

An exploratory study to identify at risk experimental group using acoustic analysis

Santhosh Simon, Towino Paramby, Bindya Baby, T.A Subha Rao

Intern, Dr. M.V. Shetty College of Speech & Hearing, Mangalore, India

Abstract

Introduction: Kathakali is “one of the most magnificent theatres of imagination” and is Kerala’s celebrated contribution to world theatre. This keralian art form which conveys the ancient mythological themes is composed of acting as well as singing which is known as “kathakali vesham” and “kathakali sangeetham” respectively. In this, drama text is sung for the performer who concentrates on the interpretation of the role. An expression or kathakali vesham artist is backed up by kathakali sangeetham artist who is supposed to sing so loudly for the perfection of the performance and also to make it audible for every one these plays are conducted on open grounds. This profession has seen an increase in the influx of young people within the past few decades. Since this line of performance demands high physical, mental and vocal stress; it is necessary to consider them as a high risk group and create awareness among them.

Aim of the study: There are very few Indian studies which have been done on professional voice users and one of them was on “yakshagana” artists who have their voice at risk. (Kalaiselvi, 2004). Since, voice disorders among professional singers is one of the areas where the speech language pathologist extend their competence, there should be professional measures and devices for advice and treatment of the same. In this study we focus on professional experimental group who use their voice to the extreme limits for a better performance but which ultimately causes them to fall under high risk groups. Thus we are marginalizing the voice misuse/abuse of these artists to an extreme out of which they are more prone to be affected by voice disorders.

Method: Voice samples of 30 kathakali sangeetham artists from kathakali institutions were collected. They varied in age range and professional experiences. Experiences of the artist ranged from seven to thirty years. Ages ranged from thirteen to fifty three years. They were asked to phonate /a/ and also to read a paragraph in Malayalam which lasted for ten seconds. All the recordings were done with professional recording systems, directly done on a recordable mp3 (digital to digital) recording.

Vaghmi (version4) was used to assess the following parameters: frequency, intensity, extent of fluctuation of frequency and intensity, range of frequency and intensity, rate of fluctuation of frequency and intensity, alpha, beta, gamma, jitter Fo, jitter To, shimmer and HNR.

13 subjects within the age range of 26-46yrs were selected as the control group. Time and resource constraints restricted the control group to the above mentioned age range. This age range was considered because majority of the artists fell in that age range.

Independent sample T-test was administered to compare the acoustical parameters of the artists with those of normal.

Results and discussion: Comparison of experimental group voice and control group ; significant differences have been obtained for alpha & intensity for /a/ phonation; and alpha beta gamma, intensity, range of intensity for speech .it can be said that alpha and intensity factors show most sensitivity in differentiating singers and normal subjects.

Comparison of experimental group and control group (all within the range 26-46years) showed significant differences for range of frequencies, alpha, beta, gamma, intensity, range of intensity for /a/; and beta, gamma & range of intensity appears to be the most sensitive values for differentiating between the two groups.

Comparison between the control and the two artists with voice problems showed significant differences in alpha, beta, gamma and intensity for /a/; and extent of fluctuation of frequency ,range of frequency, alpha, beta, gamma and intensity are most sensitive for differentiate between voice disordered singers and the normal.

The alpha, beta and gamma values are the most sensitive parameters obtained across all the three comparisons. The values for all these parameters lie within respective ranges. These values for the two artists with voice disorders were much above the range. These high values on acoustic parameters put these artists on the high risk category.

Conclusion: This study demonstrates that acoustic analysis of voice can be an effective tool in differentiating high risk groups like experimental group. The most important features of acoustic analysis that could possibly differentiate the groups are alpha, beta, gamma and intensity. The present study also has evolved to demonstrate that there is a range of values for these parameters which may differentiate normal from abnormal. This is a promising area for speech and language pathologists for further exploration.

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Introduction

Kathakali is “one of the most magnificent theatres of imagination” and is kerala’s celebrated contribution to world theatre. Kathakali means “story-play”. It’s an act of devotion featuring the universal struggle between good and evil. This keralian art form which conveys the ancient mythological themes is composed of acting as well as singing which itself known as “kathakali vesham” and “kathakali sangeetham” respectively in this drama text is sung for the performer who concentrates on the interpretation of the role. Usually performances take place in temple courtyards and last all night. An expression of kathakali vesham artist is backed up by kathakali sangeetham artist who is supposed to sing so loudly for the perfection of the performance and also to make it audible for every one as these plays are conducted on open grounds.

This profession has seen an increase in the influx of young people with the past few decades. Since this line of performance demands high physical, mental and vocal stress; it is necessary to consider them as a high risk group and create awareness among them. There is an increasing segment of the population which is depended on communication for their livelihood like actors who use their voice and they also indulge in voice overuse or abuse. They constitute the high risk groups. (Shapiro, 1996)

Singers are often those people who by natural gift or by training or by a blend of both have mastered the art of optimally using the voice mechanism. Singing requires all that speaking does but with greater skills and effort (Greene, 1992)

There are very few Indian studies which have been done on professional voice users and one of them is on “yakshagana” artists who use their voice at risk. (Kalaiselvi, 2004)

Since, voice disorders among professional singers is one of the areas where the speech language pathologist extend their competence, there should be professional measures and

device for advice and treatment of the same. In this study we focus on professional experimental group who use their voice to the extreme limits for a better performance but which ultimately causes them to fall under high risk groups. Thus we are marginalizing the voice misuse/abuse of these artists to an extreme out of which they are more prone to be affected by voice disorders.

