Voice characteristics of Teachers from Jawahar Navodaya Vidyalaya in Southern districts of Karnataka

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May, 2017

CERTIFICATE

This is to certify that this dissertation entitled **"Voice characteristics of Teachers from Jawahar Navodaya Vidyalaya in Southern districts of Karnataka"** is a bonafide work submitted in part fulfilment for degree of Master of Science (Speech-Language Pathology) of the student Registration Number: 15SLP027. This has been carried out under the guidance of a faculty of this institute and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

Mysore, May 2017

Dr. S.R. Savithri
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CERTIFICATE

This is to certify that this dissertation entitled **"Voice characteristics of Teachers from Jawahar Navodaya Vidyalaya in Southern districts of Karnataka"** has been prepared under my supervision and guidance. It is also been certified that this dissertation has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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Mysore, May,2017

DECLARATION

This is to certify that this dissertation entitled "**Voice characteristics of Teachers from Jawahar Navodaya Vidyalaya in Southern districts of Karnataka"** is the result of my own study under the guidance of Dr. K Yeshoda, HOD & Reader in Speech Sciences, Department of Speech Language Sciences, All India Institute of Speech and Hearing, Mysuru, and has not been submitted earlier to any other University for the award of any other Diploma or Degree.

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CHAPTER I

INTRODUCTION

The speech of a person speaks a lot about his/her character and since way long the speech has been given major importance in human beings. Voice is the instrument we use to create speech. Voice has been defined as "the laryngeal, modulation of the pulmonary air stream, which is further modified by the configuration of the tract", [Micheal & Wendhal (cited in Travis, 1971)].

Professional voice users are defined as those, who require the use of their voice to maintain income (Murry& Rosen, 2000). They include singers, actors, teachers, attorneys, etc. Professional voice users are of three types (a) those who use their voice for a long period of time (politicians, teachers in classrooms, telephone users, shop keepers and vendors), (b) those who use their voice under adverse circumstances (persons working in noisy environment and/ polluted environments) and (c) those who use voice for special purposes (singer, theatre artists).

Teachers are professional voice users who use speech regularly in their everyday teaching as it is their profession. In general, it is required that the teachers use a voice that is appropriate to the age and gender in terms of pitch, loudness and quality. It is important that the voice of the teachers is greater in volume and audible to all pupils in the classroom. They are expected to maintain a good volume voice throughout the teaching duration. Such extended periods of voice use results in vocal load and may result in changes in pitch and quality.

Lindstrom, Waye, Dersten, Mcallister and Ternstro (2009) investigated the correlations between noise level along with voice level and voice average fundamental frequency in preschool female teachers at their normal work place. The correlations between the noise level and F0 of voice indicated that some teachers increase their voice SPL to noise level ratio when the noise SPL was lowered or reduced and others do not.

Cutiva, Puglisi, Astolfi, and Carullo (2017) did a follow up study after four days. They did voice monitoring of 27 teachers for four working days using the Voice-Care device. It provided information about the fundamental frequency, vocal sound pressure level, and phonation time percentage. The teachers did a pre-monitoring, which had a brief conversation, prior to each monitoring session, and answered a questionnaire after each monitored lesson, in which they indicated their opinions about their voice condition and the classroom noise conditions. The results showed that in teachers who had higher standard deviation of the vocal sound pressure level and a greater phonation time percentage difference between the entire monitoring and the pre-monitoring sessions, during the pre-monitoring, reported fewer voice complaints after the four day follow up recording.

Szabo Portela, Hammarberg and Sodersten (2013) did a study to identify the voice behaviors with respect to the work demands in healthy preschool female teachers. They used a portable voice accumulator to record the F0 and phonation time during both working and leisure time for consecutive two days. The results showed that F0 was higher during the working time compared to the leisure time.

According to Martin (2003), if teachers were to teach effectively, then they needed voices that were been able to withstand the demands of prolonged voice use often at increased volume on a daily basis. It is possible to use the voice without tiring, damaging, or abusing it for prolonged periods of time, but only for a few individuals.

Koul (2004) did combination study of self- appraisal and objective methods (acoustics, aerodynamics and noise measurements) to explore the correlation of objective acoustic characters and subjective information, vocal demands and back ground noise level of classroom in primary v/s secondary school teachers and the results revealed that 12 out of 14 secondary school teachers had deviant voice quality and 9 out of 13 primary School Teachers had deviant voice quality.

There are different school set-ups catering to the educational needs of children. In the Indian scenario also different school and education setups such as day schools, semi residential schools, residential schools, and evening colleges under both Govt. and private sectors exist. Jawahar Navodaya Vidyalayas are residential schools set-up wherein the roles and responsibilities of teachers are different compared to the regular day school set-up.

Jawahar Navodaya Vidyalayas (JNVs) are run by the Navodaya Vidyalaya Samiti, an autonomous organization under the Department of School Education and Literacy, Ministry of Human Resource Development (HRD), Government of India. These schools were set up based on the National Policy on Education-1986which envisaged to promote national progress, a sense of common citizenship and culture, and to strengthen national integration. It laid stress on the need for a radical reconstruction of the education system,

to improve its quality at all stages, and gave much greater attention to science and technology, the cultivation of moral values and a closer relation between education and the life of the people (http://nvshq.org/display_page.php?page=Mission%20and%20Vision). The recruitment of teachers for JNV is under two categories: trained graduate teachers (TGT) and post graduate teachers (PGT) and follow the guidelines laid out by the Ministry of HRD, GOI.

