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Research Article

# AERODYNAMIC AND ACOUSTICAL ANALYSIS OF ADULT AND GERIATRIC

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ABSTRACT

The aim of the study is to analyse aerodynamic and acoustical changes in adult and geriatrics and provide age and gender comparison data. A total of 70 adult subjects and 67 geriatric subject participated. The study carried out in two phases (aerodynamic analysis and acoustic analysis). The participants instructed and given demonstration before recording the voice sample of vowels /a/ /i/ /u/. PRAAT software (version 6.1) was used to analyse the voice sample. Result provide data of MPT, s/z ratio, pitch, jitter, shimmer, HNR of adult and geriatrics, male and female and indicates high significance difference with acoustical parameters and no significant and no significant difference with aerodynamic analysis between groups comparison. The analysis of this variable allow us to determine value that can be used as reference for management of vocal disorders.



## INTRODUCTION

Voice is a sound made by the vibration of the vocal folds (Aronson 2009).Vocal folds vibrate by applying enough pressure to propel air past it. The vocal tract modifies this sound into a distinctive acoustic form that enables the listener to identify the speaker.

Intonation, pitch, tone and other vocal cues all convey subliminal clues about the nature of who we are, communicate our state of mind and our emotions. When used effectively, our voice can be advantageous and improve both our interpersonal and professional connections. Consequently, we may maintain control over how we speak, increase effectiveness, and utilize our voice effectively.

Anatomical and physiological effects changes voice's characteristics. Due to the lung tissue's elasticity, the respiratory muscles' decline, and the thorax's stiffness, changes in lung volumes might affect phonation. Voice quality, range, and strength decrease as people age. The majority of vocal abnormalities in elderly people are manageable or treatable and do not pose a life-threatening risk, but some voice alterations could signal a more serious medical issue.

Maximum phonation duration (MPD) is the length of time a client can maintain a vowel sound on a deep breath at a tolerable pitch and volume. An vocal function test, S/Z ratio, calculated by timing the longest time a patient can maintain the separate phonemes S and Z, and dividing the two figures to produce a numerical ratio, fundamental frequency (Fo) to determine the number of cycles produced by the vocal folds per second ,frequency perturbation (Jitter) and amplitude perturbation (Shimmer), to exhibit slight variations in frequency and amplitude from cycle to cycle when vocal folds vibrating continuously, Harmonic to noise ratio (HNR), the periodic component of a sustained vowel and the additional noise produced by the vocal folds and vocal tract.

Researchers have been carried out using tools and software to determine the pathology and provide the possible intervention. Battala, Márquez, Gonzalez, Laborda, Fernandez and Galan (2013) suggested the existence of program that are valid, reliable, minimum equipment requirements contribute quality of patient care by comparing the Praat (free) and Dr. Speech (commercial) programs the results provides similar acoustic analysis of pathological voices in clinical setting. Freitas, Pestana, Almeidaand Ferreira(2018) investigated Acoustic analysis of voice signal by Comparing four commercial and open source application software programs There is a moderate to strong correlation, The mean F0 is not statistically different among the used applications. The other acoustic measures revealed statistically significant differences. Many voice problems have been treated using aerodynamic and acoustic analysis of voice. The aim of the study was to analyse aerodynamic and acoustical analysis of adult and geriatric, male and female populations and to compare adult and geriatric, male and female

### REVIEW OF LITERATURE

The larynx's cartilage may start to calcify by age of 25years and lose their elasticity. The smoothness with which vocal fold alterations are produced during phonation or the approximation of the vocal folds may be affected by several factors. Takano, Kimura, Nito, Magawa and Tayama (2009) analyzed presbylarynx (Vocal fold atrophy in elderly individuals). Result suggested among 361, and 72 (20%) were diagnosed with vocal fold atrophy. They included 47 (65%)

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men and 25 (35%) women, with a mean age of 71 years (range, 65–89).

Aerodynamic analysis literature states that Maximum Phonation Time in Healthy Older Adults investigated by Maslan, Leng, Rees, Blalockand Butler(2011) suggest that females and males had mean MPTs of 20.96 and 23.23 seconds. Eckel and Boone (1981) suggest that S/ZRatio as an Indicator of Laryngeal Pathology by examining the dysphonic subjects with laryngeal pathology produced s/z ratios in excess of 1.4 ninety-five percent of the time when compared with normal's.

Chana and Titze (2008) The older men may worsen vocal fold vibration instability and increase fundamental frequency (F0) because of increased layer stiffness Ageing may have an impact on the extrinsic laryngeal muscles. The larynx may permanently descend as a result of this.

Kumar, Garg, Chandra, Singh & Datta (2016) investigated hormonal influence on the voice apparatus in normal and endocrine disorders and result suggested Hormonal changes might also result in voice alterations. Females experience a drop in progesterone, an increase in estrogens, and the formation of androgen after menopause.

Sebastian, Babu, Oommen & Ballraj (2012) studied acoustic measurements on geriatric voices for males and females and compared them to young adults. The normative values observed for adult male f0 131.60 (SD 12) and adult female f0 228.26 (SD 15.52), geriatric male f0 140.28 (SD 23.65) and geriatric female f0 187.48 (SD 26.35) and adult male jitter 0.73 (SD 0.35), adult female jitter 0.99 (0.55) and geriatric male jitter 0.744(SD 0.40), geriatric female jitter 0.5225 SD (0.19).The results suggested when compared to young adult norms, it showed a difference in fundamental frequency.

