

Acoustic Analysis Of Voice In Children And Adults

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Speech is complex activity involving various muscles of respiration, phonation, articulation and resonance. The end product of these neuromuscular activity is an acoustical signal i.e. speech. Speech and voice is known to change with age and maximum co-ordination between different subsystems of speech is achieved by adulthood. The importance of acoustic analysis in studying this developmental changes in neuromuscular activity in speech is highlighted in following statement by Kent (1976). "The past two decades have been witness to an increasing application of acoustic analysis to the study of speech development in children These acoustic features on various aspects of speech production indicates that the accuracy of motor control improves with age until adult like performance is achieved at about 11-12 years, somewhat after the age at which speech sound acquisition is usually judged to be complete."

Availability of sophisticated methods of measurement like digitization and computer have enabled speech scientists to study developmental changes in voice in large number of children.

The acoustic analysis to study the speech development in children has been found to be useful in early identification, diagnosis and treatment of various speech and languages disorders.

Hence the present investigation included some of the parameters which were recommended by earlier investigators. They are;

1. The maximum phonation duration of vowels.
2. The maximum duration of /s/ and /z/ and the S/Z ratio.
3. The fundamental frequency of phonation.
4. The speaking fundamental frequency.
5. Speed of fluctuation in frequency of phonation.
6. Extent of fluctuation in frequency of phonation.
7. Frequency range in phonation.
8. Frequency range in speech.
9. Speed of fluctuation in intensity of phonation.
10. Extent of fluctuation in intensity of phonation.
11. Intensity range in phonation.
12. Intensity range in speech.
13. Rise time in phonation.
14. Fall time in phonation.

These parameters were studied in sample of three hundred subjects (children and adults) age ranging from 7 - 22 years who were normal in terms of their speech, language and hearing.

Data on the maximum duration /a/, /i/,/u/ and /s/, /z/ along with the repetition of three Kannada sentences 'idu pa: pu', 'idu ko:ti' and 'idu kempu banna' were recorded. Each subject was given three trials.

The duration of vowels and the fricatives were measured using a stop watch, the longest of which was considered as the maximum phonation duration.

These samples were digitized by using ADC and fed to computer (PC-AT) to obtain the fundamental frequency of phonation, Frequency range, Intensity range, Speed & Extent of fluctuations in frequency and intensity in phonation.

The same samples were fed to the pitch analyzer (PM 100) to measure the rise and fall time in phonation. Three Kannada sentences were fed into pitch analyzer for the analysis of SFF, frequency range and intensity range in speech.

Thus the results for all the parameters were obtained for all the 300 subjects. The obtained values were then tabulated and subjected to statistical analysis to determine the mean, S.D and significance of difference. Mann-Whitney 'U' test was applied to know the significance of difference.

After the statistical analysis, the following conclusions were drawn.

I) Maximum phonation duration:

- 1) The MPT of vowels increases as a function of age in both males and females.
- 2) There is no significant difference in MPT of vowels, between males and females, across the age range studied.
- 3) The MPT of /I/ is greatest followed by /a/ and /u/.

II) S/Z Ratio:

- 1) S/Z ratio remains constant through out the age range studied.
- 2) There is no significant difference in the S/Z ratio between males and females.

III) Fundamental frequency of phonation:

- 1) In males, there is a lowering of Fo with advancing age upto the age of 15 years, after which there is a marked decrease in the fundamental frequency.
- 2) In females there is a gradual decrease upto the age of 12 years after which there is little change in Fo with age.
- 3) A significant difference in fundamental frequency of voice between males and females is observed after the age of 15 years only.
- 4) The fundamental frequency of /I/ is the highest followed by /u/ and finally /a/ has the lowest fundamental frequency of the three vowels studied.

IV) Speed of fluctuation in frequency of phonation:

- 1) Males and females show a significant decrease in the mean and S.D. values with age.
- 2) No significant difference in the speed of fluctuation in frequency between males and females was observed in younger age group, upto the age group 14-15 after which the significant differences were found.

V) Extent of fluctuation in frequency of phonation:

- 1) The extent of fluctuation in phonation in males decreased with age.
- 2) In females there is no consistent significant change in extent of fluctuation in frequency of phonation with age.
- 3) There is no significant difference between males and females with reference to the extent of fluctuation in frequency of phonation.

VI) Speed of fluctuation in intensity:

- 1) Males show significant decrease in speed of fluctuation in intensity with age.
- 2) Females also show a decrease with age but more gradual than that of males.
- 3) Males show significantly highest speed of fluctuation in intensity than that of females in lower age group only.

VII) Extent of fluctuation in intensity of phonation:

- 1) Age groups 17-18 years and above show a significantly lower age values than other age groups.
- 2) Females do not show any consistent change with age.
- 3) No significant difference is found between males and females in the age range studied.

VIII) Frequency range in phonation:

- 1) In males the frequency range in phonation decrease gradually with age.
- 2) In females the decrease in frequency range in phonation is more gradual than in males.
- 3) The significant difference in frequency range between males and females are present in adult age groups only.

IX) intensity range in phonation:

- 1) Both males and females show a gradual decrease in intensity range with the age.
- 2) Males show higher intensity ranges at 13-14 years age groups and females show in the age group 8-9 and 9-10 yrs.

X) Speaking fundamental frequency:

- 1) In case of males gradual change in SFF as a function of age upto age of 15 years, at which age a sudden decrease in the peaking Fo is observed.
- 2) In case of females there is a gradual change in the SFF with increase in age.

- 3) The SFF of males and females is not significantly different upto 15 yrs. A significantly lower speaking FF is present in the males after 15 yrs when compared to females.

XI) Frequency range in speech:

- 1) Males show significant decrease in frequency range in speech with increasing age.
- 2) In females no significant change is observed.
- 3) Significant, difference between males and females are not present.

XII) Intensity range in speech:

- 1) Males show increase in intensity range in speech.
- 2) Female do not show any consistent changes.

- 3) There is no significant difference in intensity range of speech between males and females.

XIII) Rise time:

- 1) There is no significant change in rises time for both males and females.
- 2) There is no significant difference in rise time between males and females.

XIV) Fall time:

- 1) Both males and females show increase in fall time with age.
- 2) Males show a sudden increase in fall time at the age range 14-15 yrs (for /a/ and /u/) and females at the age range 8-9 yrs.
- 3) No significant difference is found in fall time of phonation between males and females.