done on Konkani choir singers on the acoustic characteristics of voice. Hence, the present study attempts to compare the acoustic characteristics of konkani choir singers and non-singers and also between genders. Based on the results they can be referred for further assessment and intervention of voice related problems in them.

REVIEW OF LITERATURE

The human voice is not only the key to human communication but also serves as the primary musical instrument (Benninger, 2011). Voice is the laryngeal modification of the pulmonary airstream which is further modified by the configuration of vocal tract.

An occupational or a professional voice user is anyone whose voice is essential to their job. Professional voice users not only include teachers, actors, lawyers but also salespersons, telemarketers, receptionists, choir singers and other professions that rely heavily on the voice. A voice disorder is characterized by the abnormal production and/or absence of vocal quality, pitch, loudness, resonance, and/or duration, which is inappropriate for an individual's age, cultural background or geographic location. Due to the inappropriate usage of speech production system, occupational and professional voice users are at great risk for developing voice disorders. A voice disorder can have a significant negative impact on their career and quality of life. (Verdoloni and Ramig,2001).

Like other professional voice users choir singers are a group of untrained singers who sing together in a chorus of voices, at religious places, schools and community. They learn singing through observation and feedback from other fellow singers. For a choir singing to sound pleasant, each individual must sing at a same frequency and intensity to match the entire singing group. The role of a solo singer differs from that of a choir singer. A solo singer focuses on being clearly heard, whereas a choir singer focuses on contributing and blending (Ravell and Simberg,2020)

Acoustic analysis of voice has been used extensively for examining voice disorders, to compare voices to differentiate them into normal and abnormal and identify voice characteristics like pitch, loudness, hoarseness. It helps clinicians to have a quantifiable baseline for treatment follow-up. Other common objective voice measures can be derived from perceptual and electrographic assessments. Standard acoustic analysis consists of several basic acoustic measures. The acoustic measures are fundamental frequency, intensity, perturbation measures such as jitter and shimmer, and spectral based measures such as harmonics-to-noise ratio and noise to harmonic ratio. Acoustic parameters most commonly measured are fundamental frequency (F0),

perturbation measures (jitter and shimmer), harmonic to noise ratio (HNR) (Felippe, Grillo and Grechi,2006).

Fundamental frequency (F0) is total number of cycles produced by the vocal folds per second. It is the result of interactions among the vocal fold length, mass and tension during speech (Morris and Brown, 1996). It measures how high or low a person's voice sounds. Among acoustic parameters, F0 is the most uniform and less sensitive to voice recording characteristics (Carson, Ingrisano and Eggleston, 2003). It varies with gender, age, and vocal folds condition. The average F0 in normal adult male is 100-160Hz and adult female is 120-290 Hz. Children and babies have an even higher F0. F0 alone does not adequately describe many subtle aspects of voice disorders. Other finer acoustic measures of vocal quality, such as jitter, shimmer, and harmonics-to-noise ratio, are calculated using fundamental frequency (Parsa and Jamieson, 1999).

During sustained vibration, the vocal folds exhibit slight variation of frequency and amplitude from cycle- to- cycle. This phenomenon is called frequency perturbation (Jitter It is the measure of perturbation in the vibration which is opposed to shimmer. (Wang and Huang, 2004). The higher the jitter, the more abnormal voice sounds. High jitter (in excess of 1 or 2%) can be caused by a number of conditions that affect the vocal cords, including nodules, polyps, and weakness of the laryngeal muscles.

Shimmer is the cycle-to-cycle variation in the amplitude (vertical) component of fundamental frequency (Baken and Orlikoff, 2000). Shimmer, like jitter, is a finer component of the fundamental frequency. It reflects the subglottic air pressure component of the voice production. When one tries hard to sing a particular note and keep it constant, there will always be slight variations in its loudness over time. In a similar way to jitter, shimmer is calculated by measuring the change in loudness, or amplitude, over several sound waves generated by the vibration of the vocal cords. An increased shimmer (above 3%, for instance) can be the result of a number of conditions that affect the vocal cords, including nodules, polyps, and weakness of the laryngeal muscles.

