

Normative Values of Adult's Voice in Indian Population Using Praat



Medical Science

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Ms. Reshmi M.

Lecturer (Audiology & Speech Therapy) Dept. of ENT, Himalayan Institute of Medical Sciences SRHU, Jolly Grant, Dehradun-248016

Dr. Santosh Kumar

Assistant Professor (Audiology & Speech Therapy) Dept. of ENT, Himalayan Institute of Medical Sciences SRHU, Jolly Grant, Dehradun-248016

ABSTRACT

Voice plays a major role in speech and communication. Voice characteristics convey information not only related to the individuals laryngeal status but also the social origins, emotional state, physique, age and sex. Any deviation from these guidelines is considered as voice disorder. The present study included 60 voice samples (30 males and 30 females) age range 18 to 25 years. The voice samples were recorded in sound treated room and analyzed with praat software. Voice parameters were analyzed like fundamental frequency(f0), Jitter (local), jitter (local, absolute), shimmer (local), shimmer (local dB), harmonics to noise ratio(HNR), first formant frequency(f1), second formant frequency(f2), and third formant frequency(f3) for the vowels /a/, /i/, and /u/. Mean and standard deviation were calculated and also t-test was carried out to observe the significant difference across gender on voice parameters. Significant differences were noticed on some of the voice parameters between genders.

Introduction

Voice is a modality through which most of the living things like humans produces speech, expresses different emotions. Voice also depicts an individual's health condition, mood and overall personality. This is generated by the help of air flow from the lungs and Bernoulli effect which results in opening and closing of vocal folds. Components of voice are pitch, loudness and quality. Pitch is a psychological correlate of frequency, which varies across gender, as females have high and males have low pitch. Loudness is psychological correlate of intensity, while quality determines the character or distinctive aspect of voice. Voice production depends upon coordination of these fundamental systems i.e., respiratory, phonatory, resonatory and regulatory. The vocal fold vibration of female is around 200 – 220/s and 100 – 120/s for men.

Objectives

- To develop normative data of adult's voice
- To compare gender difference on voice parameters

Methodology

A total of 60 normal subjects were selected which included 30 females and 30 males. Criterion of selection was no voice abnormalities in terms of anatomy and physiology. Age range was 18 to 25 years. Recording was done using microphone attached to a laptop having praat software version (5.3.17). While recording; environmental disturbances (sound treated room), microphone to subject distance and seating comfortability of subject was taken into consideration. Here subjects were instructed to take a deep breath and phonate /a, i, u/ as long as possible. Phonation of 4-5sec of duration and sampling frequency of 44100Hz with less amplitude fluctuation was taken into consideration for recording. Following parameters were analyzed; f0 (fundamental frequency), Jitter (local), jitter (local, absolute), shimmer (local), shimmer (local dB), HNR (harmonics to noise ratio), f1 (first formant frequency), f2 (second formant frequency), and f3 (third formant frequency).

Results and Discussion

This study was undertaken to investigate the acoustic parameters in the normal individual's voice. The voice of the individuals with a variety of variables was extracted using PRAAT software version 5.3.17. Mean and standard deviation were analyzed separately for males and females. t-test was carried out to find the significant parameter to distinguish between sounds across genders.

Table 1: Group statistics of males vs females for the sound /a, i, u/

Parameters	Sounds	Males		Females		p
		Mean	SD	Mean	SD	
f0	a	138	21	235	35	<0.05
	i	140	32	241	41	<0.05
	u	145	28	256	43	<0.05
Jitt	a	.45	.38	.34	.17	>0.05
	i	.35	.42	.38	.50	>0.05
	u	.61	.59	.41	.43	>0.05
Jitt abs	a	32	25	14	5	<0.05
	i	25	33	17	21	>0.05
	u	43	37	23	33	>0.05
Shimm	a	3	3	2	2	<0.05
	i	4	5	4	4	>0.05
	u	6	7	4	5	>0.05
Shimm abs	a	.34	.34	.32	.24	>0.05
	i	.39	.43	.40	.41	>0.05
	u	.67	.64	.43	.50	<0.05
HNR	a	18	5	20	4	>0.05
	i	18	6	18	6	>0.05
	u	21	6	21	7	>0.05
f1	a	691	152	834	192	<0.05
	i	423	348	421	279	>0.05
	u	388	122	400	118	>0.05
f2	a	1309	323	1452	327	<0.05
	i	2214	421	2379	665	>0.05
	u	1163	570	1030	361	>0.05
f3	a	2661	252	2875	342	<0.05
	i	2955	289	3102	342	<0.05
	u	2703	455	2898	375	<0.05

The table 1 shows the mean and standard deviation of parameters i.e., fundamental frequency, jitter local, jitter absolute, shimmer local, shimmer absolute, HNR, and formant frequencies (1,2 & 3) across males and females for the sounds /a, i, u/. It was observed that f0 /a, i, u/ of females were seemed to be higher in comparison to that of males. The f0 /a, i, u/, jitter absolute /a/, f1 /a/, f2 /a/, f3 /a, i, u/ have significant difference across the genders. There were no significant differences on most of the voice parameters between genders.

Wang and Huang (2004) conducted study on 45 Taiwanese women and men whose age was less than 50 yrs and analysis was done with computer speech Lab and aerophone II system. It

was found that f_0 /a/ was greater for females than males. There were no significant differences in average SPL and jitter between female and male which supported our study except for jitter absolute /a/. Franca (2012) found that vowels had significant effect on shimmer and back vowels exhibited reduced noise and perturbation, but in our study there was acoustical variation in all the vowel sounds.

Brockmann, Drinnan, Storck, & Carding (2011) study revealed that voice SPL had greatest impact on jitter and shimmer, whereas f_0 , gender and vowel effects were comparatively small. In our study gender had effect only on jitter absolute /a/, while vowels had significant effect only on shimmer not on jitter.

According to Naufel de Felipe, Grillo, & Grechi (2006), normative values are as follows; for females /a/ and /i/ average measures are: f_0 205.82 Hz and 206.56 Hz; jitter of 0.62% and 0.59%; shimmer of 0.22 dB and 0.19 dB; HNR of 10.9 dB and 11.04 dB respectively. For males /a/ and /i/ had average measures of: f_0 119.84 Hz and 118.92 Hz; jitter of 0.49% and 0.5%; shimmer of 0.22 dB and 0.21 dB; HNR 9.56 dB and 9.63 dB, respectively. Fundamental frequencies of females were significantly higher than their male counterpart which was also observed in our study.

In addition, Siqueira and Moraes (2005) measured jitter value of 0.36% (ranging from 0.33% to 0.40%), using the Doctor Speech Sciences (version 4.0) software. Following are the normative values obtained from Turkish females by Oguz et al (2010); mean jitter (local) 0.3%, mean jitter (local, absolute) 1.227ms, jitter (ppq5) of 0.17%, shimmer (local) 4.54%, shimmer (local, dB) 0.4 dB. These values are very much similar to our normative range for females for /a, i, u/.

The normative which we have developed will help us to obtain a standardized data, which as far as now been less established across different parts of the world. Praat which is free software with good sensitivity and specificity can be utilized for comparative clinical studies. The major focus of our study was to mainly focus on the importance of using these normative for diagnostic and also in pre and post therapeutical purposes.

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