This study is aimed at comparing:

1. Acoustic parameters for both phonation and speech stimuli between 30 experimental group and the control group.
2. Acoustic parameters for both phonation and speech between artists falling within the age range of 26-46 yrs and the control group (age range 26-46yrs) to identify the probable high risk age range.
3. Acoustic parameters between the control group and two artists who had voice problems.

These three aims were considered to provide us with a wider base to categorize these singers as a high risk group, through differences in acoustic parameters across the two groups.

Methods:

Voice sample collection:

Voice samples of 30 kathakali sangeetham artists from kathakali institutions were collected. They varied in age range and professional experiences. Experiences of the artist ranged from seven to thirty years. Ages ranged from thirteen to fifty three years.

All the subjects went through an interview/case history session to allow the interviewing SLP to judge the quality of the voice

They were asked to phonate /a/ and also to read a paragraph in Malayalam which lasted for ten seconds. All the recordings were done with professional recording systems, directly done on a recordable mp3 (digital to digital) recording.

Evaluation parameters:

Vaghmi (version4) was used to assess the acoustic parameters.

The parameters analyzed were:-

- 1) Fundamental frequency
- 2) Intensity
- 3) Rate of fluctuation of frequency
- 4) Rate of fluctuation of intensity
- 5) Extent of fluctuation of frequency
- 6) Extent of fluctuation of intensity
- 7) Range of frequency
- 8) Range of intensity

9) HNR value

10) Jitter F0

11) Jitter T0

12) Shimmer value

13) Alpha

14) Beta

15) Gamma

Parameters		Mean	Standard deviation	Significant difference two tail
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These parameters were selected as they were most frequently used clinically and thought to reflect factors which can differentiate vocal abuse.

Control:

The maximum number of artists fell in the age range of 26-46yrs and so the control group of 13 subjects was selected keeping this age range in mind. Although it was desirable to have a control group representing entire age range of subjects, the time and resource constraints restricted the control group selection.

Statistical measures:

Independent sample T.test was administered to compare the acoustical parameters of the artists with those of normal.

Comparison was made between:

- 1) Whole group of artist v/s control group.
- 2) Artists within the age range of 26-46yrs vs control group
- 3) Two artists who showed voice problems vs the control group.

Results and discussion:

Results can be discussed under three main headings

1) Comparison of 30 experimental group vs. normal subjects:

For /a/ production, significant difference have been obtained for alpha and intensity and for speech stimuli alpha, beta, gamma, intensity, range of intensity was identified. As can be observed from table 1 the non significant differences are primarily noted for jitter, shimmer etc. it can be said that alpha and intensity factors show most sensitivity in differentiating between singers and normal subjects.

Parameters		Mean		Standard deviation		Significant difference two tail	
		/a/	speech	/a/	speech	/a/	speech
Fundamental frequency (mean)	subject	143.05	146.68	39.5	48.13	0.5	0.35
	normal	135.92	133.79	19.57	13.49		
Rate of fluctuation	subject	2.7	14.23	6.80	18.28	0.20	0.08
	normal	0.2	5.0	0.59	5.97		
Extent of fluctuation	Subject	0.87	20.40	1.65	49.53	0.7	0.2
	Normal	0.66	2.38	1.65	2.01		
Range	Subject	7.04	48.05	6.81	67.43	0.47	0.07
	Normal	8.7	13.86	7.15	8.74		
HNR	Subject	19.89	18.83	4.44	2.59	0.78	0.31
	Normal	19.39	19.78	7.01	3.29		
Jitter T0%	Subject	6.31	10.10	7.18	8.54	0.59	0.39
	Normal	7.62	7.82	7.84	6.49		
Jitter F0%	Subject	8.36	12.13	11.21	12.26	0.94	0.40
	Normal	8.12	9.02	8.36	7.42		
Shimmer dB	Subject	0.98	4.86	1.65	20.74	0.40	0.4
	Normal	0.58	0.72	0.51	0.6		
Alpha	Subject	17.71	17.24	8.80	7.19	0.004*	0.02*
	Normal	9.95	12.51	3.44	2.35		
Beta	Subject	25.84	21.82	4.46	3.51	0.1	0.00*
	Normal	18.55	15.81	3.35	2.90		
Gamma	Subject	53.43	50.30	28.1	28.57	0.1	0.004*
	Normal	26.50	25.81	2.00	2.22		
Intensity	Subject	107.82	112.07	4.75	17.69	0.00*	0.02*
	Normal	119.60	118.49	6.55	3.20		
Rate of fluctuation	Subject	1.96	18.36	8.16	13.87	0.70	0.19
	Normal	1.07	12.84	1.38	9.24		
Extent of fluctuation	Subject	0.47	2.08	0.66	2.50	0.20	0.45
	Normal	0.76	1.54	0.70	0.63		
Range	Subject	6.13	6.31	9.90	3.19	0.84	0.02*
	Normal	5.59	4.19	2.80	1.34		