Harmonic to Noise Ratio (HNR) characteristics the relationship between two components of acoustic wave of a sustained vowel: the periodic component, vocal fold regular sign and the additional noise coming and vocal tract (Ferrand, 2002). It correlates with perception of vocal roughness (Woodson and Cannito,1998). It has become

increasingly important in acoustic analysis to diagnose pathological voices (Fernandes and Texeira,2018). Noise to Harmonic ratio (NHR) is average ratio of energy of the harmonic components in the range 1500-4500 Hz to the harmonic components energy in the range 70-4500 Hz. It is a general evaluation of the noise present in the vocalization.

A higher HNR indicates high quality periodic signal, commonly seen in normal voice quality. Dysphonia increases the noise components of the signal resulting in lower HNR. PRAAT declares that a healthy voice phonating /a/ or /i/ should have a HNR of 20, and 40 for the phonation of /u/ vowel. HNR below 20 is an indication of noticeable hoarseness.

There are many computer based softwares available for the voice analysis such as PRAAT, Dr Speech, Multi Dimensional Voice Profile (MDVP) which help in providing a comprehensive report for voice quality assessment using acoustic parameters. These softwares have been studied extensively and are being used increasingly to describe various vocal conditions in research and clinical environments. In our current study we have used PRAAT software to compare the acoustic characteristics in Konkani choir singers and non-singers.

Goldman (2004) reported that PRAAT is designed to cater for different needs with easy interface, many default options to learn by trying, searchable manual, and various possibilities of analysis, manipulation and labeling.

WESTERN STUDIES

Brown, Rothman & Sapienza (2000) investigated perceptual and acoustic study of professionally trained vs untrained voice when speaking and singing on 20 professional singers and 20 non-singers by sustaining a vowel, reading modified rainbow passage and singing. Acoustic measures included F0, duration, jitter%, shimmer %, NHR and determination of presence or absence of both vibrato and singer's formants. Results indicated that acoustic parameters differentiated singers from non-singers within sex, no significant differences were found across males or females for either speaking or singing. The most consistent differences were the presence or absence of the singer's vibrato and formant in the singers versus the non-singers respectively. Perceptual analysis indicated that

singers could be correctly identified with greater frequency than by chance alone from their singing, but not their speaking utterances.

Mendes, Brown, Rothman & Christine (2004) investigated selected acoustic cues in the speaking voices of 14 professional singers (12 females and 2 males) in the age range (17-20 years) by sustaining vowels and reading the rainbow passage. Acoustic parameters chosen were speaking fundamental frequency (SFF). jitter, shimmer, and HNR. Results showed that as SFF increased, jitter and shimmer decreased.

Redher & Behlau (2008) evaluated the acoustic voice quality using Dr speech in 100 choir conductors (males and females) based on the production of a sustained vowel during singing and when speaking to observe auditory and acoustic differences between genders. The results suggested that most choir conductors have adapted voices showing more alterations in their speaking voices. Acoustic analysis showed different values between genders. F0 was higher in singing voice and first formant, second formant presented lower values in singing voice, with statistically significant results for women.

Mohseni & Sandoughdar (2016) evaluated the acoustic parameters in Iranian female teachers and compared with non-teachers. 90 Iranian female elementary teachers, of age range 30-50 years old, and 90 Iranian female non-teachers in the same age were assessed, the difference measures of F0, jitter, shimmer, HNR and maximum of phonation time (MPT) between two groups were investigated. Results showed higher F0 in teachers (210.03Hz) than non-teachers (194.11 Hz; p<0.001) and the values of perturbation measures were greater in teachers (jitter 0.32% and shimmer 4.63%) than those in control group (jitter 0.22% and shimmer 3.15%; p<0,001), but in HNR and MPT values, non-teachers showed higher levels (p<0.001). HNR values in teachers was (18.84+1.56) but it was (21.3+1.73) in non-teachers and MPT value in teachers was (16.83+3.65) and in non- teachers it was (22.5+5.2).

Genilhu & Gama (2018) investigated the acoustic and aerodynamic measures between male and female singers among 30 males and 30 females.Results indicated that women presented higher values of F0 when compared with those of men. No differences were identified in evaluation of aerodynamic measures between groups.