Special features of JNV Teachers: Generally, teachers do not reside in the same campus as pupils in residential schools. In contrast, teachers appointed in Jawahar Navodaya Vidyalaya (JNV) reside in the same campus as students. Therefore, teachers in JNV will be different compared to other residential schools. They teach for a duration of 45 minutes and handle 22-26 classes in a week for a classroom of 40 students along with additional hours of remedial classes. These teachers are assigned with additional duties to improve their knowledge/ skills, such as, (a) frequent, regular compulsory training programs on different subjects, example, subject enrichment/ teaching methods/ safety & security/ classroom management/ safety of a girl child/ moral value education/ upliftment of slow learners/ counseling of students/ special concern for children with special needs such as, hearing impairment, slow learners, physically handicapped, visually disabled, (b) scope for innovation/ sharing their views on management of school/ effective teaching through presentations / handling specially abled children, (c) enrolling for Diploma course for guidance & counseling and (d) special attention to students with special needs by recommending such children for use of aids & other rehabilitation options in consultation with parents concerned and district health officer/s.

Need for the study

JNV set-up is a residential school system and hence the responsibilities of teachers working in such set-ups will be different when compared to teachers of day-schools. It will be interesting to study the voice characteristics in them as the teachers are responsible for the overall development of pupils including the co-curricular activities of pupils. There are limited studies available on voice characters in teachers of Jawahar Navodaya Vidyalaya. Hence the present study was planned.

CHAPTER II

REVIEW OF LITERATURE

A professional voice user is anyone whose voice is essential to their job. All accustomed to thinking of singers, actors, actresses, and broadcast personalities as professional voice users and other occupational voice users include, teachers, clergy, salespeople, courtroom attorneys, telemarketers, and receptionists are also people for whom spoken communication is an essential part of what they do, and there are countless other professions that rely heavily on the voice. Anyone who needs their voice in order to carry out their job is considered as a professional voice user. Professional voice users are often considered "athletic" voice users because their voice use is more extensive and strenuous than that of non-professional voice user (Lions voice clinic- 2000).

Koufman and Isaacson (1991) proposed a classification based on levels of vocal usage as follows,

a) Level I: The level I elite vocal performer is a person for whom even a slight aberration of voice may have dire consequences. Most singers and actors are in this group, the opera singers being the quintessential level I performer.

b) Level II: The professional voice user, level II, is a person for whom a moderate vocal problem might prevent adequate job performance. This group includes teachers, lecturers, etc.

c) Level III: The non-vocal professional, level II is a person for whom a severe vocal problem would prevent adequate job performance. This group includes lawyers, businessmen, etc.

d) Level IV: The non-vocal non-professional, level IV is a person for whom vocal quality is not a prerequisite for adequate job performance. This group includes office workers, factory workers, venders, bus conductors, agriculturist' coolie, and so forth. Although persons in this group may suffer very significant social liability because of voice disorders, they are not prevented from doing work.

Mohseni and Sandoughdar (2016) investigated the acoustic parameters of voice in Iranian female teachers and compared them with non-teachers and the analysed the F_0, jitter, shimmer, harmonic to noise ratio (HNR), and maximum of phonation time (MPT) of both groups. And results showed that the values of F_0 were higher in teachers than in non-teachers, perturbation measures were greater in teachers than those in the control group but in HNR and MPT values, non-teachers showed higher levels than the teachers.

Schmidt, Andrews and McCutcheon (1998) examined the perceptual evaluations of classroom teachers, acoustic measures of their voice (fundamental frequency, frequency range, jitter % and shimmer %) and behavioural measures (rate of speech, disfluencies and episodes of vocal fry). And the results showed that there was a correlation between the perceptual judgements of teaching effectiveness and specific adjective descriptors for the frequency range, frequency variability, rate and number of disfluencies. And there were no correlation between fundamental frequency, jitter % and shimmer % perceptually and the perceptual judgements.

Dehqan and Scherer (2013) conducted the acoustical analysis of Iranian school teachers. They considered 30 Iranian teachers (15 males and 15 females) and compared with the 30 Iranian adults (15 males and 15 females) who were nurses, wives and other professions who did not require more vocal loading. The results indicated that there was no significant difference in males teachers voice compared to control group, but there was significant difference in female teachers in their fundamental frequency (190.27Hz) when compare to the control group where they had fundamental frequency (236.32Hz) indicating significantly lower fundamental frequency in female teachers. And teachers had the higher jitter %, shimmer % and lower harmonics to noise ratio as compared to control group.

Teachers use a higher fundamental frequency (F0) during lessons than during breaks and their F0 increases toward the end of the working day, which might be an effect of vocal loading and it was found that even two hours of vocal loading resulted in increased F0 (Rantala & Vilkman, 1999; Rantala, Vilkman, & Bloigu, 2002). Stemple, Stanley and Lee (1995) reported that weakness of the thyroarytenoid muscle consequent to vocal loading causes increased mean F0.

In Indian context few studies have been done. Prasad (2012) did a study to check vocal characteristics of normally sighted male teachers and visually impaired male teachers using phonation and speech monologue samples. He took two groups of subjects: Group I consisted of 20 visual impaired primary school teachers and Group II consisted of 20 normal sighted primary school teachers. Using the acoustic analysis (MDVP) eight major multi-dimensional voice parameters and speech parameters were

extracted and perceptual assessment was also done. Results indicated that there were no significant differences in the both groups with respect acoustical and perceptual parameters.