Mifune, Justino, Camarg & Gregio (2007) investigated the ageing voice in elderly adults of both genders using vowel /a/ in stressed (S) and pre-stressed (PS) syllables. the average f0 values in PS syllables were 114.14 Hz at the beginning of sentences and 102.71 Hz at the end for male subjects and 151 Hz at the beginning and 146.87 Hz at the end for female subjects. For S syllables the values were 117.42 Hz at the beginning and 92.85 Hz at the end for male subjects and 175 Hz at the beginning and 122.50 Hz at the end for female subjects. Their findings revealed that there was a significant difference in f0 values between gender in elderly patients. Devadiga, Bhat & Guddattu (2019) examined perturbation-related measures of voice in geriatrics, and the findings suggested acoustic measurements are observed to considerably vary across the age groups and the genders.

## METHOD

***Aim:*** The aim of the study was to analyze the aerodynamic and acoustical analysis of Adult and Geriatrics with following objectives

1. To determine aerodynamic and acoustic analysis of adult population
2. To determine aerodynamic and acoustic analysis of elderly population
3. Compare the age related changes in geriatric population with young adult population

***Method:*** A group of 70 adults (33-male, 37-female) and 67 geriatrics (32- male, 35-female) in the age range of 20-25 years and 70-75 years participated in the present study. Participants with no history of past or present speech, language or hearing problems are included Subjects with any neurological involvement, vocal pathology, respiratory dysfunction, articulatory deficits, speech, language and hearing impairment are excluded from the study.

***Aerodynamic sampling:*** Voice samples were recorded in a quiet room with a stopwatch Participants were asked to perform two tasks: Maximum phonation duration (MPD) and S/Z ratio. Before the data was collected demonstration was given to all participants.

***Procedure:*** The subjects asked to inhale deeply and phonate /a/ /i/ /u/ for as long as possible loudly and comfortably .Three trials in total were conducted, and the best of the three attempts were taken into account for maximum phonation duration. The second task required the subjects to inhale deeply and phonate /s/ and/z/ individually as possible loudly and comfortably. There were three trials and by dividing the longest duration's time /s/ by its longest duration's time /z/, the S/Z ratio is determined.

***Acoustic analysis:*** PRAAT (version 6. 1. 04.) Boersma and Weenink (2009), was utilized to sample acoustic variables.

***Procedure:*** The sampling was carried out in a quite well illuminated with less noise. A microphone connected to an Acer laptop roughly 3 inches away from partcipant. The participants were instructed to inhale deeply and phonate /a/, /i/, and /u/ .Pitch, Jitter, shimmer, the harmonic to noise ratio were the voice parameters that were analyzed

***Analysis:*** The obtained data was analyzed statistically, using paired t test and mann whitney test to get significance score within and across the group and the obtained results are discussed.

## RESULT

The statistical analysis of the data are discussed below.
Pitch:

**Table 1** shows mean pitch of adult male, adult female and geriatric male, geriatric female for vowels \a\ \i\ \u\

| | | Male | Female |
|---|---|---|---|
| f0-/a/ | Adult | 125.18 | 230.93 |
| | Geriatric | 137.36 | 186.06 |
| f0-/i/ | Adult | 128.58 | 237.12 |
| | Geriatric | 140.01 | 187.57 |
| f0-/u/ | Adult | 127.41 | 239.34 |
| | Geriatric | 139.96 | 190.55 |

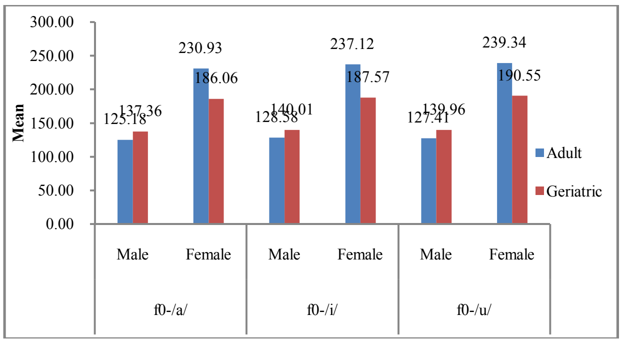


**Fig 1** Shows mean pitch of adult male, adult female and geriatric male, geriatric female for vowels \a\ \i\ \u\

Table 1 and Fig 1indicates mean pitch of adult male /a/-125.18, /i/-128.58,/u/-127.41, adult female /a/-230.93, /i/-

237.12,/u/-239.34, geriatric male /a/-137.96, /i/-140.01,/u/-139.96, geriatric female /a/-186.06, /i/-187.57,/u/-190.55.

**Table 2** Shows Adult and geriatric gender comparison of mean, standard deviation, interval mean and significance

| | Group | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| f0-/a/ | Adult | Male | 33 | 125.18 | 9.43 | 121.84 | 128.52 | | |
| | | Female | 37 | 230.93 | 21.12 | 223.89 | 237.97 | 0.000 | HS |
| | | Total | 70 | 181.08 | 55.69 | 167.80 | 194.36 | | |
| | Geriatric | Male | 32 | 137.36 | 9.47 | 133.94 | 140.77 | | |
| | | Female | 35 | 186.06 | 11.07 | 182.26 | 189.86 | 0.000 | HS |
| | | Total | 67 | 162.80 | 26.57 | 156.32 | 169.28 | | |
| f0-/i/ | Adult | Male | 33 | 128.58 | 8.20 | 125.67 | 131.48 | | |
| | | Female | 37 | 237.12 | 15.00 | 232.12 | 242.12 | 0.000 | HS |
| | | Total | 70 | 185.95 | 55.92 | 172.62 | 199.29 | | |
| | Geriatric | Male | 32 | 140.01 | 6.57 | 137.65 | 142.38 | | |
| | | Female | 35 | 187.57 | 11.35 | 183.67 | 191.47 | 0.000 | HS |
| | | Total | 67 | 164.86 | 25.68 | 158.59 | 171.12 | | |
| f0-/u/ | Adult | Male | 33 | 127.41 | 8.79 | 124.30 | 130.53 | | |
| | | Female | 37 | 239.34 | 17.69 | 233.44 | 245.24 | 0.000 | HS |
| | | Total | 70 | 186.57 | 58.02 | 172.74 | 200.41 | | |
| | Geriatric | Male | 32 | 139.96 | 6.60 | 137.58 | 142.34 | | |
| | | Female | 35 | 190.55 | 12.03 | 186.42 | 194.69 | 0.000 | HS |
| | | Total | 67 | 166.39 | 27.26 | 159.74 | 173.04 | | |