Ravell & Simberg (2020) investigated the prevalence of vocally harmful behaviours in 350 choir singers. The results showed that choir singers with vocally

demanding profession reported several frequently occurring symptoms with significant relation with number of other health related risk factors. Overall voice knowledge among choir singers is limited.

Tepe, Deutsch, Sampson & Reiley (2022) determined vocal patterns in young choir singers and to correlate vocal problems with demographic and behavioural information. A questionnaire on vocal habits and hygiene was given to 571 young choir singers. The results revealed that voice difficulties such as chronic fatigue, hoarseness are common among them. Results suggested that choral conductors must be given choral educational strategies to develop the incidence of voice disorders.

INDIAN STUDIES

Bhoomithan (2005) identified vocal and non-vocal habits of Indian light music singers. Results showed that singers experienced more difficulty in manipulating low and high pitches. With respect to the habits, most studies have reported that the Indian singers consume spicy food, hot/cold food items, tobacco intake and exhibit throat clearing behaviors.

Devdas, Usha, Rajashekar Aithal & Venkataraja (2009) analyzed the voice parameters in yakshagana singers (Bhagavata). Results revealed that Bhagavatas had a higher fundamental frequency and lower MPD than non-singing counterparts, and laryngeal examination revealed symptoms of vocal abuse in bhagavatas

Prakup (2011) examined whether differences in acoustic measures of fundamental frequency (F0), jitter, shimmer and intensity of amateur singers and non-singers. Acoustic measurements were obtained in 60 singers (30 male and female singers, 30 male and female non singers). Participants were asked to phonate the vowel /a/. Results indicated that significant differences were found between male and female non singers regarding jitter and intensity, with singers displaying less jitter than non -singers

Maruthy & Ravibabu (2014) compared dysphonia severity index (DSI) and its parameters between female carnatic classical singers and non-singers and also investigated the effect on DSI and its parameters in both singers and non-singers. 30 singers were compared with 30 age and gender matched non-singers. Results indicated that singers had significantly greater highest phonational frequency, longer maximum phonation time, and higher DSI values than non-singers

Ravikumar, Bhoominathan & Mahalingam (2014) analyzed the nature of voice problems and apply a routine protocol to assess voice in 36 males and 9 female carnatic singers. Results revealed that voice change, difficulty singing higher pitches and vocal fatigue were major complaints. Most singers suffered laryngopharyngeal reflux that co-existed with muscle tension dysphonia and chronic laryngitis.

Ravi, George Shabnam & Saraswathi (2018) investigated and compared the acoustic and aerodynamic characteristics of 20 choir singers and 20 non singers in the age range of 20-30 years with no vocal pathology. Results from acoustic analysis of female groups indicated higher F0 in singers than non-singers, higher jitter, shimmer and NHR values for non- singers compared to singers and from the acoustic analysis of male groups revealed significantly higher F0 in singers than non-singers and higher shimmer and NHR values for non- singers compared to singers. Results from aerodynamic analysis for male and female groups revealed higher vital capacity, forced vital capacity, and slow vital capacity in singers than non-singers.

Kakulkar, Ravi & Gunjawate (2021) aimed to profile voice-related complaints, as well as vocal and non-vocal habits among 61 Hindustani classical singers. The results showed that 41% of singers reported atleast three vocal symptoms. The most common vocal symptoms included excessive phone use, Loud coughing, sneezing, throat clearing and excessive speaking. High consumption of caffeinated beverages and spicy food was also reported

Sharma, Nayak & Devdas (2021) did a survey on vocal health in 148 church choir singers. Eighty-four percent of the choir singers reported two or more vocal symptoms sometimes or more frequently while or after singing. More than half of the church choir singers had experienced vocal symptoms such as accessing notes in the upper range, loss of vocal endurance, pitch breaks, hoarseness, dryness and discomfort in the throat. Among the different variables, systemic hydration found to have a significant association with reporting of voice problems in church choir singers. The overall knowledge regarding the factors influencing vocal health was found to be limited.