Smitha Bahera and Savithri (2005) studied voice characteristics of prospective and professional teachers using phonation samples. They included two groups of subjects: Group I consisted of 10 prospective teachers (5 males and 5 females) and Group II consisted of 10 professional teachers (2 males and 8 females). They did the acoustical assessment using the MDVP software. The results indicated that there was significant voice difference between the prospective and professional teachers. There were abnormal frequency and amplitude perturbation measures indicating hoarse voice in professional teachers and more abnormalities were seen in professional teachers compared to prospective teachers.

Rajasudhakar and Savithri (2009) studied vocal loading in five primary school teachers. The subjects performed phonation and speech tasks which were acoustically analyzed. Eight major multi dimensional voice and speech parameters were extracted. The results indicated that after 6 hours of teaching, fundamental frequency of phonation, standard deviation of fundamental frequency of phonation, jitter and speaking fundamental frequency were increased compared to the pre-teaching (baseline) condition.

Yeshoda & Rajasudhakar (2015) studied the voice characteristics in normal teachers in Indian set-up and check for differences if any when compared with non professional voice users. They also aimed to find gender effect in voice characteristics of teachers using combinations of objective (acoustic, aerodynamic measures) and

subjective method to evaluate the voice characteristics of teachers. Acoustic analysis was done using Multi Dimensional Voice Profile (MDVP) and Real Time Pitch (RTP) software of Computerized Speech Lab (CSL) 4500 model. The experimental group consisted of 264 female and 42 male school teachers, age ranging from 30-45 years. The control group (non teachers) consisted of 100 female and 33 male adults also aged between 30-45 years.

Apart from development of a normative data base of voice in normal teachers in Indian context, the outcome indicated following results: (a) F0 related measures were lower in male teachers, Standard deviation in F0 (STD) predictor of monotonicity in phonation was found significantly more for female teachers compared to male teachers, (b) Tremor related measure (ATRI) and voice irregularity measure (NUV) were significantly higher for female teachers than male teachers, (c) Short and long term frequency and amplitude perturbation, voice irregularity measures (DUV), tremor measure (Fftr) and noise related measures (SPI and NHR) were significantly higher for male teachers compared to female teachers. Majority of the fundamental frequency related measures (SF0, minimum F0, maximum F0, and STD of F0) for speech was higher for female teachers compared to male teachers. They also noted that female teachers had a significantly higher standard deviation of fundamental frequency during speaking compared to male teachers.

Review of literature indicates that majority of studies are done in western context and on day-school teachers. Limited studies focus on the vocal characters of residential school teachers. In India there are different school setups which include day, semi-

residential and complete residential school set ups. Jawahar Navodaya Vidyalaya (JNV) are a type of residential schools across India with unique rules and regulations across all JNVs throughout the country, where the teachers are supposed to teach throughout the day, work for the betterment of the children and reside in the same campus as the pupils. The present study was planned to examine the vocal characteristics of the residential school teachers.

Aim of the study

To explore the voice characteristics of teachers of Jawahar Navodaya Vidyalaya (JNV) from southern districts of Karnataka.

Objectives of the Study

- To investigate the voice characteristics of teachers from Jawahar Navodaya Vidyalaya (JNV) using acoustic measures.
- To compare the voice characteristics of male and female teachers from JNV based on the acoustic measures.

CHAPTER III

METHOD

The main objective of the current study was to study the voice characteristics of teachers from Jawahar Navodaya Vidyalaya in southern districts of Karnataka

Subjects

51 female and male teachers (employed at the Jawahar Navodaya Vidyalaya of Mysore, Mandya, Kodagu, Chamarajanagar and Hassan districts) in the age range of 25 years-50 years were selected for the study. Demographic (age, languages known, teaching experience), teaching details and written consent were taken from all the subjects. Both post graduate teachers (PGT) and trained graduate teachers (TGT) were considered for the study.

The subjects fulfilled the following inclusion criteria to participate in the study,

1. Minimum teaching experience of 2 years
2. No history of any speech, language, hearing, neurological and psychological problems
3. No history of any upper respiratory infections, voice problem/ disorder at the time of recording

Procedure

All the subjects carried out the following tasks individually in a quiet environment in their respective schools. Subjects' voice samples were recorded individually.

Task

1. Phonation of vowels /a/, /i/ and /u/ at comfortable pitch and loudness for about 5 seconds.
2. Reading of the standard "Rainbow" passage
3. Monologue on a specific topic (Teaching experience at Navodaya)

Recording

The tasks were audio recorded using the digital voice recorder, Olympus (LS-100). The samples were recorded directly on to the digital voice recorder. The microphone was positioned at a distance of about 15cms from the subject's mouth during recording. First phonation samples of /a/, /i/ and /u/, followed by reading sample and monologue was recorded. All the recordings were done in a quiet environment. Following instructions were given to subjects before the performance of the task.

1. The subjects were asked to sit comfortably on a chair and relax themselves for 2-3 minutes.
2. Then they were instructed to take a breath and phonate the vowels /a/, /i/ and /u/ at their habitual intensity and pitch one after the other with a small break of one minute after each vowel.
3. Then they were asked to read the "Rainbow passage" at their comfortable and habitual intensity and pitch level and in the same way they were asked to speak for two minutes about their teaching experience at Navodaya.

Acoustic analysis: involved analysis of samples of phonation and speech separately using the Multi Dimensional Voice Profile (MDVP) and Real Time Pitch software of CSL 4500 (Kay Pentax, New Jersey) respectively. The phonation samples were subjected to MDVP analysis and monologues were subjected to Real Time Pitch analysis.