**Table 3** Shows mean, standard deviation, interval mean with p value and significance of age compared data of male and female for vowels /a/ /i/ /u/

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| f0-/a/ | Male | Adult | 33 | 125.18 | 9.43 | 121.84 | 128.52 | 0.000 | HS |
| | | Geriatric | 32 | 137.36 | 9.47 | 133.94 | 140.77 | | |
| | Female | Adult | 37 | 230.93 | 21.12 | 223.89 | 237.97 | 0.000 | HS |
| | | Geriatric | 35 | 186.06 | 11.07 | 182.26 | 189.86 | | |
| f0-/i/ | Male | Adult | 33 | 128.58 | 8.20 | 125.67 | 131.48 | 0.000 | HS |
| | | Geriatric | 32 | 140.01 | 6.57 | 137.65 | 142.38 | | |
| | Female | Adult | 37 | 237.12 | 15.00 | 232.12 | 242.12 | 0.000 | HS |
| | | Geriatric | 35 | 187.57 | 11.35 | 183.67 | 191.47 | | |
| f0-/u/ | Male | Adult | 33 | 127.41 | 8.79 | 124.30 | 130.53 | 0.000 | HS |
| | | Geriatric | 32 | 139.96 | 6.60 | 137.58 | 142.34 | | |
| | Female | Adult | 37 | 239.34 | 17.69 | 233.44 | 245.24 | 0.000 | HS |
| | | Geriatric | 35 | 190.55 | 12.03 | 186.42 | 194.69 | | |

From Table 2 it can be inferred that cross gender comparison scores of F0 across adult vs geriatric, male and female for /a/ (0.000), /i/ (0.000) and /u/ 0.000 yielded high significant difference. From Table 3 it can be interpreted that cross gender comparison scores of F0 across male vs female, adult and geriatric for /a/ (0.000), /i/ (0.000) and /u/ 0.000 yielded high significant difference.

### *JITTER*

**Table 4** Shows mean of jitter for adult male, adult female and geriatricmale, geriatric female of /a/, /i/, /u/

| | | Male | Female |
|---|---|---|---|
| jitter%-/a/ | Adult | 0.44 | 0.36 |
| | Geriatric | 0.66 | 0.57 |
| jitter%-/i/ | Adult | 0.36 | 0.37 |
| | Geriatric | 0.70 | 0.62 |
| jitter %-/u/ | Adult | 0.58 | 0.38 |
| | Geriatric | 0.64 | 0.52 |

Table 4 and fig 2 indicates mean jitter of adult male /a/-0.44, /i/-0.36,/u/-0.58, adult female /a/-0.36, /i/-0.37,/u/-0.38, geriatric male /a/-0.66, /i/-0.70,/u/-0.64, geriatric female /a/-0.57, /i/-0.62,/u/-0.52.

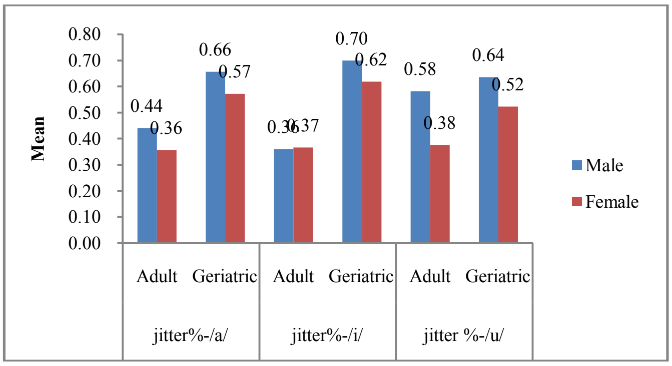


**Fig 2** Shows mean jitter values of adult male, adult female and geriatric male, geriatric female for vowels \a\ \i\ \u\

From Table 5 it can be inferred that cross gender comparison scores of jitter across adult vs geriatric, male and female for /a/ (0.000) and /u/ 0.000 yielded high significant difference, for adult /i/ (0.453) shows no significance and geriatric /i/ (0.000) shows high significance difference.

From Table 6 it can be interpreted that cross gender comparison scores of jitter across male vs female, adult and geriatric for /a/ (0.000), /i/ (0.000) and /u/ 0.000 yielded high significant difference.

**Table 5** Shows adult and geriatric gender comparison data of mean, Standard deviation. Interval mean, p value with significance

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| jitter%-/a/ | Adult | Male | 33 | 0.44 | 0.03 | 0.43 | 0.45 | | |
| | | Female | 37 | 0.36 | 0.04 | 0.34 | 0.37 | 0.000 | HS |
| | | Total | 70 | 0.40 | 0.06 | 0.38 | 0.41 | | |
| | Geriatric | Male | 32 | 0.66 | 0.02 | 0.65 | 0.66 | | |
| | | Female | 35 | 0.57 | 0.07 | 0.55 | 0.59 | 0.000 | HS |
| | | Total | 67 | 0.61 | 0.06 | 0.60 | 0.63 | | |
| jitter%-/i/ | Adult | Male | 33 | 0.36 | 0.03 | 0.35 | 0.37 | | |
| | | Female | 37 | 0.37 | 0.03 | 0.36 | 0.38 | 0.453 | NS |
| | | Total | 70 | 0.36 | 0.03 | 0.36 | 0.37 | | |
| | Geriatric | Male | 32 | 0.70 | 0.03 | 0.69 | 0.71 | | |
| | | Female | 35 | 0.62 | 0.07 | 0.60 | 0.64 | 0.000 | HS |
| | | Total | 67 | 0.66 | 0.07 | 0.64 | 0.67 | | |
| jitter %-/u/ | Adult | Male | 33 | 0.58 | 0.04 | 0.57 | 0.60 | | |
| | | Female | 37 | 0.38 | 0.03 | 0.36 | 0.39 | 0.000 | HS |
| | | Total | 70 | 0.47 | 0.11 | 0.45 | 0.50 | | |
| | Geriatric | Male | 32 | 0.64 | 0.01 | 0.63 | 0.64 | | |
| | | Female | 35 | 0.52 | 0.06 | 0.50 | 0.55 | 0.000 | HS |
| | | Total | 67 | 0.58 | 0.07 | 0.56 | 0.59 | | |