NEED FOR THE STUDY

From the above literature, it can be summarized that acoustic analysis of Voice in

professional voice users like yakshagana singers, radio jockey, dubbing artists, female evangelists, thullal artists, news broadcasters etc were assessed in different languages; including kannada. Few or limited studies were carried out to assess acoustic characteristics of voice in konkani choir singers. Choir singers are also professional voice users who sing in church choir groups. Hence the aim of the current study is to compare acoustic characteristics of Konkani choir singers and non-singers and to rule out if gender differences are there in acoustic parameters between male and female konkani choir singers and non-singers. The results of the present study will help speech language pathologists to create awareness in choir singers and non-singers regarding voice problems because of vocal abuse and they can be referred for further voice assessment and intervention for voice related problems.

METHOD

AIM:

The aim of the present study was to compare the acoustic characteristics of Konkani choir singers and non-singers and to know if there is gender differences in voice characteristics in Konkani choir singers and non-singers.

PARTICIPANTS:

A total of 30 choir singers (15 males and 15 females) and 30 non singers (15 males and 15 females) volunteered to participate in the study. All participants were in the age range of 20-35 years. The Choir singers have a singing experience of 5-8 years.

PARTICIPANTS SELECTION:

Inclusion criteria:

- Participants with age range of 20-35 years.
- Participants who are in choir singing for more than 6-8 years.

- Participants with no complaints of voice problems, upper respiratory tract infection, allergies and respiratory dysfunction.

- No history of oromotor, communicative or cognitive impairments.

Exclusion criteria:

- Participants with any neurological involvement, articulatory deficits and any speech, language and hearing impairment.

- Participants who have undergone vocal surgeries.

EQUIPMENT

PRAAT software (version 6.1.16) was used to record the voice samples. The acoustic parameters chosen for the present study were fundamental frequency, jitter %, shimmer %, Harmonic to Noise Ratio (HNR) and Noise to Harmonic Ratio (NHR).

PROCEDURE

The data was collected as follows:

For acoustic analysis of voice, participants were instructed to be seated comfortably and recordings were made using a microphone attached to Acer Laptop in a quiet environment. The placement of microphone was 3 cm away from mouth of the participants. Participants were asked to take a deep breath and produce a sustained phonation of /a/ vowel at a comfortable pitch and loudness for as long as possible. This was demonstrated by examiner for all participants.

ANALYSIS

The data was subjected to statistical analysis to determine the significant differences. Independent sample "t" test was used to find significant differences for the two groups. Data was analyzed using the SPPS software (SPPS Inc: Chicago, IL) version 26.0.

RESULTS AND DISCUSSION

The present study aimed to compare the acoustic characteristics of Konkani choir singers and non-singers in males and females and to compare the acoustic characteristics between genders in Konkani choir singers and non-singers by analyzing voice parameters such as Fundamental frequency (F0), Jitter%, Shimmer%, Harmonic to noise ratio (HNR) and Noise to harmonic ratio (NHR). PRAAT voice analysis software was used to record the phonation of a vowel /a/. The results obtained were statistically analyzed and the results are as follows:

Table 4.1:

Showing the mean and SD scores of Konkani choir singers and non-singers in male and female groups.

			Mean	S.D.	"t"	p value	Significance
Male	Fundamental frequency	Choir singers	150.06	9.44	5.338	< 0.001	S
		Non singers	131.81	9.29			
	Jitter%	Choir singers	0.31	0.13	-3.722	0.001	S
		Non singers	0.51	0.17			
	Shimmer%	Choir singers	2.30	0.58	-4.398	< 0.001	S
		Non singers	3.17	0.50			
	HNR	Choir singers	16.95	3.32	2.937	0.007*	S
		Non singers	13.81	2.47			
	NHR	Choir singers	0.03	0.02	-4.49	< 0.001	S
		Non singers	0.06	0.02			
Female	Fundamental frequency	Choir singers	222.16	8.13	1.772	0.153	NS
		Non singers	218.58	7.51			
	Jitter%	Choir singers	0.37	0.12	-1.013	0.320	NS

		Mean	S.D.			
	Non singers	0.42	0.14			
Shimmer%	Choir singers	2.10	0.32	0.726	0.936	NS
	Non singers	2.17	0.42			
HNR	Choir singers	17.50	3.88	0.636	0.530	NS
	Non singers	16.45	5.11			
NHR	Choir singers	0.04	0.02	-1.689	0.102	NS
	Non singers	0.05	0.03			

*S- Significant, NS – Non Significant

The above table 4.1 reveals there is significant difference for all the acoustic parameters (F0, Jitter, Shimmer, HNR and NHR) in male choir singers and male non-singers and no significant difference were observed for any of the acoustic parameters in female choir singers and female non-singers.