(A) Acoustic analysis of phonation

The middle 3 seconds duration of the phonation samples, eliminating the initial and final portions of the recordings was used for analysis. This was done to avoid the influence of voice onset and offset on the acoustic measures. The acoustic measures extracted for phonation after MDVP analysis are listed as shown,

I. Fundamental Frequency Information Measures

1. Mean Fundamental Frequency (MF0): Average value of all extracted period to period fundamental frequency values.
2. Highest Fundamental Frequency (Fhi): Highest fundamental frequency value in phonation.
3. Lowest Fundamental Frequency (Flo): Lowest fundamental frequency values in phonation.
4. Standard Deviation of Frequency (STD): Variation of F0 within the analysed voice sample.

II. Short and Long Term Frequency Perturbation Measures

1. Absolute Jitter (Jita): An evaluation of period-to-period variability of pitch period with in the analyzed voice sample.

2. Jitter Percent (jitt): Relative evaluation of period-to-period (very short- term) variability of the pitch within analyzed voice sample.
3. Relative Average Perturbation (RAP): Relative evaluation of period-to-period variability of the pitch within analyzed voice sample with a smoothing factor of 3 periods.
4. Pitch Perturbation Quotient (PPQ): Relative evaluation of period-to-period variability of the pitch within analyzed voice sample with a smoothing factor of 5 periods.
5. Smoothed Pitch Perturbation Quotient (sPPQ): Relative evaluation of the short or long term variability of the pitch period within the analysed voice sample at smoothing factor defined by the user. The setup for the smoothing factor is 55 periods.
6. Fundamental Frequency Variation (vF0): It is the Relative standard deviation of the period-to-period calculated Fundamental frequency. It reflects the very long-term variations of Fundamental frequency for all analyzed voice samples.

III. Short and Long Term Amplitude Perturbation Measures

1. Shimmer in dB (ShdB): It is the period to period variability of the peak to peak amplitude within the analyzed voice sample.
2. Shimmer Percent (Shim): It is the relative evaluation of the period-period variation of the peak to peak amplitude within the analyzed voice sample.
3. Amplitude Perturbation Quotient (APQ): Relative evaluation of the period-period variation of the peak to peak amplitude within the analyzed voice sample at smoothing of 11 periods.

4. Smoothed Amplitude Perturbation Quotient (sAPQ): It is a relative evaluation of the short or long term variability of the peak to peak amplitude within the analyzed voice sample at smoothing factor defined by the user. The set up for the smoothing factor is 55 periods.
5. Peak Amplitude Variation (vAm): It is the relative standard deviation of the period-to-period calculated peak-to-peak amplitude. It reflects the very long term amplitude variations within the analyzed voice sample.

IV. Voice Break related measures

1. Degree of Voice Breaks (DVB): The ratio of total length of voice breaks to voicing.
2. Number of Voice Breaks (NVB): Number of times the fundamental period interrupted during the voice sample.

V. Sub-Harmonic Related Measures

1. Degree of Sub Harmonic Segments (DSH): Estimated relative evaluation of sub-harmonics to F0 components in the voice sample.
2. Number of Sub Harmonic Segments (NSH): Number of auto correlation segments where the pitch was found to be a sub-harmonic F0.

VI. Voice Irregularity Related Measures

1. Degree of Voice less (DUV): Estimated relative evaluation of non-harmonic areas (where F0 can't be detected) in the voice samples.
2. Number of Unvoiced Segments (NUV): Number of unvoiced segments detected during the auto-correlation analysis.

VII. Noise Related Measures

1. Noise to Harmonic Ratio (NHR): Average ratio of harmonic energy in range of 1500-4500 HZ to harmonic energy in the range of 70-4500 Hz.
2. Voice Turbulence Index (VTI): A ratio of the spectral in-harmonic high frequency energy in range 1800-5800 Hz to the spectral harmonic energy in the range 70-4200 Hz.
3. Soft Phonation Index (SPI): Average ratio of the lower frequency harmonic energy in the range of 70-1550 Hz to the higher frequency harmonic energy in the range of 1600-4200 Hz.

VII. Tremor Related Measures

1. F0 Tremor Intensity Index (FTRI): Average ratio of frequency magnitude of the lowest frequency modulation to the total frequency magnitude.
2. Amplitude Tremor Intensity Index (ATRI): Average ratio of the amplitude of the most intense low- amplitude modulating component for the total amplitude of the analyzed voice sample.
3. F0 Tremor Frequency (Fftr): It is the frequency of the lowest frequency modulation component.
4. Amplitude Tremor Frequency (Fatr): Frequency Tremor Amplitude Index Average ratio of the frequency.

(B) Acoustic Analysis of the Monologue

The middle 30 seconds duration segments from the monologue sample were considered for acoustic analysis using Real Time Pitch. The extracted acoustic measures as follows,

1. Mean F0 (SMF0): Mean F0 reports the harmonic mean. It is calculated using the formula M=n / (1/f1+1/f2+….+1/fn), where n is the total number of voice periods and f1…..fn are the frequency values for each period. For pitch synchronous F0 extraction, the Mean F0 is not weighted toward the higher frequency values as is the arithmetic mean. Mean F0 is the inverse of Mean Period.
2. Minimum F0 (SMinF0): One of the extremes of data distribution reflecting the lower limit, or lowest value, among the captured data. The minimum F0 refers to the lowest pitch value recorded.
3. Maximum F0 (SMaxF0): One of the extremes of data distribution reflecting the upper limit, or highest value, among the captured data. The maximum F0 refers to the highest pitch value recorded.
4. Standard Deviation F0 (SDF0): This is the measure of variability in the data. It reflects the spread of the data, or the average amount of which the data deviates from the harmonic mean. Standard deviation of F0 is computed in Hz on all F0 values in the selection area. It indicates how much variation in pitch occurred around the average value and is a useful indicator of monotonicity.
5. Fundamental Frequency Variation (vF0): It is defined as the standard deviation of F0 divided by the arithmetic mean. It is useful in facilitating comparisons regardless of F0 obtained.