**Table 6** Shows Jitter mean, standard deviation, interval mean with p value and significance of age compared data of male and female for vowels /a/ /i/ /u/

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| jitter%-/a/ | Male | Adult | 33 | 0.44 | 0.03 | 0.43 | 0.45 | 0.000 | HS |
| | | Geriatric | 32 | 0.66 | 0.02 | 0.65 | 0.66 | | |
| | Female | Adult | 37 | 0.36 | 0.04 | 0.34 | 0.37 | 0.000 | HS |
| | | Geriatric | 35 | 0.57 | 0.07 | 0.55 | 0.59 | | |
| jitter%-/i/ | Male | Adult | 33 | 0.36 | 0.03 | 0.35 | 0.37 | 0.000 | HS |
| | | Geriatric | 32 | 0.70 | 0.03 | 0.69 | 0.71 | | |
| | Female | Adult | 37 | 0.37 | 0.03 | 0.36 | 0.38 | 0.000 | HS |
| | | Geriatric | 35 | 0.62 | 0.07 | 0.60 | 0.64 | | |
| jitter %-/u/ | Male | Adult | 33 | 0.58 | 0.04 | 0.57 | 0.60 | 0.000 | HS |
| | | Geriatric | 32 | 0.64 | 0.01 | 0.63 | 0.64 | | |
| | Female | Adult | 37 | 0.38 | 0.03 | 0.36 | 0.39 | 0.000 | HS |
| | | Geriatric | 35 | 0.52 | 0.06 | 0.50 | 0.55 | | |

### *Shimmer*

**Table 7** Shows mean shimmer% of adult male, adult female and geriatric male, geriatric female for vowels \a\ \i\ \u\

| | | Male | Female |
|---|---|---|---|
| shimmer%-/a/ | Adult | 0.33 | 0.25 |
| | Geriatric | 0.82 | 0.61 |
| shimmer%-/i/ | Adult | 0.37 | 0.35 |
| | Geriatric | 0.74 | 0.57 |
| shimmer %-/u/ | Adult | 0.66 | 0.42 |
| | Geriatric | 0.64 | 0.53 |

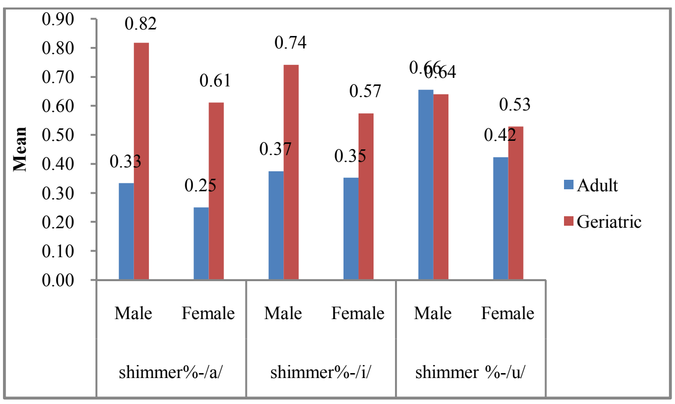


**Fig 3** Shows mean shimmer of Adult and geriatric

Table7 and figure 3 indicates mean shimmer of adult male /a/-0.33 /i/-0.37,/u/-0.66, adult female /a/-0.25, /i/-0.35,/u/-0.42, geriatric male /a/-0.82, /i/-0.74,/u/-0.64, geriatric female /a/-0.61, /i/-0.57,/u/-0.53.

From Table 8 it can be inferred that cross gender comparison scores of shimmer across adult vs geriatric, male and female for /a/ (0.000), and /u/ 0.000 yielded high significant difference and adult /i/ (0.0.26) significance difference and geriatric /i/ (0.000) high significance difference.

From Table 9 it can be interpreted that cross gender comparison scores of Shimmer across male vs female, adult and geriatric for /a/ (0.000), /i/ (0.000) and /u/ 0.000 yielded high significant difference.

**Table 8** Shows adult geriatric age comparison data of shimmer mean, standard deviation, interval mean, and significance

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| shimmer%-/a/ | Adult | Male | 33 | 0.33 | 0.03 | 0.32 | 0.34 | 0.000 | HS |
| | | Female | 37 | 0.25 | 0.03 | 0.24 | 0.26 | | |
| | | Total | 70 | 0.29 | 0.05 | 0.28 | 0.30 | | |
| | Geriatric | Male | 32 | 0.82 | 0.02 | 0.81 | 0.82 | 0.000 | HS |
| | | Female | 35 | 0.61 | 0.05 | 0.59 | 0.63 | | |
| | | Total | 67 | 0.71 | 0.11 | 0.68 | 0.74 | | |
| shimmer%-/i/ | Adult | Male | 33 | 0.37 | 0.04 | 0.36 | 0.39 | 0.026 | sig |
| | | Female | 37 | 0.35 | 0.04 | 0.34 | 0.37 | | |
| | | Total | 70 | 0.36 | 0.04 | 0.35 | 0.37 | | |
| | Geriatric | Male | 32 | 0.74 | 0.02 | 0.73 | 0.75 | 0.000 | HS |
| | | Female | 35 | 0.57 | 0.05 | 0.56 | 0.59 | | |
| | | Total | 67 | 0.65 | 0.09 | 0.63 | 0.68 | | |
| shimmer %-/u/ | Adult | Male | 33 | 0.66 | 0.02 | 0.65 | 0.66 | 0.000 | HS |
| | | Female | 37 | 0.42 | 0.05 | 0.41 | 0.44 | | |
| | | Total | 70 | 0.53 | 0.12 | 0.50 | 0.56 | | |
| | Geriatric | Male | 32 | 0.64 | 0.02 | 0.63 | 0.65 | 0.000 | HS |
| | | Female | 35 | 0.53 | 0.05 | 0.51 | 0.54 | | |
| | | Total | 67 | 0.58 | 0.07 | 0.57 | 0.60 | | |