Comparison of acoustic characteristics of Konkani choir singers and non-singers

Table 4.2:

Showing the mean and SD value for F0, jitter, shimmer, HNR and NHR in male Konkani choir singers and non-singers.

Acoustic Parameters	Male	Mean	S.D.	"t"	p value	Significance
Fundamental Frequency	Choir singers	150.06	9.44	5.338	< 0.001	S
	Non singers	131.81	9.29			
Jitter %	Choir singers	0.31	0.13	-3.722	0.001	S
	Non singers	0.51	0.17			
Shimmer %	Choir singers	2.30	0.58	-4.398	< 0.001	S
	Non singers	3.17	0.50			
HNR	Choir singers	16.95	3.32	2.937	0.007*	S
	Non singers	13.81	2.47			
NHR	Choir singers	0.03	0.02	-4.49	< 0.001	S
	Non singers	0.06	0.02			

Table 4.2 shows that there is significant differences in all acoustic parameters among male Konkani choir singers and non-singers for phonation of a vowel /a/.

Table 4.3:

Showing the mean and SD value for F0, jitter, shimmer, HNR and NHR in female Konkani choir singers and non-singers

Acoustic Parameters	Female	Mean	S.D.	"t"	p value	Significance
Fundamental Frequency	Choir singers	222.16	8.13	1.772	0.153	NS
	Non singers	218.58	7.51			
Jitter %	Choir singers	0.37	0.12	-1.013	0.320	NS
	Non singers	0.42	0.14			
Shimmer %	Choir singers	2.10	0.32	0.726	0.936	NS
	Non singers	2.17	0.42			
HNR	Choir singers	17.50	3.88	0.636	0.530	NS
	Non singers	16.45	5.11			
NHR	Choir singers	0.04	0.02	-1.689	0.102	NS
	Non singers	0.05	0.03			

Table 4.3 reveals that significant differences was not found in any of the acoustic parameters among female Konkani choir singers and non-singers for phonation of a vowel /a/.

Comparison of acoustic parameters between genders in Konkani choir singers and non-singers.

Table 4.4:

Showing the mean and SD values of male and female Konkani choir singers

Acoustic Parameters	Choir singers	Mean	S.D.	"t"	p value	Significance
Fundamental Frequency	Male	150.06	9.44	-22.419	< 0.001	S
	Female	222.16	8.13			
Jitter %	Male	0.31	0.13	-1.374	0.180	NS
	Female	0.37	0.12			

Shimmer %	Male	2.30	0.58	1.188	0.245	NS
	Female	2.10	0.32			
HNR	Male	16.95	3.32	-0.422	0.676	NS
	Female	17.50	3.88			
NHR	Male	0.03	0.02	-0.941	0.355	NS
	Female	0.04	0.02			

The above table 4.4 shows that there is no significant difference observed in any of the acoustic parameters except F0 in male and female Konkani choir singers for the phonation of a vowel /a/.

Table 4.5:

Showing the mean and SD values of male and female Konkani non-singers.

Acoustic parameters	Non-singers	Mean	S.D.	"t"	p value	Significance
Fundamental Frequency	Male	131.81	9.29	-18.217	< 0.001	S
	Female	208.57	13.42			
Jitter %	Male	0.51	0.17	1.611	0.118	NS
	Female	0.42	0.14			
Shimmer %	Male	3.17	0.50	4.107	< 0.001	S
	Female	2.47	0.42			
HNR	Male	13.81	2.47	-1.803	0.082	NS
	Female	16.45	5.11			
NHR	Male	0.06	0.02	1.057	0.300	NS
	Female	0.05	0.03			

On examining Table 4.5 the acoustic parameters of male and female non-singers reveals that significant difference was noted in F0 and shimmer only for the phonation of a vowel /a/.

DISCUSSION

Professional voice users are those individuals who rely solely on vocal communication for a living. Professional voice users are singers, teachers, actors, broadcasters, coaches (Lions voice clinic,2003). Another important professional voice users are choir singers.