6. Relative Average Perturbation (SRAP %): It gives an evaluation of the variability of the peak to peak amplitude within the analyzed voice sample. It represents relative period to period (very short term) variability of the peak to peak amplitude.

Statistical analysis

SPSS version 20 was used for statistical analysis of the acoustical data. Descriptive statistics was employed to find mean, median and standard deviation of the extracted acoustic measures. A non-parametric test Mann-Whitney test was used for finding the significance difference for the extracted parameters.

CHAPTER IV

RESULTS AND DISCUSSION

The present study evaluated the vocal characteristics of 51 Jawahar Navodaya Vidyalaya school teachers. The phonation and monologue samples were obtained and analyzed using the MDVP and Real Time Pitch software of CSL 4500 (Kay Pentax, New Jersey). The results of the acoustic data were further subjected to statistical analysis using SPSS version 20.

Descriptive statistics, non-parametric test., viz, Mann-Whitney test was performed to evaluate any significant difference among the parameters. The mean, standard deviation (SD), Z and p values are tabulated below. The results of the present study are discussed under the following subsections.

A. Acoustic analysis of Phonation.

B. Acoustic analysis of Monologue

The Tables 1-13 in this section show the mean, SD, Z and p values for phonation and monologue samples for all the teachers. Group comparisons were done for all teachers across the two sexes, females and males.

A. Phonation samples were subjected to MDVP analysis for extraction of acoustic parameters.

Table 1: Mean and Standard deviation for Fundamental frequency related measures in phonation samples of /a/, /i/, and /u/

Parameters	Groups	Vowel /a/		Vowel /i/		Vowel /u/	
		Mean	SD	Mean	SD	Mean	SD
MF0	Male	117.94	18.37	125.66	22.06	127.58	23.88
	Female	196.33	28.43	209.20	27.14	210.26	28.20
Fhi	Male	125.83	19.61	131.66	23.82	132.80	24.33
	Female	209.13	25.49	218.00	24.50	221.75	28.29
Flo	Male	108.55	25.28	119.77	20.81	121.75	24.03
	Female	173.46	47.18	201.40	29.82	201.73	28.33
STD	Male	1.71	0.78	1.83	0.70	1.45	0.49
	Female	3.04	1.18	2.51	1.00	2.70	0.88

Table 2: /Z/ and p values for fundamental frequency related measures in phonation samples of /a/, /i/, and /u/

Parameters	Teachers	Vowel / a /		Vowel / i /		Vowel / u /	
		/ Z /	P	/ Z /	P	/ Z /	P
MF0	Male Female	5.39	0.00	5.35	0.00	5.33	0.00
Fhi	Male Female	5.45	0.00	5.35	0.00	5.33	0.00
Flo	Male Female	4.06	0.00	5.34	0.00	5.33	0.00
STD	Male Female	3.51	0.00	2.16	0.00	4.52	0.00

From Table 1, it can be observed that the MF0, Fhi and Flo increased from vowel /a/ to /i/ to /u/ in both males and females. The mean STD value was lesser in males. The difference between fhi and flo which indicates the frequency range is lesser in males and

higher females. None of the fundamental frequency measures revealed statistical significance as noted from table 2.

Yeshoda & Rajasudhakar (2015) reported F0 related measures to be lower in male teachers, standard deviation in F0 (STD) predictor of monotonicity in phonation was found significantly more for female teachers compared to male teachers. This suggests that the control during phonation is better in males than in females. Females in general have higher vocal frequency when compared to males and hence, may be difficult to achieve complete glottal closure during voice production. Also the presence of posterior glottal chink may also contribute for the loose adductory behavior in females.

Table 3: Mean and standard deviation for short and long term frequency perturbation measures in phonation samples of /a/, /i/, and /u/

Para-meters	Groups	Vowel /a/		Vowel /i/		Vowel /u/	
		Mean	SD	Mean	SD	Mean	SD
Jita	Male	94.58	65.55	114.23	77.15	77.87	48.95
	Female	86.64	55.44	58.93	51.71	64.34	37.08
Jitt	Male	1.67	0.72	1.37	0.90	0.97	0.54
	Female	4.57	0.96	1.07	0.84	1.26	0.67
RAP	Male	0.66	0.47	0.82	0.56	0.61	0.37
	Female	0.93	0.57	0.64	0.50	0.76	0.40
PPQ	Male	0.67	0.49	0.82	0.55	0.60	0.36
	Female	0.90	0.57	0.63	0.50	0.74	0.41
sPPQ	Male	0.93	0.44	0.99	0.47	0.95	1.01
	Female	1.47	1.70	0.76	0.50	0.87	0.40
vF0	Male	1.42	0.66	1.46	0.52	1.08	0.38
	Female	4.24	7.17	1.29	0.66	1.33	0.48

Table 4: /Z/ and p values for short and long term frequency perturbation measures in phonation samples of /a/, /i/, and /u/.

