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Acoustic Voice Analysis of Young Malayalam Speakers across Genders

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Abstract: ***The production of human voice involves a complex series of events in the peripheral phonatory organs which are controlled by the central nervous system (Sataloff, 2006). PRAAT is very flexible tool to do speech analysis. The word PRAAT is derived from Dutch language which means to talk. The PRAAT software is created by Boersma and Weenink from university of Amsterdam (1992). With advances in computer technology; the sophisticated acoustic analysis of voice has become common practice for many speech and hearing clinicians. Amount of researches has been done to know the norm values for voice parameters using PRAAT Software is less. The aim of the study was to analyse the acoustic voice parameters in young Malayalam speakers across genders. The aim of the study was to establish a normative data of acoustic parameters of voice for Malayalam speakers in the age range of 18 -30 years using PRAAT software. The native Malayalam speakers with normal voice aged between 18 and 30 years were included in the study (30 women, 15 men). The subjects were comfortably seated and recordings were made using a microphone attached to hp laptop in a quiet and well illuminated environment. The microphone was placed at about 3 inches from the mouth of the subjects. Subjects were asked to take a deep breath and phonate /a/, /i/, /u/, as long as possible at a comfortable pitch level. This was demonstrated by examiner for all subjects. The result shows that the mean pitch for female was found to be more than males. The highest mean pitch for both males and females was observed for the vowel /i/. The mean maximum pitch is greatest for female. When each vowel are compared the maximum pitch is found to be highest for female in vowel /i/ and vowel /u/ for males. The result also showed that mean minimum pitch is highest for females than males. On vowel comparison, Vowel /i/ had the highest mean minimum pitch across the gender. The mean jitter value for vowel /u/ was found to be more in both male and females. When compared between the males and females the mean jitter value of male was found to be higher. The mean shimmer value was highest for the vowel /u/ across the gender. However on comparison the mean shimmer value for females was found to be more. The mean NHR value is more for males and females on vowel comparison the value was highest for vowel /u/ for females and vowel /i/ for males. The mean HNR value was found to be higher for females than males, and vowel /i/ had the highest value for males and vowel /a/ for females. So the present study was aimed to establish a normative data across genders for 18 to 30 years adult population using PRAAT software in Indian population, that is the attempt to set a value for Fo, Jitter, Shimmer, NHR and HNR.***

Keywords: Acoustic, Voice analysis, PRAAT, Gender, Voice parameters

1. Introduction

The production of human voice involves a complex series of events in the peripheral phonatory organs which are controlled by the central nervous system(Sataloff, 2006).

Voice experiences changes with age and gender because of anatomical and physiological changes. Age related changes happening in the framework of larynx also will change the voice parameters. As the age increases the development of laryngeal structures also become increase during the life time of child to adult stage. Gender related structural changes in larynx also will change the voice parameters

In the assessment and diagnosis of voice disorders, both subjective and objective measures have been widely used by clinicians and researchers. Acoustic analysis is one of the highly preferred tools for objective assessment of voice. Because it is non-invasive and easily applicable procedure that provides quantitative data on laryngeal function, computerized acoustic voice analysis gained importance. Fundamental frequency (F0), jitter, shimmer, and noise-to-harmonics ratio (NHR) are the most commonly used acoustic parameters to evaluate vocal function.

PRAAT is very flexible tool to do speech analysis. The word PRAAT is derived from Dutch language which means to talk. The PRAAT software is created by Boersma and Weenink from university of Amsterdam (1992).

With advances in computer technology; the sophisticated acoustic analysis of voice has become common practice for many speech and hearing clinicians. Amount of researches has been done to know the norm values for voice parameters using PRAAT Software is less. The aim of the study was to analyse the acoustic voice parameters in young Malayalam speakers across genders.

2. Methodology

Aim:
The aim of the study was to establish a normative data of acoustic parameters of voice for Malayalam speakers in the age range of 18 -30 years using PRAAT software.

Subjects:
The native Malayalam speakers with normal voice aged between 18 and 30 years were included in the study (30 women, 15 men)

Subjects Selection:

Inclusion criteria

- Individuals who are healthy and between the age of 18 to 30
- None of the subjects had a history of vocal pathology or voice disorder, cold, allergies, neurological disease and respiratory dysfunction
- No history of past or present speech, language or hearing problem.

