

Cepstral Analysis of Voice in 3-6 year children

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ABSTRACT

*Studies on Cepstral analysis of voice in paediatric population are limited. Hence, the present study is taken up. **Aim of the Study:** The present study focused on finding the effect of age (3 – 6 years) and gender on Cepstral Peak Prominence (CPP) and smoothed Cepstral Peak Prominence (CPPs) for phonation of /a/, /i/, /u/. **Method:** 60 children in the age range of 3-6 years participated in this study. Phonation of vowels /a/ /i/ /u/ at comfortable pitch and loudness for three trials were recorded. The best voice sample with steady portion of vowel for duration of 5 second was taken for analysis of CPP and CPPs for phonation of /a/, /i/, /u/ using speech tool software. **Results:** There was no significant effect of gender on Cepstral parameters, whereas there was significant main effect of age from 3 to 6 years on cepstral parameters (CPP) and (CPPs).*

Keywords: Cepstral Analysis (CPP and CPPs), 3-6 years children

INTRODUCTION

The over allaryngeal structure changes as an individual matures from a child to an adult. Anatomical differences in terms of size and dimension of the larynx attributes for changes in voice of the children and adult. These developmental transformations lead to differences in vocal function. There are various subjective and

objective measures to evaluate voice quality. Measures have been advocated for acoustic study of vocal function. These measures overcome the limitation of traditional based measures.

Cepstral analysis is one among the derived measures of spectral measure. "Cepstrum is described as a discrete Fourier transform of the logarithm power spectrum (Hillenbrand & Houde 1996). This measure gives a better picture of the degree of harmonic organization in a signal. Cepstral Peak Prominence (CPP) and smoothed Cepstral Peak Prominence (CPPs) are Cepstral measures. Cepstral Peak Prominence (CPP) is a measure of the amplitude of the cepstral peak corresponding to the fundamental period, which is normalized for overall signal amplitude (Krom 1993). Smoothed Cepstral peak prominence (CPPs), here the individualized Cepstra of voice signal are averaged over a given number of frames before extracting the Cepstral peak and calculating the peak prominence (Hillenbrand et al. 1994).

Usha Manjunatha (2017) studied the effect of age and gender on CPP and CPPs Cepstral measures in Young children (6-12) years and adults (20-40) years for phonation of vowel /a/. The results of the study showed that there was overall main effect of age was seen for CPP and CPPs and there was no gender effect on CPP and CPPs. Infusion et al. (2015) studied acoustic patterns of the normal pediatric voice using cepstral analysis of voice samples from a normal pediatric voice database (children aged 4 to 17 years). Results revealed significant changes in fundamental frequency with a distinct shift in slope at ages 11 and 14 years in boys for sustained vowel, voiced, glottal attack, and rainbow. A decreasing linear trend in fundamental frequency among all recordings (vowel, all voiced, easy onset, glottal attack, plosives, and rainbow) was found in girls. A significant linear increase in CPP for girls was only seen in all voiced. L/H ratio showed a linear increase with age among all speech samples (vowel, all voiced, easy onset, glottal attack, plosives, and rainbow) in boys and girls.

NEED

Anatomical differences in terms of size and dimension of the larynx attributes for changes in voice of the children and adult. To date data for Cepstral measurements of voices are more available for adult population and various voice disorders. Cepstral analysis of voice in paediatric populations is very limited. Hence, the present study was taken up to investigate the Cepstral based voice measures (CPP and CPPs) for children in the age 3 to 6 years. This information helps one to understand how structural changes in children's vocal folds correspond to acoustic changes during sustained phonation of /a/, /i/, /u/.

AIM

1. To study the effect of age (3-6 years) on CPP and CPPs for phonation /a/, /i/, /u/
2. To study the effect of gender on CPP and CPPs for phonation /a/, /i/, /u/

METHOD

Participants

60 children in the age range 3-6 years, sub divided into 3 groups: 3-4 years (G1); 4.1-5 years (G2); 5.1-6 (G3) years participated in this study. 20 participants (10 male and 10 female) in each age range respectively. Participants were from native Kannada speakers. Children with normal voice (perceptually) as judged by a speech language pathologist, normal hearing, normal speech language skills and no neurological deficits were included for the study.

Instrumentation

Speech tool program (Hillenbrand algorithm for the calculation of cepstral measures) was used to analyse Cepstral Peak Prominence (CPP) and smoothed Cepstral Peak Prominence (CPPs) for phonation of /a/, /i/, /u/.

Procedure

An informed written consent was obtained from the parents of children before the data collection. Voice recordings were done in a less background noise room the participants were made to sit comfortably on a chair and were instructed to phonate vowels /a/ /i/ /u/ at comfortable pitch and loudness for three trials. The task was demonstrated and instruction was repeated whenever required. Voice recording was done using Speech tool software (Hillenbrand algorithm) using good quality microphone with a microphone distance of 15cm from the participants. The best voice sample with steady portion of vowel /a/, /i/, /u/ for duration of 5 second each was taken for analysis of Cepstral Peak Prominence (CPP) and smoothened Cepstral Peak Prominence (CPPs) were calculated for each sample using Speech tool software. The values obtained were subjected to statistical analysis using SPSS software.

Statistical analysis

Independent samples T test, MANOVA and Post Hoc test was used using SPSS 17.0 for analysis of Cepstral Peak Prominence (CPP) and smoothened Cepstral Peak Prominence (CPPs) measures for vowels /a/, /i/, /u/.