Parameters	Teachers	Vowel / a /		Vowel / i /		Vowel / u /	
		/ Z /	P	/ Z /	P	/ Z /	P
Jita	Male Female	0.22	0.820	2.24	0.013	0.51	0.605
Jitt	Male Female	1.54	0.124	1.11	0.264	1.79	0.072
RAP	Male Female	1.42	0.154	1.09	0.275	1.56	0.118
PPQ	Male Female	1.12	0.260	1.26	0.207	1.60	0.109
sPPQ	Male Female	1.13	0.255	1.45	0.145	0.73	0.463
vF0	Male Female	1.24	0.215	0.88	0.374	1.82	0.069

*Depicts significant difference $p < 0.05$

From table 3 it can be observed that the Jita was higher in males compared to females for all vowels. It was also noted that Jita was highest for /i/ in males whereas it was highest for /a/ in females. Jitt, RAP, PPQ, sPPQ and vF0 were higher in females compared to males for the vowels /a/ and /u/ except sPPQ for /u/ in females. Mixed results were noticed for other parameters for all the remaining vowels. Statistical significance was absent for all short and long term frequency perturbation measures (table 4).

These results in general indicate that the short and long term frequency perturbation parameters did not follow any trend with respect to fundamental frequency or range. It is reported widely in literature that when fundamental frequency range in

phonation is increased, short and long term frequency perturbation parameters is also noted to be high. This feature was not noticed in the results of the present study.

Koul (2004) found that the frequency perturbations measures were increased in teachers. Similar findings were reported by Smitha Bahera & Savithri (2005). Rajasudhakar and Savithri (2009) also reported increased jitter, fundamental frequency and standard deviation of fundamental frequency after 6 hours of teaching compared to pre teaching condition.

Table 5: Mean and standard deviation values for short and long term amplitude perturbation measures in phonation samples of /a/, /i/, and /u/

Parameters	Groups	Vowel /a/		Vowel /i/		Vowel /u/	
		Mean	SD	Mean	SD	Mean	SD
ShdB	Male	0.40	0.18	0.26	0.08	0.99	4.29
	Female	0.40	0.23	0.21	0.10	0.22	0.11
Shim	Male	4.61	2.05	3.08	1.01	3.86	4.47
	Female	4.62	2.60	2.34	1.13	2.58	1.32
APQ	Male	3.67	1.34	2.38	0.67	2.55	1.66
	Female	3.21	1.47	1.87	0.86	2.23	1.57
sAPQ	Male	5.88	1.93	4.02	1.38	4.48	2.55
	Female	5.25	1.73	3.96	1.54	4.91	2.88
vAm	Male	10.76	3.74	7.34	2.90	9.05	6.52
	Female	10.47	4.53	8.09	3.01	11.43	7.44

Table 6: /Z/ and p values for short and long term amplitude perturbation measures in phonation samples of /a/, /i/, and /u/

Parameters	Teachers	Vowel / a /		Vowel / i /		Vowel / u /	
		/ Z /	P	/ Z /	P	/ Z /	P
ShdB	Male Female	0.41	0.679	2.34	0.019	1.06	0.287
Shim	Male Female	0.41	0.679	2.77	0.006	1.17	0.239
APQ	Male Female	1.23	0.219	3.19	0.001	1.37	0.169
sAPQ	Male Female	0.98	0.326	0.35	0.725	0.12	0.901
vAm	Male Female	0.49	0.620	0.88	0.374	1.14	0.157

Depicts significant difference $p < 0.05$

From table 5, it can be observed that most of the short and long term amplitude perturbation parameters were higher for males than females. The mean ShdB was same for both males and females for the vowel /a/. However males had higher mean values compared to females for ShdB for the vowels /i/ and /u/. For Shim, males showed increased mean values for /a/, females showed increased values for /i/ and /u/. Males showed increased mean values compared to females for the parameter APQ across all the vowels /a/, /i/ and /u/. Males had higher mean sAPQ values compared to females for the vowels /a/ and /i/whereas females showed increased values sAPQ values for the vowels /u/. Table 6 indicates no statistical significance for short and long term amplitude perturbation measures.

This indicates poor control of loudness of voice in males when compared to that of females. Smitha Bahera & Savithri (2005) found that the frequency and amplitude perturbations were increased in male teachers more than that of female teachers resulting

in an abnormal vocal quality. Increased amplitude and amplitude perturbations in voice of teachers' in general draws support from findings of (Martin 2003; Koul, 2004; Bahera & Savithri 2005). Martin (2003) reported that teachers working in primary education along with extended talking often used increase in voice intensity levels. Teachers were required to use their voice at greater loudness levels to compete with back ground noise (Koul, 2004).

Table 7: Mean and standard deviation values for voice break, sub-harmonic and voice irregularity measures in phonation of /a/, /i/, and /u/

Para-meters	Groups	Vowel /a/		Vowel /i/		Vowel /u/	
		Mean	SD	Mean	SD	Mean	SD
DVB	Male	0.02	1.13	0.00	0.00	0.02	0.12
	Female	0.00	0.00	0.00	0.00	0.00	0.00
NVB	Male	0.27	0.16	0.00	0.00	0.27	0.16
	Female	0.00	0.00	0.00	0.00	0.00	0.00
DSH	Male	0.00	0.00	0.26	0.16	0.08	0.35
	Female	0.38	0.78	0.00	0.00	0.00	0.00
NSH	Male	0.00	0.00	0.27	0.16	0.08	0.36
	Female	0.40	0.82	0.00	0.00	0.00	0.00
DUV	Male	1.03	1.97	0.51	1.36	2.25	8.44
	Female	0.55	1.13	0.13	0.51	0.26	1.01
NUV	Male	1.05	2.01	0.52	1.40	0.97	2.15
	Female	0.13	0.35	0.13	0.51	0.28	1.06

Table 8: /Z/ & p values for voice break, sub-harmonic and voice irregularity measures in phonation samples of /a/, /i/, and /u/