Exclusion criteria

- Having ear pathology or hearing loss
- Having upper respiratory tract infection in last 3 weeks
- Having professional voice training ;
- History of surgery in head and neck region
- Having neurological or respiratory disease
- Having structural pathology of oral cavity, pharynx, or larynx

3. Procedure

The subjects were comfortably seated and recordings were made using a microphone attached to hp laptop in a quiet and well illuminated environment. The microphone was placed at about 3 inches from the mouth of the subjects. Subjects were asked to take a deep breath and phonate /a/, /i/, /u/, as long as possible at a comfortable pitch level. This was demonstrated by examiner for all subjects.

The selected voice parameters include mean pitch(Hz), minimum pitch(Hz), maximum pitch(Hz), jitter(%), shimmer(%), NHR(dB), and HNR(dB) were calculated for each vowels and the values of three recordings were averaged. All these measures were analysed using PRAAT [version 5.1.04] and were statistically analysed.

4. Result

Mean pitch of female

Table 3.1: Showing Mean, SD of Mean Pitch for /a/, /i/, /u/

Stimulus	Number	Mean	Standard Deviation
a	30	225.19	20.56
i	30	227.11	29.5
u	30	222.70	41.42

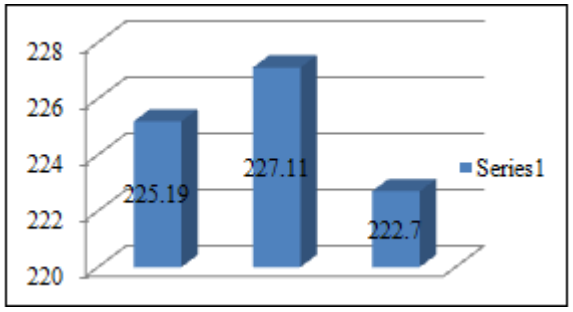

Figure 3.1: Showing mean pitch for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of mean pitch for vowel /a/, /i/ , /u/ are 225.19, 227.11, 222.7 respectively. The mean pitch of vowel /i/ is more compare to vowel /a/ and /u/.

Mean pitch of male

Table 3.2: Showing Mean, SD of Mean Pitch for /a/, /i/, /u/

Stimulus	Number	Mean	Standard Deviation
a	15	126.36	13.28
i	15	130.66	17.72
u	15	129.94	15.69

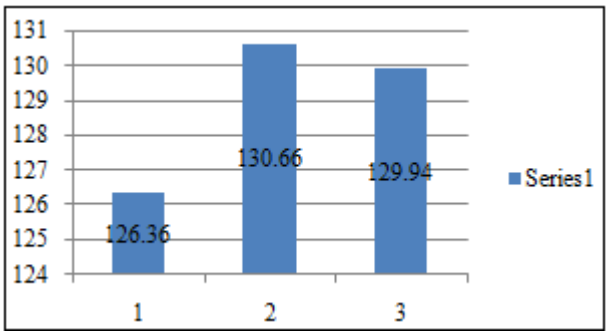

Figure 3.2: Showing mean pitch for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of mean pitch for vowel /a/, /i/ , /u/ are 126.36, 130.66, 129.94 respectively. The mean pitch of vowel /i/ is more compare to vowel /a/ and /u/. When comparing vowel /a/ and /u/ the mean value of vowel /a/ is lesser than that of vowel /u/.

Maximum Pitch of female

Table 3.2: Showing Mean, SD of Maximum Pitch for vowels /a/, /i/, /u/

Stimulus	Number	Mean	Standard Deviation
a	30	224.88	21.108
i	30	225.77	29.247
u	30	221.33	41.455

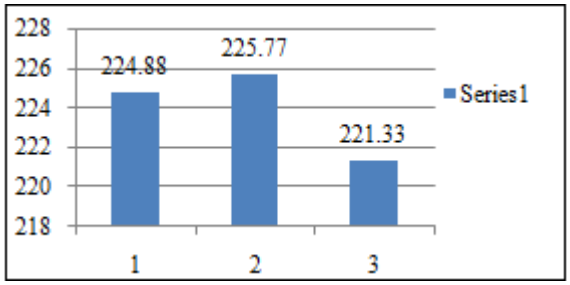

Figure 3.2: Showing maximum pitch for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of maximum pitch for /a/,/i/,/u/ are 224.88, 225.77, 221.33 respectively. The maximum pitch of vowel /u/ is less compare to vowel /a/ and /i/. When comparing vowel /a/ and /u/ the mean value of vowel /u/ is lesser than that of vowel /a/.