**Table 9** Shows mean, standard deviation, interval mean, p value with significance of Age compared data of male and female for vowels \a\ \i\ \u\

| Group | | | N | Mean | SD | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| shimmer%-/a/ | Male | Adult | 33 | 0.33 | 0.03 | 0.32 | 0.34 | 0.000 | HS |
| | | Geriatric | 32 | 0.82 | 0.02 | 0.81 | 0.82 | | |
| | Female | Adult | 37 | 0.25 | 0.03 | 0.24 | 0.26 | 0.000 | HS |
| | | Geriatric | 35 | 0.61 | 0.05 | 0.59 | 0.63 | | |
| shimmer%-/i/ | Male | Adult | 33 | 0.37 | 0.04 | 0.36 | 0.39 | 0.000 | HS |
| | | Geriatric | 32 | 0.74 | 0.02 | 0.73 | 0.75 | | |
| | Female | Adult | 37 | 0.35 | 0.04 | 0.34 | 0.37 | 0.000 | HS |
| | | Geriatric | 35 | 0.57 | 0.05 | 0.56 | 0.59 | | |
| shimmer %-/u/ | Male | Adult | 33 | 0.66 | 0.02 | 0.65 | 0.66 | 0.008 | HS |
| | | Geriatric | 32 | 0.64 | 0.02 | 0.63 | 0.65 | | |
| | Female | Adult | 37 | 0.42 | 0.05 | 0.41 | 0.44 | 0.000 | HS |
| | | Geriatric | 35 | 0.53 | 0.05 | 0.51 | 0.54 | | |

*HNR*

**Table 10** Shows mean HNR of adult male, adult female and geriatric male, geriatric female for vowels \a\ \i\ \u\

| | | Male | Female |
|---|---|---|---|
| HNR-/a/ | Adult | 9.87 | 21.71 |
| | Geriatric | 13.76 | 14.42 |
| HNR-/i/ | Adult | 9.88 | 21.05 |
| | Geriatric | 17.15 | 17.36 |
| HNR-/u/ | Adult | 11.04 | 21.33 |
| | Geriatric | 19.27 | 18.53 |

Table 10 and figure 4 indicates mean HNR of adult male /a/-9.87, /i/-9.88,/u/-11.04 , adul female /a/-21.71, /i/-21.05,/u/-21.33, geriatric male /a/-13.76, /i/-17.15,/u/ 19.27, geriatric female /a/-14.42, / i/-17.36,/u/-18.53Figure 7 graph of mean HNR of adult male, adult female, geriatric male and geriatric female

**Table 11** Shows adult and geriatric gender comparison data of HNR mean, Standard deviation, Interval mean , p value with significance

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| HNR-/a/ | Adult | Male | 33 | 9.87 | 0.60 | 9.65 | 10.08 | 0.000 | HS |
| | | Female | 37 | 21.71 | 3.85 | 20.43 | 22.99 | | |
| | | Total | 70 | 16.13 | 6.58 | 14.56 | 17.70 | | |
| | Geriatric | Male | 32 | 13.76 | 1.08 | 13.37 | 14.15 | 0.013 | sig |
| | | Female | 35 | 14.42 | 1.01 | 14.07 | 14.77 | | |
| | | Total | 67 | 14.10 | 1.09 | 13.84 | 14.37 | | |
| HNR-/i/ | Adult | Male | 33 | 9.88 | 0.48 | 9.71 | 10.05 | 0.000 | HS |
| | | Female | 37 | 21.05 | 4.47 | 19.56 | 22.54 | | |
| | | Total | 70 | 15.79 | 6.49 | 14.24 | 17.33 | | |
| | Geriatric | Male | 32 | 17.15 | 1.16 | 16.73 | 17.56 | 0.474 | NS |
| | | Female | 35 | 17.36 | 1.23 | 16.93 | 17.78 | | |
| | | Total | 67 | 17.26 | 1.19 | 16.97 | 17.55 | | |
| HNR-/u/ | Adult | Male | 33 | 11.04 | 0.63 | 10.82 | 11.26 | 0.000 | HS |
| | | Female | 37 | 21.33 | 3.87 | 20.04 | 22.62 | | |
| | | Total | 70 | 16.48 | 5.90 | 15.07 | 17.88 | | |
| | Geriatric | Male | 32 | 19.27 | 0.90 | 18.94 | 19.59 | 0.002 | HS |
| | | Female | 35 | 18.53 | 0.97 | 18.20 | 18.87 | | |
| | | Total | 67 | 18.88 | 1.00 | 18.64 | 19.13 | | |

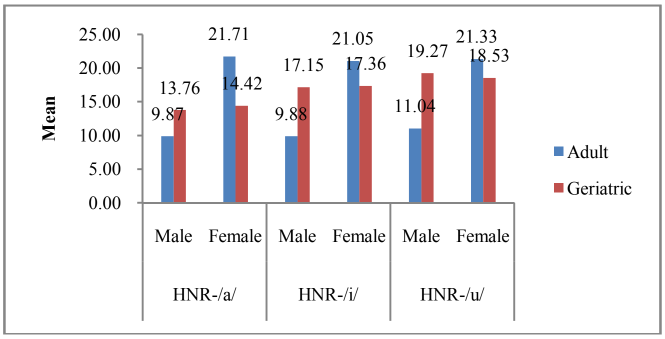


**Figure 4** Shows mean HNR of Adult and geriatric

From Table 11 it can be inferred that cross gender comparison scores of HNR across adult, male and female for /a/ (0.000), /i/ (0.000) and /u/ 0.000 yielded high significant difference and geriatric /a/ 0.013 /u/ 0.002 yielded significant difference, /i/ no significant difference.