Parameters	Teachers	Vowel / a /		Vowel / i /		Vowel / u /	
		/ Z /	P	/ Z /	P	/ Z /	P
DVB	Male Female	0.64	0.519	0	1.00	0.64	0.519
NVB	Male Female	0.64	0.519	0	1.00	0.64	0.519
DSH	Male Female	3.19	0.001	0.64	0.519	0.92	0.357
NSH	Male Female	3.19	0.001	0.64	0.519	0.92	0.357
DUV	Male Female	0.66	0.506	0.96	0.333	1.72	0.085
NUV	Male Female	1.63	0.103	0.96	0.333	1.61	0.106

Depicts significant difference $p < 0.05$

From table 7 it can be observed that for the parameters DVB and NVB, males had higher mean values than females, whereas females had mean value of zero for the vowels /a/ and /u/, for vowel /i/ both males and females had mean values as zero. And males had higher mean values compared to females for the parameters DSH and NSH whereas females had mean values of zero for vowel /a/ and it was higher for vowels /i/ and /u/. For the parameters DUV and NUV males had greater mean values compared to females in all the vowels. But none of the parameters revealed statistical significance as seen in table 8.

Table 9: Mean and standard deviation values for noise related measures in phonation samples of /a/, /i/, and /u/

Parameters	Groups	Vowel /a/		Vowel /i/		Vowel /u/	
		Mean	SD	Mean	SD	Mean	SD
NHR	Male	0.13	0.02	0.56	2.64	0.13	0.02
	Female	0.14	0.04	0.11	0.02	0.11	0.03
VTI	Male	0.03	0.01	0.04	0.02	0.02	0.01
	Female	0.03	0.01	0.04	0.01	0.02	0.01
SPI	Male	21.59	11.08	12.29	9.61	49.73	22.99
	Female	17.65	11.20	10.91	6.37	60.01	21.11

Table 10: /Z/ and p values for noise related measures in phonation samples of /a/, /i/, and /u/

Parameters	Teachers	Vowel / a /		Vowel / i /		Vowel / u /	
		/ Z /	P	/ Z /	P	/ Z /	P
NHR	Male Female	0.53	0.596	1.34	0.179	0.97	0.331
VTI	Male Female	0.84	0.398	0.58	0.562	0.75	0.448
SPI	Male Female	1.25	1.021	0.01	0.992	1.57	0.116

Depicts significant difference $p < 0.05$

Tables 9 and 10 showed higher or equal mean values for all noise related measures in males except SPI for /u/ which was noticed to be higher for females. But these differences were not significant statistically.

Table 11: Mean and Standard deviation values for tremor related measures in phonation samples of /a/, /i/, and /u/

Parameters	Groups	Vowel /a/		Vowel /i/		Vowel /u/	
		Mean	SD	Mean	SD	Mean	SD
FTRI	Male	0.59	0.90	0.34	0.16	0.22	0.13
	Female	0.37	0.24	0.32	0.15	0.26	0.12
ATRI	Male	3.78	2.40	6.19	18.66	3.44	3.54
	Female	3.49	2.51	3.08	1.39	3.79	3.01
Fftr	Male	5.02	3.15	4.20	2.54	3.90	2.30
	Female	3.71	1.74	3.62	1.57	3.90	2.20
Fatr	Male	4.11	2.09	4.19	1.93	3.66	2.13
	Female	4.24	2.04	3.72	1.69	3.52	1.03

Table 12: /Z/ and p values for tremor related measures in phonation samples of /a/, /i/, and /u/

Parameters	Teachers	Vowel / a /		Vowel / i /		Vowel / u /	
		/ Z /	P	/ Z /	P	/ Z /	P
FTRI	Male Female	0.88	0.378	0.29	0.772	1.20	0.229
ATRI	Male Female	0.51	0.604	0.63	0.527	0.94	0.344
Fftr	Male Female	0.93	0.348	0.45	0.648	0.48	0.624
Fatr	Male Female	0.11	0.907	0.89	0.372	0.94	0.344

Depicts significant difference $p < 0.05$

Tremor related measures in phonation were mostly higher in males except Fatr for vowels /a/, /i/ compared to females (Table 11). Females had a higher Fatr values compared to males for the vowel /a/, whereas males had higher mean Fatr values for vowels /a/ and /u/. Mean FTRI and ATRI values were higher in females for vowel /u/.

The mean values for Fftr did not vary between males and females for the vowel /u/. Table 12 showed no statistical significance for the above parameters.

Tremor related measure (ATRI) and voice irregularity measure (NUV) were significantly higher for female teachers than male teachers, short and long term frequency and amplitude perturbation, voice irregularity measures (DUV), tremor measure (Fftr) and noise related measures (SPI and NHR) were significantly higher for male teachers compared to female teachers as reported by Yeshoda & Rajasudhakar (2015).

When male and female subjects were compared on phonation task, though it was found that male teachers revealed increased mean values for most of the F0 related measures, short and long term frequency, amplitude perturbation, voice break, sub-harmonic, voice irregularity, noise related and tremor related measures when compared to females, statistical significance was not noticed. This may specify that no consistent pattern was followed by both female and male subjects in speech during the course of speaking for their profession. It could be speculated that the voice control was imprecise in males as noticed from the higher mean values even though their mean fundamental frequency was lower. The present study results are in consonance with the results of Koul (2004) and Prasad (2012) who reported that frequency related measures had increased values compared to other measures. But in general, the mean values were high for all acoustic parameters in male teachers compared to that of female teachers. The reason was that male teachers would have more years of experience and also taught larger number of children in classrooms. These changes in increased perturbation, noise related, sub-

harmonic and tremor related measures can be accounted for teachers' usage of higher speaking Frequency (F0) and intensity (I0) during lessons than during breaks. Similarly it was noted that their voice related parameters tend to increase toward the end of the working day, which might be an effect of vocal loading.