RESULTS AND DISCUSSION

The present study aimed to measure Cepstral Peak Prominence (CPP) and smoothened Cepstral Peak Prominence (CPPs) for phonation of /a/, /i/, /u/ in the voices of typically developing children in the age of 3 to 6 years.

Table 1. Mean and standard deviation of CPP across group

Age (years)	Male						Females					
	/a/		/i/		/u/		/a/		/i/		/u/	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
3-4	11.9	1.79	11.5	1.6	11.5	2.07	10.6	2.22	11.3	0.98	11.3	2.01
4.1-5	11.4	1.76	11.4	2.82	11.7	1.42	11.6	2.01	12.4	1.91	11.1	1.86
5.1-6	9.83	0.75	8.7	0.78	8.8	0.61	9.5	8.4	9.2	1.03	8.7	0.99

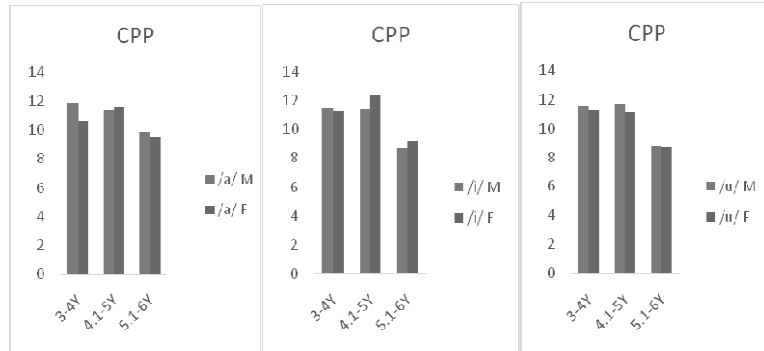


Figure1. Mean of CPP across group

Table 2. Mean and standard deviation of CPPs across group

Age (years)	Male						Female					
	/a/		/i/		/u/		/a/		/i/		/u/	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
3-4	1.2	0.38	0.9	0.68	1.3	0.60	0.8	0.45	1.2	0.19	1.6	0.55
4.1-5	1.1	0.41	1.1	0.49	1.3	0.39	1.2	0.49	1.5	1.7	1.0	0.53
5.1-6	0.6	0.19	0.5	0.25	0.5	0.15	0.5	0.29	0.5	0.20	0.5	0.15

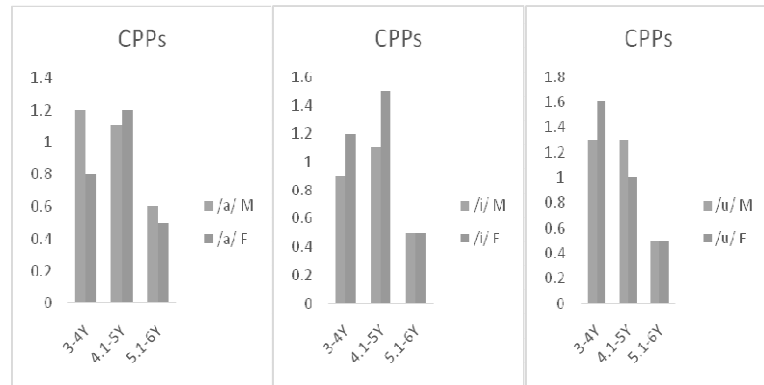


Figure 2. Mean of CPPs across group

Table 1 and Figure 1 indicates mean value for CPP across group. Table 2 and Figure 2 indicates mean value for CPPs across group. The results indicated no statistically significant difference between

male and female for mean values for CPP and CPPsat .05 level of significance. This may be due to voice quality and fundamental frequency of children would be similar before puberty. The result supports the study Usha Manjunatha (2017) indicating no gender difference for CPP and CPPs below pubertal age.

MANOVA was carried out to determine the effect of age for Cepstral Peak Prominence (CPP). The results indicated significant differences at .05 level of significance for /a/ (F, 7.24); /i/ (F, 15.98); and /u/ (F, 19.09). Post Hoc test results revealed significant differences at .05 level of significance for /a/, /i/ and /u/ for the groups studied; G1 Vs G3; G2 Vs G3; G3 Vs G1 and G3 Vs G2. For smoothed Cepstral Peak Prominence (CPPs) the results indicated significant differences at .05 level of significance for /a/ (F, 10.69); /i/ (F, 3.99); and /u/ (F, 27.14). Post Hoc test results revealed significant differences at .05 level of significance for /a/ and /u/ for the groups studied - G1 Vs G3; G2 Vs G3; G3 Vs G1 and G3 Vs G2. For /i/ - G2 Vs G3; and G3 Vs G2. The results are in support with Usha Manjunatha (2017) indicating age difference for CPP and CPPs below pubertal age.

CONCLUSION

The present study is an attempt to estimate the presence or absence of age and gender effect for Cepstral measures (CPP and CPPs) on phonation of /a/, /i/, and /u/ in 3-6 years children. Overall results of the study revealed no significant effect of gender on Cepstral parameters, whereas there was significant main effect of age from 3 to 6 years on cepstral parameters i.e. Cepstral Peak Prominence (CPP) and smoothed Cepstral Peak Prominence (CPPs). The present study may support future endeavours' of developmental CPP norms and clinical application.

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