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

		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.

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