Maximum Pitch for Male

Table 3.3: Showing Mean, SD of Maximum Pitch for vowels /a/, /i/, /u/

Stimulus	Number	Mean	Standard Deviation
a	15	127.99	13.50
i	15	129.89	16.01
u	15	131.37	16.14

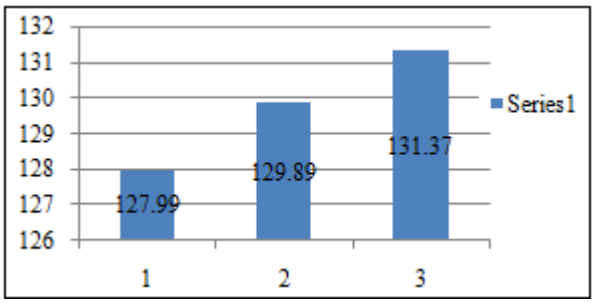

Figure 3.3: Showing maximum pitch for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of maximum pitch for /a/,/i/,/u/ are 127.99, 129.89, 131.37 respectively. The maximum pitch of vowel /u/ is more compare to vowel /a/ and /i/.

Minimum Pitch of female

Table 3.4: Showing Mean, SD of Minimum Pitch for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	30	226.53	20.896
e	30	228.7	29.833
u	30	225.14	41.855

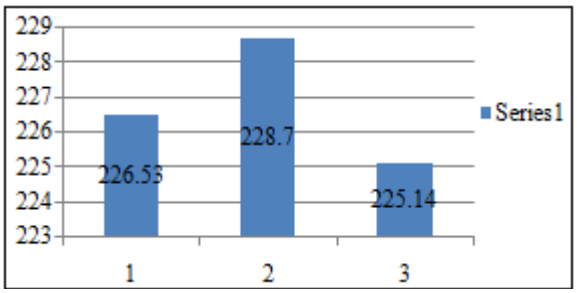

Figure 3.4: Showing minimum pitch for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of minimum pitch for /a/,/i/,/u/ are 226.53, 228.7, 225.14 respectively. The minimum pitch of vowel /i/ is more compare to vowel /a/ and /u/.When comparing vowel /a/ and /u/ the mean value of vowel /u/ is lesser than that of vowel /a/.

Minimum Pitch for Male

Table 3.5: Showing Mean, SD of Minimum Pitch for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	15	124.73	13.12
e	15	130.24	16.91
u	15	128.74	15.30

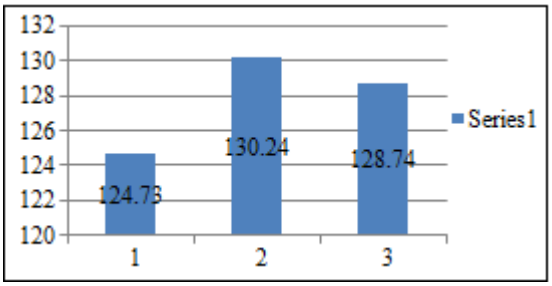

Figure 3.5: Showing minimum pitch for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of minimum pitch for /a/,/i/,/u/ are 124.73, 130.24, 128.74 respectively. The minimum pitch of vowel /i/ is more compare to vowel /a/ and /u/.When comparing vowel /a/ and /u/ the mean value of vowel /u/ is more than that of vowel /a/.

Jitter value for female

Table 3.6: Showing Mean, SD of Jitter for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	30	16.4	6.98
e	30	24.84	21.85
u	30	46.92	55.38

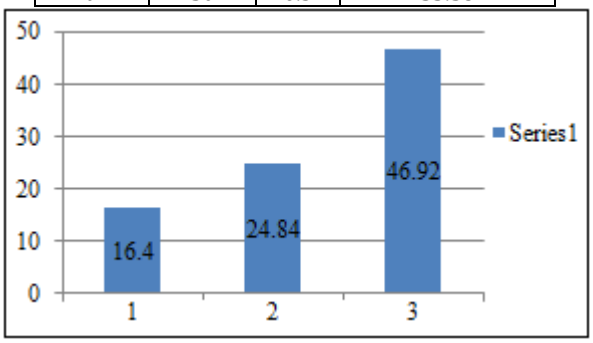

Figure 3.6: Showing means Jitter value for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of jitter for vowel /a/,/i/,/u/ are 16.4, 24.84, 46.92 respectively. The mean value of Jitter for vowel /u/ is more compare to vowel /a/ and /i/.When comparing vowel /a/ and /i/ the mean value of vowel /a/ is lesser than that of vowel /i/.