From Table 12 it can be interpreted that cross gender comparison scores of HNR across male vs female, adult and geriatric for /a/ (0.000), /i/ (0.000) and /u/ 0.000 yielded high significant difference.

Table 13 and figure 5 indicates mean MPT of adult male /a/-14.97 /i/-15.15,/u/-14.88, adult female /a/-14.16, /i/-15.38,/u/-15.16, geriatric male /a/-11.06, /i/-11.97,/u/-11.75, geriatric female /a/-11.46, /i/-10.71,/u/-10.54

From Table 14 it can be inferred that cross gender comparison scores of MPD across adult, male and female for /a/ (0.135), /i/ (0.665) and /u/ 0.584 yielded no significant difference and geriatric /a/0.486 shows no significance difference, /i/ 0.029, /u/ 0.015 shows significant difference.

From Table 15 it can be interpreted that cross gender comparison scores of MPD across male vs female, adult and geriatric for /a/ (0.000), /i/ (0.000) and /u/ 0.000 yielded high significant difference.

**Table 12** Shows mean, Standard deviation, interval mean, significance of age compared data of male and female for vowels /a/ /i/ /u/

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| HNR-/a/ | Male | Adult | 33 | 9.87 | 0.60 | 9.65 | 10.08 | 0.000 | HS |
| | | Geriatric | 32 | 13.76 | 1.08 | 13.37 | 14.15 | | |
| | Female | Adult | 37 | 21.71 | 3.85 | 20.43 | 22.99 | 0.000 | HS |
| | | Geriatric | 35 | 14.42 | 1.01 | 14.07 | 14.77 | | |
| HNR-/i/ | Male | Adult | 33 | 9.88 | 0.48 | 9.71 | 10.05 | 0.000 | HS |
| | | Geriatric | 32 | 17.15 | 1.16 | 16.73 | 17.56 | | |
| | Female | Adult | 37 | 21.05 | 4.47 | 19.56 | 22.54 | 0.000 | HS |
| | | Geriatric | 35 | 17.36 | 1.23 | 16.93 | 17.78 | | |
| HNR-/u/ | Male | Adult | 33 | 11.04 | 0.63 | 10.82 | 11.26 | 0.000 | HS |
| | | Geriatric | 32 | 19.27 | 0.90 | 18.94 | 19.59 | | |
| | Female | Adult | 37 | 21.33 | 3.87 | 20.04 | 22.62 | 0.000 | HS |
| | | Geriatric | 35 | 18.53 | 0.97 | 18.20 | 18.87 | | |

*MPT*

**Table 13** Shows mean MPD of adult male, adult female and geriatric male, geriatric female for vowels \a\ \i\ \u\

| | | Male | Female |
|---|---|---|---|
| MPD-/a/ | Adult | 14.97 | 14.16 |
| | Geriatric | 11.06 | 11.46 |
| MPD-/i/ | Adult | 15.15 | 15.38 |
| | Geriatric | 11.97 | 10.71 |
| MPD-/u/ | Adult | 14.88 | 15.16 |
| | Geriatric | 11.75 | 10.54 |

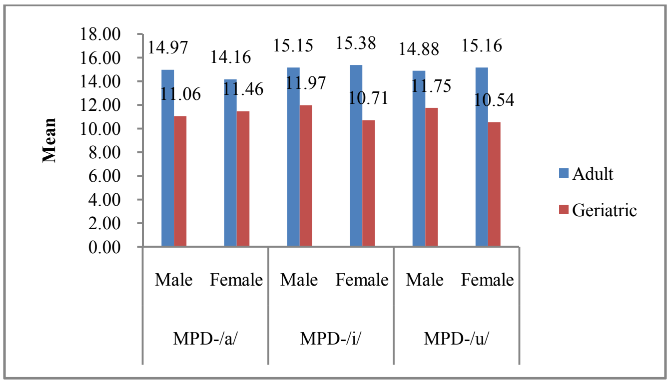


**Fig 5** Shows mean MPD of adult and geriatrics

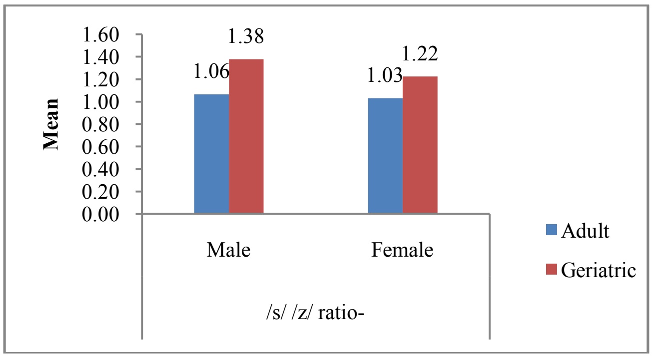


**Fig 6** Shows mean s/z ratio of adult and geriatric

**Table 14** Shows Adult and geriatric age comparison of MPD Mean, standard deviation, interval mean, p value with significance