The aim of this study was to compare the acoustic characteristics between konkani choir singers and non-singers and the results of the current study revealed higher F0 in

male choir singers than non-singers. Lower jitter and shimmer values was obtained in male choir singers than non-singers. Higher HNR and lower NHR in male choir singers and lower HNR and higher NHR in male non singers. In female groups higher F0 was obtained in choir singers than non-singers, lower jitter and shimmer values was obtained in choir singers than non-singers. Higher HNR and lower NHR in choir singers and lower HNR and higher NHR in non-singers which are in accordance with the study by Ravi, Shabnam and Saira (2018) which showed similar findings in Kannada choir singers. Similar results were reported by Brown, Rothman and Sapienza (2000) who reported that acoustic parameters did differentiate professional trained western singers from non- singers.

When comparing the gender differences in acoustic parameters of voice between male and female konkani choir singers and non-singers, results revealed that F0 was higher in female choir singers than male choir singers and no changes in other acoustic parameters like jitter, shimmer HNR and NHR. Higher F0 in female choir singers is seen in the current study is in accordance with the results obtained by Genilhu and Gama (2018). When acoustic characteristics in male and female non- singers were compared it showed higher F0 was seen in females than male non singers and no changes in other parameters like jitter, shimmer, HNR and NHR.

To conclude, acoustic analysis is an effective tool in comparing choir singer's voices and distinguishing them from normal voices to identify any changes in vocal characteristics. Therefore, utilizing acoustic analysis will help SLP's assessing any changes in their voice, create awareness in them to prevent voice disorders.

SUMMARY AND CONCLUSION

Voice is the primary instrument through which most of the people project their personality and influence their environment. Production of human voice includes complex serious of events in the peripheral phonatory organs which are controlled by the central nervous system. The vibration of vocal folds is an essential event for voice production (Sataloff,2006)

The current study aimed at comparing the acoustic characteristics of Konkani choir singers and non -singers in males and females and to compare the acoustic characteristics between genders in Konkani choir singers and non -singers. Participants

chosen in the study were 30 choir singers (15 males, 15 females) and 30 non singers (15 males,15 females) in the age range of 20-35 years. All the choir singers had a singing experience of more than 5-8 years.

For acoustic analysis of voice, all the participants were asked to phonate /a/ in a quiet environment and were recorded. PRAAT software 6.1.16 version was used to extract voice related parameters. The acoustic parameters selected in our study were fundamental frequency (F0) jitter%, shimmer%, HNR and NHR.

The results of the current study revealed higher F0 in male choir singers than non-singers. Lower jitter and shimmer values was obtained in male choir singers than non-singers. Higher HNR and lower NHR in male choir singers and lower HNR and higher NHR in male non singers. In female groups higher F0 was obtained in choir singers than non-singers, lower jitter and shimmer values was obtained in choir singers than non-singers. Higher HNR and lower NHR in choir singers and lower HNR and higher NHR in non-singers.

When comparing acoustic parameters between male and female konkani choir singers results revealed that F0 was higher in female choir singers than male choir singers and no changes in other acoustic parameters like jitter, shimmer HNR and NHR When male and female non-singers were compared, higher F0 was seen in females than male non-singers and no changes in other parameters like jitter, shimmer, HNR and NHR.

The current study emphasized on the importance of acoustic analysis to compare the voice of choir singers and to differentiate them from normal voice. Therefore, Konkani choir singers and non-singers must be aware of the voice problems that they might face due to the over usage of voice which can result in voice disorders. They should undergo systematic vocal assessment utilizing acoustic characteristics to examine the voice changes and also for any vocal intervention. The study by Ravell and Simberg (2020) on prevalence of voice disorders and voice knowledge among choir singers reveals choir singers with vocally demanding profession are at a higher risk for developing voice disorders indicating that choir singers have limited knowledge about the importance of vocal hygiene. Hence SLP's should conduct vocal hygiene awareness programs among singers and non-singers to increase their knowledge on the use of voice and the dos and don'ts of good vocal health which helps in better prevention.

LIMITATIONS OF THE STUDY

- Limited sample size
- Study was only conducted in age group of 20-35 years.