Jitter value for Male

Table 3.7: Showing Mean, SD of Jitter for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	15	30.81	14.7
e	15	29.51	24.3
u	15	56.45	79.8

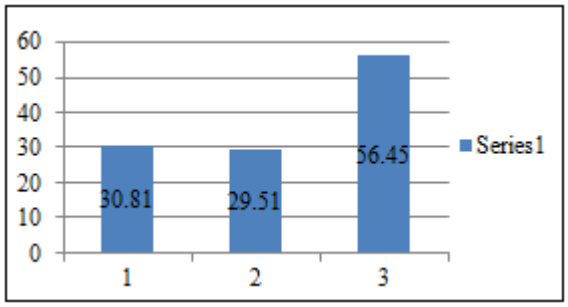

Figure 3.7: Showing means Jitter value for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of minimum pitch for /a/,/i/,/u/ are 30.18, 29.51, 56.45 respectively. The minimum pitch of vowel /u/ is more comparing to vowel /a/ and /i/.

Shimmer value for female

Table 3.8: Showing Mean, SD of Shimmer for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	30	0.39	0.21
e	30	0.67	0.61
u	30	0.86	14.75

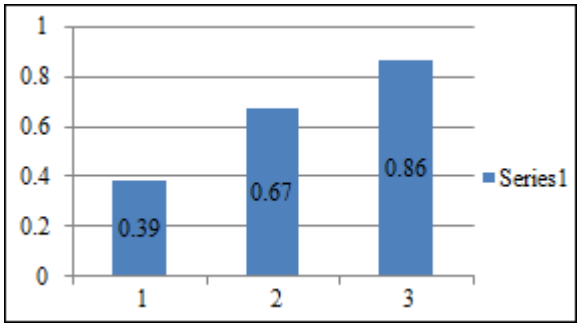

Figure 3.8: Showing mean Shimmer value for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of Shimmer for vowel /a/,/i/,/u/ are 0.391, 0.675, 0.869 respectively. The mean value of Shimmer for vowel /u/ is more compare to vowel /a/ and /i/.When comparing vowel /a/ and /i/ the mean value of vowel /a/ is lesser than that of vowel /i/.

Shimmer value for male

Table 3.9: Showing Mean, SD of Shimmer for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	15	0.32	0.17
e	15	0.46	0.33
u	15	0.85	0.45

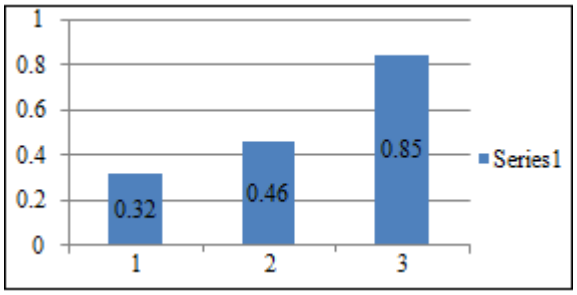

Figure 3.9: Showing mean Shimmer value for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of Shimmer for vowel /a/,/i/,/u/ are 0.32, 0.46, 0.85 respectively. The mean value of Shimmer for vowel /u/ is more compare to vowel /a/ and /i/.When comparing vowel /a/ and /i/ the mean value of vowel /a/ is lesser than that of vowel /i/.

Noise Harmonic Ratio of female

Table 3.10: Showing Mean, SD of NHR for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	30	0.03	0.01
e	30	0.09	0.18
u	30	0.08	0.16

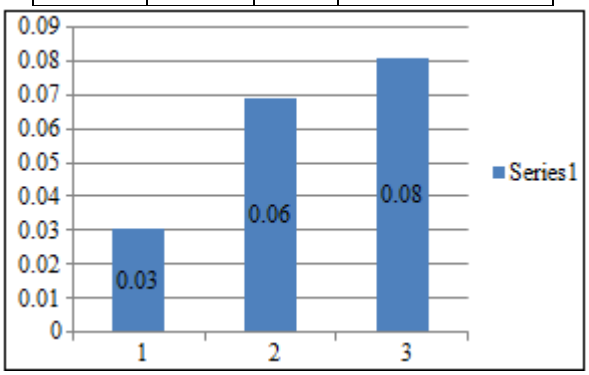

Figure 3.10: Showing means NHR value for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of NHR for vowel /a/,/i/,/u/ are 0.03, 0.06, 0.08 respectively. The mean value of NHR for vowel /u/ is more compare to vowel /a/ and /i/.When comparing vowel /a/ and /i/ the mean value of vowel /a/ is lesser than that of vowel /i/.