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| MPD-/a/ | Adult | Male | 33 | 14.97 | 2.10 | 14.23 | 15.71 | | |
| | | Female | 37 | 14.16 | 2.34 | 13.38 | 14.94 | 0.135 | NS |
| | | Total | 70 | 14.54 | 2.25 | 14.01 | 15.08 | | |
| | Geriatric | Male | 32 | 11.06 | 2.37 | 10.21 | 11.92 | | |
| | | Female | 35 | 11.46 | 2.24 | 10.69 | 12.23 | 0.486 | NS |
| | | Total | 67 | 11.27 | 2.29 | 10.71 | 11.83 | | |
| MPD-/i/ | Adult | Male | 33 | 15.15 | 2.21 | 14.37 | 15.94 | | |
| | | Female | 37 | 15.38 | 2.15 | 14.66 | 16.10 | 0.665 | NS |
| | | Total | 70 | 15.27 | 2.17 | 14.75 | 15.79 | | |
| | Geriatric | Male | 32 | 11.97 | 2.21 | 11.17 | 12.76 | | |
| | | Female | 35 | 10.71 | 2.37 | 9.90 | 11.53 | 0.029 | sig |
| | | Total | 67 | 11.31 | 2.36 | 10.74 | 11.89 | | |
| MPD-/u/ | Adult | Male | 33 | 14.88 | 2.01 | 14.17 | 15.59 | | |
| | | Female | 37 | 15.16 | 2.27 | 14.41 | 15.92 | 0.584 | NS |
| | | Total | 70 | 15.03 | 2.14 | 14.52 | 15.54 | | |
| | Geriatric | Male | 32 | 11.75 | 1.81 | 11.10 | 12.40 | | |
| | | Female | 35 | 10.54 | 2.12 | 9.81 | 11.27 | 0.015 | sig |
| | | Total | 67 | 11.12 | 2.06 | 10.62 | 11.62 | | |

**Table 15** Shows MPD mean. Standard deviation, interval mean, p value with significance of age compared data of male and female for vowels /a/ /i/ /u/

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| MPD-/a/ | Male | Adult | 33 | 14.97 | 2.10 | 14.23 | 15.71 | 0.000 | HS |
| | | Geriatric | 32 | 11.06 | 2.37 | 10.21 | 11.92 | | |
| | Female | Adult | 37 | 14.16 | 2.34 | 13.38 | 14.94 | 0.000 | HS |
| | | Geriatric | 35 | 11.46 | 2.24 | 10.69 | 12.23 | | |
| MPD-/i/ | Male | Adult | 33 | 15.15 | 2.21 | 14.37 | 15.94 | 0.000 | HS |
| | | Geriatric | 32 | 11.97 | 2.21 | 11.17 | 12.76 | | |
| | Female | Adult | 37 | 15.38 | 2.15 | 14.66 | 16.10 | 0.000 | HS |
| | | Geriatric | 35 | 10.71 | 2.37 | 9.90 | 11.53 | | |
| MPD-/u/ | Male | Adult | 33 | 14.88 | 2.01 | 14.17 | 15.59 | 0.000 | HS |
| | | Geriatric | 32 | 11.75 | 1.81 | 11.10 | 12.40 | | |
| | Female | Adult | 37 | 15.16 | 2.27 | 14.41 | 15.92 | 0.000 | HS |
| | | Geriatric | 35 | 10.54 | 2.12 | 9.81 | 11.27 | | |

**Table 16** Shows mean pitch of adult male, adult female and geriatric male, geriatric female

| | | Male | Female |
|---|---|---|---|
| /s/ /z/ ratio- | Adult | 1.06 | 1.03 |
| | Geriatric | 1.38 | 1.22 |

Table 16 and figure 6 indicates S/Z ratio of adult male 1.06, adult female 1.03, geriatric male 1.38, geriatric female 1.22

From Table 17 it can be inferred that cross gender comparison scores of s/z ratio across adult, male and female shows 0.134 no significant difference and geriatric yielded 0.013 significant difference. From Table 18 it can be interpreted that cross gender comparison scores of s/z ratio across male vs female, adult and geriatric (0.000) yielded high significant difference.

**Table 17** Shows Adult and geriatric age comparison of s/z ratio Mean, standard deviation, interval mean, p value with significance

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| /s/ /z/ ratio- | Adult | Male | 33 | 1.06 | 0.09 | 1.03 | 1.10 | | |
| | | Female | 37 | 1.03 | 0.10 | 1.00 | 1.06 | 0.134 | NS |
| | | Total | 70 | 1.05 | 0.09 | 1.02 | 1.07 | | |
| | Geriatric | Male | 32 | 1.38 | 0.28 | 1.28 | 1.48 | | |
| | | Female | 35 | 1.22 | 0.21 | 1.15 | 1.30 | 0.013 | sig |
| | | Total | 67 | 1.30 | 0.26 | 1.23 | 1.36 | | |

**Table 18** Shows s/z ratio Mean, standard deviation, interval mean, p value with significance of age compared data of male and female

| Group | | | N | Mean | Std. Deviation | Lower Bound | Upper Bound | t test p value | |
|---|---|---|---|---|---|---|---|---|---|
| /s/ /z/ ratio- | Male | Adult | 33 | 1.06 | 0.09 | 1.03 | 1.10 | 0.000 | HS |
| | | Geriatric | 32 | 1.38 | 0.28 | 1.28 | 1.48 | | |
| | Female | Adult | 37 | 1.03 | 0.10 | 1.00 | 1.06 | 0.000 | HS |
| | | Geriatric | 35 | 1.22 | 0.21 | 1.15 | 1.30 | | |