Table 1 comparison of 30 experimental group vs. normal subjects:

*: significant differences

		/a/	speech	/a/	speech	/a/	speech
Fundamental frequency (mean)	subject	124.31	118.87	16.20	36.50	0.1	0.1
	Normal	135.92	133.79	19.57	13.49		
Rate of fluctuation	Subject	0.000	8.84	0.000	14.19	0.1	0.3
	Normal	0.23	5.0	0.59	5.97		
Extent of fluctuation	Subject	0.000	35.97	0.00	71.51	0.15	0.10
	Normal	0.66	2.38	1.65	2.01		
Range	Subject	4.04	60.30	2.94	88.48	0.04*	0.07
	Normal	8.70	13.86	7.15	8.74		
HNR	Subject	20.17	18.85	5.89	1.70	0.76	0.37
	Normal	19.39	9.78	7.01	3.29		
Jitter T0%	Subject	7.45	13.78	7.76	8.75	0.95	0.06
	Normal	7.62	7.82	7.84	6.49		
Jitter F0%	Subject	11.78	17.57	14.57	14.57	0.43	0.07
	Normal	8.12	9.02	8.36	7.42		
Shimmer dB	Subject	1.48	1.35	2.46	1.16	0.20	0.11
	Normal	0.5	0.72	0.51	0.60		
Alpha	Subject	13.86	13.79	4.37	6.46	0.03*	0.5
	Normal	9.95	12.51	3.44	2.35		
Beta	Subject	24.63	19.31	6.69	3.67	0.00*	0.02*
	Normal	18.55	15.81	3.35	2.90		
Gamma	Subject	60.54	51.88	30.06	32.50	0.001*	0.009*
	Normal	26.50	25.81	2.00	2.22		
Intensity	Subject	105.74	118.28	3.67	34.65	0.00*	0.98
	Normal	119.60	118.49	6.55	3.20		
Rate of fluctuation	Subject	0.37	21.62	0.51	18.23	0.187	0.15
	Normal	1.07	12.84	1.38	9.24		
Extent of fluctuation	Subject	0.40	1.56	0.55	0.31	0.23	0.93
	Normal	0.76	1.54	0.70	0.63		
Range	subject	10.5	5.89	18.55	1.9	0.03*	0.02*
	normal	5.59	4.19	2.80	1.34		

Table 2: comparing age range (26-46yrs) normal vs. experimental group

*: significant difference

2) Comparing age range (26-46yrs) control group vs. experimental group:

An effort was made to look at the measures for a specific/ normal age range of 26-46yrs. In this group, for /a/ , frequency range , alpha , beta, gamma, intensity and range of intensity; and for speech stimuli beta, gamma and range of intensity showed a sig. difference.

Among all, beta, gamma and range of intensity appear to be the most sensitive values for differentiating the two groups which is evident from the graph presented above.

3) Comparison between two experimental group having voice problems and the control group:

A further attempt was made to select two subjects of experimental group who had reported as having voice problems primarily hoarse voice with throat pain and comparing them with normal control group.

For /a/ alpha, beta, gamma, intensity and for speech; extent of fluctuation of frequency, range of frequency, alpha, beta, gamma and intensity showed significant difference and they appeared to be the most sensitive values for differentiating between voice disordered experimental group and the normal subjects.

From our study, we concluded that the alpha, beta, gamma and intensity values are the most sensitive values obtained across the three comparisons.

Table 3: Mean values for the four parameters across the three groups

Parameters	Normal	Subjects	Abnormal subjects
Alpha	4.86	17.46	19.97
Beta	7.44	23.83	26.89
Gamma	11.33	51.87	83.75
Intensity	51.58	109.95	131.58

From the above table, a normal range could be concluded for all the four parameters. If the values lie above this range it could indicate that they fall into the risk group, as their means for the singers with voice problems lie much above the normal range.

Experimental group sing loudly during their performances which could be the reason why the mean for intensity is higher in them as compared to normal and those with voice problems. Singing loudly requires immense sub glottal air pressure which has direct impact on the vocal cords and thereby creating changes in voice quality (Zemlin,1998). Frequent use of high intensity voice has direct impact on voice quality which gets reflected through the alpha, beta and gamma values (Padmanabhan A, 2000). In Experimental group, these parameters are higher as compared to normal and lesser than those with voice problems. Therefore in experimental group, any value which lies above the mentioned range, would fall into the high risk category.

Conclusion:

In conclusion, the current study demonstrates that the acoustic analysis of the voice and the speech samples can be an effective tool in differentiating high risk groups like experimental group who would develop voice disorders from those who may not develop. The most important features of acoustic analysis that could differentiate the groups are alpha, beta, gamma and intensity. The present study also has evolved to demonstrate that there is a range of values for these parameters which may differentiate normal from abnormal. This is a promising area for speech and language pathologists for further exploration.

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