Noise Harmonic Ratio of male

Table 3.11: Showing Mean, SD of NHR for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	15	19.19	3.33
e	15	21.18	4.60
u	15	17.62	5.39

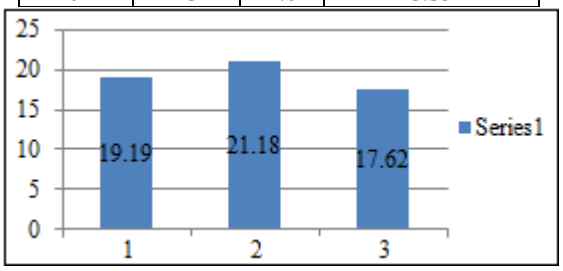

Figure 3.11: Showing mean NHR value for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of NHR for vowel /a/,/i/,/u/ are 19.19, 21.18, 17.62 respectively. The mean value of NHR for vowel /i/ is more compare to vowel /a/ and /u/.When comparing vowel /a/ and /u/ the mean value of vowel /a/ is more than that of vowel /u/.

Harmonic Noise Ratio of female

Table 3.12: Showing Mean, SD of HNR for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	30	20.26	3.63
e	30	19.09	5.82
u	30	17	7.06

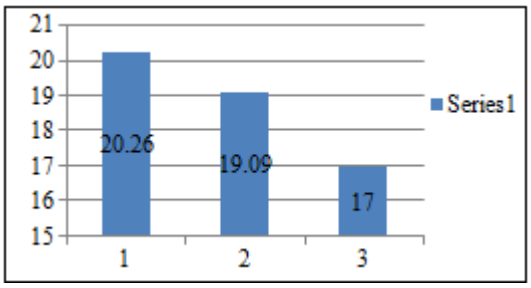

Figure 3.12: Showing mean HNR value for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of HNR for vowel /a/,/i/,/u/ are 20.26, 19.09, 17respectively. The mean value of HNR for vowel /a/ is more compare to vowel /i/ and /u/.When comparing vowel /i/ and /u/ the mean value of vowel /u/ is lesser than that of vowel /i/.

Harmonic Noise Ratio of male

Table 3.13: Showing Mean, SD of HNR for vowels /a/, /i/, /u/.

Stimulus	Number	Mean	Standard Deviation
a	15	0.021	0.018
e	15	0.113	0.024
u	15	0.025	0.028

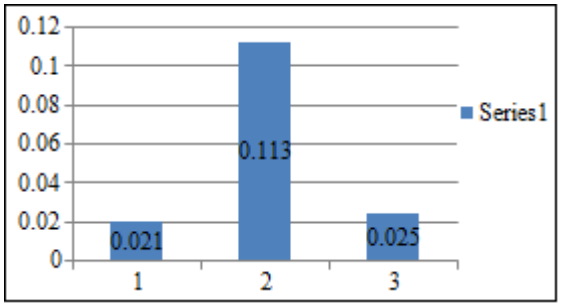

Figure 3.13: Showing mean HNR value for vowels /a/, /i/, /u/.

From the above table and figure it can be seen that the mean value of HNR for vowel /a/,/i/,/u/ are 0.021, 0.113, 0.025respectively. The mean value of HNR for vowel /I/ is more compare to vowel /a/ and /u/.

5. Discussion

Purpose of this study was to establish the normative data of acoustic parameters of voice across genders in the age range of 18 to 30 tears using PRAAT software in the Indian population. The study provide an acoustic normative value across genders for the acoustic parameters i,e, mean pitch, maximum pitch, minimum pitch, Jitter, Shimmer, NHR, HNR of adult peoples.

On comparison the mean pitch for female was found to be more than males. The highest mean pitch for both males and females was observed for the vowel /i/.

The mean maximum pitch is greatest for female. When each vowel are compared the maximum pitch is found to be highest for female in vowel /i/ and vowel /u/ for males.

The result also showed that mean minimum pitch is highest for females than males. On vowel comparison, Vowel /i/ had the highest mean minimum pitch across the gender.

The mean jitter value for vowel /u/ was found to be more in both male and females. When compared between the males and females the mean jitter value of male was found to be higher.

The mean shimmer value was highest for the vowel /u/ across the gender. How ever on comparison the mean shimmer value for females was found to be more.

The mean NHR value is more for males and females on vowel comparison the value was highest for vowel /u/ for females and vowel /i/ for males.

The mean HNR value was found to be higher for females than males, and vowel /i/ had the highest value for males and vowel /a/ for females.

6. Conclusion

In summary although several software has there on normative data; there is no normative data available for the PRAAT software especially across genders in adult Indian context. So the present study was aimed to establish a normative data across genders for 18 to 30 years adult population using PRAAT software in Indian population, that is the attempt to set a value for Fo, Jitter, Shimmer, NHR and HNR.

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