FUTURE DIRECTIONS

- Sample size can be increased
- Aerodynamic analysis in Konkani choir singers can be done in the same age group
- Study can be done in other age groups
- Studies can be done in choir singers who have more than 10 years of singing experience.

REFERENCE

Arunachalam, R., Boominathan, P., & Mahalingam, S. (2014). Clinical voice analysis Carnatic singers. *Journal of Voice*, *28*(1), 128-e1. https://doi.org/10.1016/j.jvoice.2013.08.003

Baken & Haskel (2001). Acoustic parameters of trained singers perceptually identified from speaking samples. *Journal of voice*, *15*(1), 25-35. https://doi.org/10.1016/S0892-1997(01)00004-2

Behrman, A., & Orlikoff, R. F. (1997). Instrumentation in voice assessment and treatment: what's the use?. *American Journal of Speech-Language Pathology*, *6*(4), 9-16. https://doi.org/10.1044/1058-0360.0604.09

Benninger, M. S. (2011). The professional voice. *The Journal of Laryngology & Otology*, *125*(2), 111-116. https://doi.org/10.1017/S0022215110001970

Boominathan, P., & Ravi, S. (2005). A profile of vocal and non-vocal habits in Indian Light Music Singers. *J ITC Sangeet Res Acad*, *19*, 1-12.

Brown Jr, W. S., Rothman, H. B., & Sapienza, C. M. (2000). Perceptual and acoustic study

of professionally trained versus untrained voices. *Journal of Voice*, *14*(3), 301-30

https://doi.org/10.1016/S0892-1997(00)80076-4

Carson, C. P., Ingrisano, D. R. S., & Eggleston, K. D. (2003). The effect of noise on

computer-aided measures of voice: a comparison of CSpeechSP and the Multi-

Dimensional Voice Program software using the CSL 4300B Module and Multi-

Speech for Windows. *Journal of Voice*, *17*(1), 12-20.

https://doi.org/10.1016/S0892-1997(03)00031-6

Clara Naufel., de Felippe., Maria Helena Marotti Martelletti Grillo & Thaís Helena Grechi

(2006), 72(5):659-64 *Brazilian Journal of Otorhinolaryngology*

https://doi.org/10.1590/S0034-72992006000500013

De Felippe, A. C. N., Grillo, M. H. M. M., & Grechi, T. H. (2006). Standardization of

acoustic measures for normal voice patterns. *Brazilian Journal of*

Otorhinolaryngology, *72*(5),659-664.

https://doi.org/10.1590/S0034-72992006000500013

Devdas, Usha., Rajashekar, B Aithal & Venkataraja U (2009). Analysis of Voice in

Yakshagana Singers. *Journal of All India Institute of Speech and Hearing*

(JAIISH),28. pp. 59-64

Fernandes, J. F., Teixeira, F. L., Guedes, V., Candido Junior, A., & Teixeira, J. P. (2018).

Harmonic to noise ratio measurement-selection of window and length.

In *International Conference on ENTERprise Information Systems* (Vol. 138, pp.

280-285). Elsevier.

https://doi.org/10.1016/j.procs.2018.10.04

Ferrand, C.T (2002). Harmonics-to-noise ratio: an index of vocal aging. Journal of Voice

16(4):480-7

https://doi.org/10.1016/S0892-1997(02)00123-6

Franco, R. A., & Andrus, J. G. (2007). Common diagnoses and treatments in professional

Voice users. *Otolaryngologic Clinics of North America*, *40*(5), 1025-

1061.https://doi.org/10.1016/j.otc.2007.05.008

Genilhú, P. F. L., & Gama, A. C. C. (2018). Acoustic and aerodynamic measures in singers: a comparison between genders. In *Codas* (Vol. 30, No. 5, pp. e20170240-e20170240*).* https://doi.org/10.1590/2317-1782/20182017240

Jean Phileppe (2004) http://latterie.unige.ch/phonjetique/easy align/tutorial praat

Joseph C, Stemple., Leslie E Glaze, Bernice K., & Gerdeman (1995)- Clinical voice pathology: Theory and management

Karulkar, R. R., Ravi, R., & Gunjawate, D. R. (2021). Voice-related complaints and vocal and nonvocal habits of Hindustani classical singers: a questionnaire-based study. *Logopedics Phoniatrics Vocology*, *46*(4), 149-154. https://doi.org/10.1080/14015439.2020.1788158