## DISCUSSION

From the table and figures mentioned above, Aerodynamic analysis of MPD data reveals no significance difference(p value < 0.1) between Adult gender comparison /a/, /u/ /i/ and geriatric /a/ except geriatric /i/ /u/ with significance difference (p value >0.1)and age comparison data shows high significance difference (p value 0.000 ) for vowels /a/ /i/ /u/ for both male and female, s/z ratio data reveals no significance difference(p value < 0.1) between Adult gender comparison and geriatric with significance difference (p value >0.1)and age comparison data shows high significance difference (p value 0.000 ) for vowels /a/ /i/ /u/ for both male and female.
Acoustic analysis of pitch data results reveals high significance difference (p value 0.000) with gender comparison of both age group because the increase in vocal fold mass brought on by hormonal changes associated with menopause may be the cause of the decline in F0 in females. The internal thyroarytenoid atrophy caused by ageing in men causes reduced vocal fold mass, which causes thinner vocal folds and a higher f0 (Sebastian, Babu, Oommen, and Ballraj - 2012), significance difference (p value 0.000) with age comparison between male and female, jitter% data reveals and data reveals high significance difference(p value 0.000) between adult and geriatric gender comparison /a/, /u/, except geriatric /i/ and adult /i/ which indicates no significant difference with p value 0.453 and age comparison data shows high significance difference (p value 0.000 in jitter for vowels /a/ /I/ /u/ for both male and female , shimmer % data revels high significance difference(p value 0.000) between geriatric gender comparison /a/, /u/ /i/ , except Adult /i/ with significant difference p value 0.026 with high significance (p value 0.000) for /a/ /u/ and age comparison data shows high significance difference (p value 0.000 ) for vowels /a/ /i/ /u/ for both male and female, HNR data revels geriatric gender comparison shows significance difference with 0.013 p value for /a/, high significance difference(p value 0.000) /u/ ,no significant difference with p value 0.474 for /i/ , Adult gender comparison reveals high significance (p value 0.000) for /a/ /i / /u/ and age comparison data shows high significance difference (p value 0.000) for vowels /a/ /i/ /u/ for both male and female.

From the investigation it has been seen that there is a high significant difference in acoustic and aerodynamic measurements between male and female age comparison data and high significant difference in gender comparison with pitch, jitter, shimmer and no significant difference with MPD and s/z ratio. The PRAAT analysis tool found to be a useful and reliable tool for investigating the fundamental vocal parameters. The analysis of this variables allows us to determine that the parameters provide standard values that can be used as a reference for management of voice disorders.

## SUMMARY AND CONCLUSION

The impacts of anatomy and physiology influences voice qualities and related anatomical changes like changes in lung volumes, the degeneration of the respiratory muscles, and the stiffness of the thorax. As people age, their voice strength, range, and quality decrease. Although most vocal abnormalities in elderly may be managed or treated , other voice changes may indicate a more serious medical condition. Thus it is important to know about the aerodynamic and acoustical analysis of voice in adult and geriatric.

The purpose of the study was to compare the age-related changes in the geriatric population with the population of young adults and to analyse the aerodynamic and acoustical analysis of adult and geriatrics. The study included 70 adults (33 male, 37 female) and 67 geriatrics (32 male, 35 female) between the ages of 20 -25 and 70 - 75. Aerodynamic analysis was performed using a stopwatch, asking the participant to phonate as long as they can and get maximum phonation duration and as long as they could for the s/z ratio. By instructing the patient to phonate/a/ /il, and/u/, acoustic analysis was elicited, which was then analyzed with PRAAT. The findings showed according to age and gender comparisons, the results showed highly significant changes in the acoustical analysis, but no significant differences with aerodynamic analyses across the groups. By analyzing these variables, we can determine that the parameters offer approximate value that act as a reference for the management of voice disorders. for adult and geriatric , male and female.

## Reference


1. Arnold Aronson, Arnold E. Aronson, Diane Bless - *Clinical Voice Disorders*2009
2. Hari Kumar KV, Garg A, Ajai Chandra NS, Singh SP, Datta R. Voice and endocrinology. Indian Endocrinol Metab. 2016 Sep-Oct;20(5):590-594
3. Sebastian S, Babu S, Oommen NE, Ballraj A. *Acoustic measurements of geriatric voice*- journal of Laryngol Voice 2012;2:81-4
4. Maslan J, Leng X, Rees C, Blalock D, Butler SG. *Maximum phonation time in healthy older adults*. J Voice. 2011 Nov;25(6):709-13
5. Erika Mifune, Vanessa da Silva Saraiva Justino, Zuleica Camarg, and Fabiana Gregio, . *Acoustic analysis of aging voice: fundamental frequency-Characterization*, 2007, vol.9, n.2, pp.238-247
6. Devadiga DN, Bhat JS, Guddattu V. *Perturbation-related Measures of Voice in Geriatrics: A Normative Using Multidimensional Voice Profile*. It J Otorhinolaryngol Clin 2019; 11 (2):34-37.
7. Faustino Nuñez-Batalla Rocio Gonzalez Marquez M Belén Peláez González Irene González Laborda- *Acoustic Voice Analysis Using the Praat programme: Comparative Study With the Dr. Speech Programme*- March 2014 Acta Otorrinolaringológica Española 65(3).
8. Zhaoyan Zhang-*Cause-effect relationship between vocal fold physiology and voice production in a three-dimensional phonation model* April 2016 The Journal of the Acoustical Society of America 139(4):1493-1507.
9. Shingo Takano, Miwako Kimura, Takaharu Nito, Hiroshi Imagawa, Ken-IchiSakakibara, Niro Tayama- *Clinical analysis of presbylarynx-vocal fold atrophy in elderly individuals*- Auris Nasus Larynx. 2010 Aug;37(4):461-4
10. Vaz-Freitas, S., Pestana, P. M., Almeida, V., & Ferreira, A. (2018). *Acoustic analysis of voice signal: Comparison of four applications software.* Biomedical Signal Processing and Control, 40, 318-323.
11. Eckel, F. C., & Boone, D. R. (1981). *The s/z ratio as an indicator of laryngeal pathology.* Journal of speech and hearing disorders, 46(2), 147-149.