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Original Research Article

To analyse and identify different parameters of normal human voices

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Abstract

Background & Methods: The aim of the study is to analyse & identify different parameters of normal human voices. Only quality samples in terms of uniformity of volume & pitch were available because of technical reasons. The 3 sec sustained vowels were then extracted in the spectrogram to get the most stable & uniform middle 1 sec segment.

Results: Out of 200 voices, the number of male voice sample size was 46% & female voices were 54%.

Conclusion: Voice can be objectively analysed using Acoustic Parameters like mean Pitch, Jitter, Shimmer & Harmonic Noise Ratio. Most of the studies show that normal voice parameters depend on gender, region, methodology of the voice collection. Voices can be objectively analysed using acoustic parameters like mean pitch, jitter, shimmer & harmonic to noise ratio. A large database yields more reliable normative parameters. Institutions should develop their own standard protocol for selection of subjects, recording of voices & their analysis.

Keywords: analyse, normal, human & voices.

Study Design: Observational Study.

Introduction

Since ages the people have been dreaming of holding sounds & listening to it when they wanted. Wolfgang von Kempelen invented Speaking Machine in 1769. It took him 20 years of his life to work on it[1]. It represented the model of the human vocal tract. Kempelen used kitchen bellows to replace lungs, A bagpipe's reed replaced vocal cords. He could produce simple vowel sounds. Later he improvised his machine to produce vowels, plosives, nasals & some words. Kempelen finally created a machine to produce 's' 'sh', & 'r' sounds. For the

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purpose he used several layers of tubes, rods & smaller bellows & a string operated flap to function as throat, nasal cavity, mouth & tongue[2].

After 40 years, Kempelen's work was well recognised by Charles Wheat stone. But no development occurred till 19th Century. The tracheobronchial diverticulum appears at the 4th week of development from the anterior wall of the primitive pharynx. A partition called esophageal septum develops which fuses at the caudal level leaving an opening at the upper end at the pharynx[3]. This results in a tube forming respiratory tract. Larynx & trachea are developed by its upper end. The lower end of the primitive pharynx develops into bronchi & lungs. The cartilage, muscle & blood vessels of bronchi & lungs develop from the mesenchyma of the endoderm of foregut. By the side of this tube arytenoids & the aryepiglottic folds develop. Hypoglossal eminence gives rise to epiglottis[4].

Phonation is due to the vibrations of the vocal folds caused by forced passage of air through the glottis. As such the larynx functions as a reed instrument. The lungs during expiration act as bellows & push air through the glottis. The vocal folds are the reeds. The larynx continues down into trachea which bifurcates into left & right principal bronchi. Each principal bronchus further divides into secondary & tertiary segments & bronchioles. Bronchioles terminate as small air sacs, the alveoli. The diaphragm lies at the base of thorax & is the main muscle of inspiration. As this muscle contracts & descends, air is sucked into the lungs through respiratory passage[5-7]. Muscle of the rib cage wall, the external & internal intercostal, sternomastoid, pectoralis major & minor, scalene group, serratus group, latissmus dorsi & the muscle of the abdominal wall, the external & internal oblique, rectus abdominus & transversus abdominus do take part in expiration & phonation especially during production of loud sounds & in singing.

Material & Methods

Present Study was conducted at Ram Krishna Medical College, Bhopal for 01 Year. Microphone was held at a distance of 5cm in front of the lips & 3 cm above the breath stream. Each person was first trained to produce sustained vowel /a/ by the examiner herself through utterance of the voice at comfortable loudness & pitch. The sustained vowel, /a/ was recorded for minimum of 3 seconds using PRAAT1 software.

1. The voice samples were recorded in a sound treated room.

2. A microphone, unidirectional microphone

Inclusion Criteria: 1. Detailed history specifically about systemic diseases, upper respiratoty tract infection, tobacco & alcohol consumption & voice abuse was taken. They underwent detailed clinical examination.

2. Those that were screened by the above said procedure were selected for study.

Exclusion Criteria: 1. Voice abuse

2. Hearing loss

3. Upper or lower respiratory tract infection

ISSN: 0975-3583, 0976-2833 VOL14, ISSUE11, 2023

4. Any chronic systemic illness like tuberculosis, diabetes, hyper or hypothyroidism, Neurological disease etc.

Result

Table 1: The computed values of Pitch

Statistical Parameter	Male	Female
Mean	136.08	233.26
Sd	31.37	32.29
Range of Pitch values	106.70-167.46	202.97-265.55

Out of 200 voices, the number of male voice sample size was 46% & female voices were 54%.

Table 2: The values of jitter (ddp)

Jitter Parameter	Male	Female
Mean	0.0114	0.0108
Sd	0.0126	0.0098
Range of Pitch values	0.00117-0.02415	0.001026-0.020764

Table 3: Shimmer Values

Shimmer Parameter	Male	Female
Mean	0.0837	0.0789
Sd	0.068467	0.0023
Range of Pitch values	0.015282-0.15282	0.017474-0.140335

Table 4: HARMONIC TO NOISE RATIO - HNR

HNR Parameter	Male	Female
Mean	19.481	20.732
Sd	4.824	5.013
Range of Pitch values	15.6339 to 25.32931	16.71965-26.74582

Discussion

Our objective was to identify & standardise the parameters of normal voice by a simple, easier & non-invasive method so that this becomes a handy tool for day to day use to the clinical practitioner who addresses vocal disorders.

The perceptive methods have been subjective, difficult to quantify, document & not reproducible. Other non-subjective methods wherein instruments are used are invasive, time

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consuming & need expensive equipment. With stroboscopy analysis alone it is difficult to diagnose disorders like spasmodic dysphonia[8].

As a non-invasive, objective, easier method acoustic analysis proves valuable in diagnosis & management of voice disorders. Acoustic analysis requires a simple computer, a microphone & a voice analysis software. Worldwide acoustic analysis became a standard practice & many researchers began to analyse normal & abnormal voices & soon came to know that voice is multidimensional. Pitch Jitter, Shimmer & Harmonics to noise Ratio are the most commonly selected parameters[9].

It was evident that values of the same parameters were different in different situations. For e.g., in different ages, sexes, durations of the day, emotional factors, regions, types of program, algorithims, hardware used for analysis etc. Hence most of the authors felt that voice evaluation by acoustic analysis require standardisation of the normal voice parameters[10].

When we tried to compare our values with that of other studies, it was found that most of the data were calculated in different ways. For e.g., Jitter can be measured as Jitter%, Jitter ddp, absolute Jitter, local jitter etc. Similarly Shimmer can be measured as dda, Shimmer %, Shimmer Db, absolute Shimmer etc. Hence comparision becomes difficult. There are some studies given below which we tried to compare with our study. For example, Ana Clara Felippe et Al. [11], considered jitter in terms of % jitter. Deqhan et Al[12] considered Average jitter. Simone13 took jitter factor for calculation. The author of this study considered Jitter(ddp).

Conclusion

Voice can be objectively analysed using Acoustic Parameters like mean Pitch, Jitter, Shimmer & Harmonic Noise Ratio. Most of the studies show that normal voice parameters depend on gender, region, methodology of the voice collection. Voices can be objectively analysed using acoustic parameters like mean pitch, jitter, shimmer & harmonic to noise ratio. A large database yields more reliable normative parameters. Institutions should develop their own standard protocol for selection of subjects, recording of voices & their analysis.

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