Lions voice clinic- University of Minnesota- Med.umn.edu/ent/patient-edu/lions-voice-clinic/about-the-voice/you-and-your-voice

Maruthy, S., & Ravibabu, P. (2015). Comparison of dysphonia severity index between younger and older carnatic classical singers and non-singers. *Journal of Voice*, *29*(1), 65-70. https://doi.org/10.1016/j.jvoice.2014.05.001

Mohseni, R., & Sandoughdar, N. (2016). Survey of voice acoustic parameters in Iranian female teachers. *Journal of Voice*, *30*(4), 507-e1 https://doi.org/10.1016/j.jvoice.2015.05.020

Morris, R. J., & Brown, W. S. J.(1996). Comparison of various automatic means for measuring mean fundamental frequency. Journal of Voice,10(2)159-65. https://doi.org/10.1016/S0892-1997(96)80043-9

N D Hogikyan , S Appel., L W Guinn, & M J Haxer (1999).Vocal fold nodules in adult singers: regional opinions about etiologic factors, career impact, and treatment. A survey of otolaryngologists, speech pathologists, and teachers of singing voices. (1):128-42 doi: 10.1016/s0892-1997(99)80067-8

Parsa & Jamiesson N. (2016). Acoustic parameters among singers. *Journal of Voice*, *30*(4), 507-e1 https://doi.org/10.1016/j.jvoice.2015.05.020

Prakup B. (2012). Acoustic measures of the voices of older singers and non-singers. *Journal of Voice*, *26*(3), 341-350. https://doi.org/10.1016/j.jvoice.2011.05.007

Ramon A, Franco MD, Jennifer G & Andrus MD(2007). Common Diagnoses and Treatments in Professional Voice Users https://doi.org/10.1016/j.otc.2007.05.008- *vol 40, issue 5, Page 1025- 1061*

Ravall, S., & Simberg, S. (2020). Voice disorders and voice knowledge in choir singers *Journal of Voice*, *34*(1), 157-e1. https://doi.org/10.1016/j.jvoice.2018.07.005

Ravi, S. K., Shabnam, S., George, K. S., & Saraswathi, T. (2019). Acoustic and aerodynamic characteristics of choral singers. *Journal of voice,33(5) 803-e1* https://doi.org/10.1016/j.jvoice.2018.03.018

Rehder, M. I., & Behlau, M. (2008). Perceptual, auditory and acoustic vocal analysis of speech and singing in choir conductors. *Pro-fono: Revista de Atualizacao Cientifica*, *20*(3), 195-200. https://doi.org/10.1590/S0104-56872008000300010

Rothman, H. B., Brown Jr, W. S., Sapienza, C. M., & Morris, R. J. (2001). Acoustic analyses of trained singers perceptually identified from speaking samples. *Journal of voice*, *15*(1), 25-35. https://doi.org/10.1016/S0892-1997(01)00004-2

Sharma, V., Nayak, S., & Devadas, U. (2021). A survey of vocal health in church choir singers. *European archieves of Otolaryngology 278(8).* https://doi.org/10.1007/s00405-021-06770-0singers

Smith, B., & Sataloff, R. T. (2013, 15 mayo). *Choral Pedagogy, Third Edition* (Third). Plural Publishing, Inc.

Tepe, E. S., Deutsch, E. S., Sampson, Q., Lawless, S., Reilly, J. S., & Sataloff, R. T. (2002). A pilot survey of vocal health in young singers. *Journal of Voice*, *16*(2), 244-250. https://doi.org/10.1016/S0892-1997(02)00093-0

Verdolini, K., & Ramig, L. O. (2001). Occupational risks for voice problems. *Logopedics Phoniatrics Vocology*, *26*(1), 37-46. https://doi.org/10.1080/14015430119969

Wang, C. C., Huang, H.T. (2004). Voice acoustic analysis of normal Taiwanese adults. Journal of Chinese Medical Association, 67, 179-84.

Woodson, G. E., Cannito, M. (1998). Voice analysis. In: Cummings. CW, editors. Otolaryngology-head and neck surgery. 3rd edition. St. Louis: Mosby-Year Book.