In general, the obtained results are similar to that of studies of Rantala & Vilkman (1999) and Rantala, et.al, (2002) wherein they reported that the frequency and amplitude perturbations were increased in normal speakers. Rajasudhakar & Savithri (2009), Prasad (2012) and Yeshoda & Rajasudhakar (2015) also reported increased jitter, fundamental frequency and standard deviation of fundamental frequency after 6 hours of teaching compared to pre teaching condition.

B. **Acoustic analysis of monologue**

Table 13: Mean, SD, Z and p values for monologue.

		Monologue			
Parameters	Groups	Mean	SD	| Z |	P
MF0	Male	131.61	19.23	5.20	0.00
	Female	201.53	34.76		
Min F0	Male	89.19	16.12	2.49	0.013
	Female	113.26	48.87		
Max F0	Male	347.91	36.88	0.03	0.975
	Female	350.66	27.88		
SD F0	Male	33.90	8.69	1.55	0.121
	Female	29.92	8.95		
vF0	Male	0.25	0.07	4.52	0.000*
	Female	0.14	0.03		
SRAP	Male	2.13	1.08	5.03	0.000*
	Female	4.68	1.13		

*Depicts significant difference $p < 0.05$

Tables 13 and 1 show that Mean F0 values were higher for speech (monologue) compared to phonation in both males and females subjects. Table 13 indicates an increase in frequency range for males compared to females as MaxF0 was increased and MinF0 was decreased. But these results did not reach statistical significance. vF0 was statistically higher in males compared to females at ($p< 0.05$). SRAP was higher in females than males and it showed statistical significance at $p=< 0.05$. The increased MaxF0 and decreased MinF0 which indicates increased F0 range may point to the fact that the male subjects were more expressive in their speech as against female subjects. This might have also resulted in increased variations in mean speech fundamental frequency and amplitude.

This may be speculated to be due to the variations in the fine-tuning of the vocal fold vibrations and glottal valving combined with supra-glottal and supralaryngeal modifications in the presence of voiced and voiceless sounds that occur in habitual speech due professional demands. These adjustments are affected by various factors including age, sex, environmental factors along with emotions and everyday situations.

According to Yeshoda & Rajasudhakar (2015) majority of the fundamental frequency related measures (SF0, Min F0, Max F0, and STD of F0) for speech was reported to be higher for female teachers compared to male teachers and female teachers had a significantly higher standard deviation of fundamental frequency during speaking compared to male teachers.

Stemple, Stanley and Lee (1995) reported that weakness of the thyroarytenoid muscle consequent to vocal loading causes increased mean F0. When the muscular layer

of the thyroarytenoid slackens resulting in stiffness of the cover and transition layers of the vocal folds, it leads to an increase in F0. They also reported that even two-hour of voice loading resulted in increased F0. According to Rantala, Vilkman, and Bloigu (2002) the compensatory reactions of the speakers alter the mucosa resulting in increased vocal fold vibration and glottal adductory forces (hyperfunction). These studies lend support to the findings of the present study wherein majority of frequency and its related parameters showed increased values.

The results of the present study in general showed increased mean fundamental frequency in phonation and speech to be higher in male teachers compared to female teachers. Frequency and amplitude perturbations, noise and other related measures increased in teachers. These findings are in consonance with results reported by Rantala & Vilkman (1999), Rantala, et.al, (2002), Amita (2004), Rajasudhakar & Savithri (2009), Prasad (2012) and Yeshoda & Rajasudhakar (2015). Based on these findings it may be concluded that that the teachers of JNV (residential set-up) were similar to teachers of day school set-up.

CHAPTER V

SUMMARY AND CONCLUSION

The present study aimed to investigate voice characteristics in Jawahar Navodaya Vidyalaya school teachers. A total of 51 teachers: 36 male teachers and 15 female teachers were considered for the study. Acoustic analysis was carried out for the tasks phonation and monologue. All the subjects phonated vowel /a/, /i/ and /u/ for 5 seconds and spoke about there working experience at Navodaya for 2 minutes as monologue which were audio recorded on to the digital voice recorder.

The sustained phonation samples were subjected to MDVP analysis and acoustic parameters under eight major categories were extracted. Acoustic analysis of monologues was done using Real Time Pitch and 6 acoustic measures for speech were extracted. Statistical analysis was conducted to note descriptive statistics and measures of significance.

Generally, the results indicated that in phonation task, male teachers compared to female teachers revealed increased mean values for some of the F0 related measures, short and long term frequency and amplitude perturbation measures, tremor related measures when compared to that of females across vowels. And in speech (monologue) task, again male teachers showed increased MF0, MaxF0 and lower MinF0 when compared to females. They also had higher values in vF0 whereas female teachers had higher values in SRAP and the same showed a statistical significance.

In conclusion, the male subjects had better Mean F0, narrower F0 range in phonation but greater short and long term perturbation in frequency and amplitude, voice turbulence, sub-harmonic, noise and tremor related measures. Speaking mean fundamental frequency and range also was noticed to be increased for male teachers when compared to female teachers. The differential control and variations in the vocal fold vibrations, glottal valving and supra-glottal alterations in habitual speech contexts and under the influence of vocal load owing to professional demands may be speculated as the cause for such results.

The current study was explorative in nature and hence, the results have to be viewed with caution. Further, similar studies using large sample size, multidimensional assessment protocols including perceptual, acoustical and self-assessment could be carried out for recognizing the varied voice characteristics in such residential school teachers.

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