**COVER LETTER**

**Original articles:**

**Title:** A COMPARATIVE STUDY BETWEEN NASAL VIEW AND NASOMETRIC PARAMETERS ON NASALANCE MEASURES IN GURUMUKHI LANGUAGE SPEAKERS

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COMPARATIVE STUDY BETWEEN NASAL VIEW AND NASOMETRIC PARAMETERS ON NASALANCE MEASURES IN GURUMUKHI LANGUAGE SPEAKERS.

**Abstract**

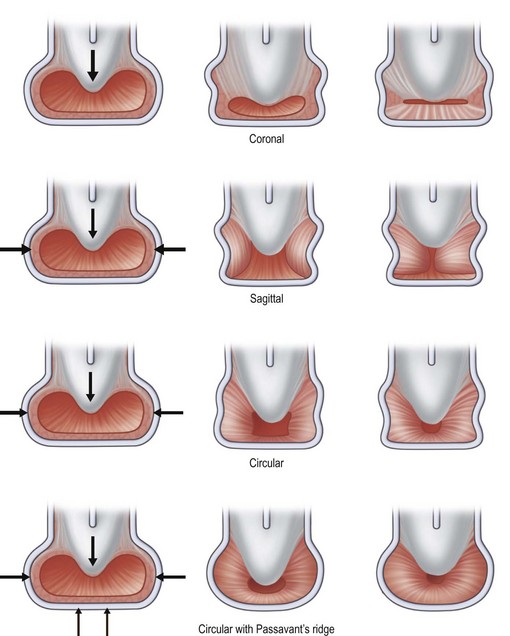
**Purpose:**The purpose of the study is to compare Nasal view and Nasometric parameters on nasalance measures in Gurumukhi language speakers. **Method:**Forty participants were divided into Group I (20 male) and Group II (20 female). Nasometer II Model 6400 (version 2.6) and Nasal View (Model T-02) were used for the measurement of mean nasalance. The Zoo passage, the Rainbow passage, and a set of five Nasal sentences were used for the measurements of nasalance. **Results:**The Nasal view showed a higher mean nasalance score than Nasometer in Zoo passage, Rainbow passage, and Nasal sentences. A high correlation was obtained between Zoo passage, Rainbow passage, and Nasal sentences as measured on Nasometer (r =.735 p<.001) and Nasal View (r=.338, p<.001). The mean nasalance scores in male (m=26.55, SD=6.93) and female (m=32.05, SD=6.57) respectively. Nasometer showed a significant difference between Zoo passage and Nasal sentences, and Zoo and Rainbow passages. No significant difference was observed on the mean nasalance of the Rainbow passage and Nasal sentences in English language. Differences of mean nasalance between Zoo passage and Nasal sentences showed (t=7.706, p<0.001) Nasal sentences and Rainbow passage (t=-4.165, p <.001) and between Zoo passage and Rainbow passage (t=-4.125,p<.001) measured by Nasal view showed a significant difference in between the passages. **Conclusion:**Nasalance scores obtained with Nasal View were qualitatively and quantitatively different from those nasalance scores obtained with the Nasometer. This suggests that the two instruments provide different information, and the scores are not interchangeable.

**Key word**: Nasal view, Nasometer, Gurumukhi language, Zoo passage, Rainbow, Nasal sentences

**INTRODUCTION**

Speech sounds can be produced by precisely graduated movement of the peripheral articulators like lips, tongue and palate. The simultaneous movement of the jaw, larynx and pharyngeal walls are equally important.Respiration, phonation, resonation and articulation involve in the process of the mechanism of speech production. The production of speech required the energy which comes from the process of respiration which consists of inhalation and exhalation. The main function of the respiratory system in speech is to push air into the airway component of the larynx, oral and nasal cavities. The larynx directs the airflow to create both voice and voiceless segments from the lungs (Weiss, Gordon & Lillywhite, 1987). The vocal tract which is also known as the upper airway runs from the larynx to the mouth or nose and is the site of what is commonly called speech articulation. During the process of phonation the source of sound for speech is obtained by the vibrating vocal folds. For normal phonation it requires normal functioning of the vocal folds, which includes normal laryngeal structure, innervations and aerodynamic function (Zemlin 1998). Resonance depends on the selective filtering or modification of the vocal tract cavities. The sound produced by our vibrating vocal folds, a complex periodic tone consisting of a fundamental frequency which is known as resonation (the rate at which vibration is occurring measured in cycles per second/Hertz). The resultant vibration of sound energy connects the resonance quality to the speech. Various factors can affect the vibration and the overall acoustic product of the voice. These characteristics include the size and shape of the cavities of the vocal tract. By age and gender we often determine the variations among individuals in size and shape of the resonating cavities .The nasal cavity is above the pharynx and oral cavities which is the resonating chamber that connects the nasal quality to the original character of the glottal tone. The velopharynx is complex, three-dimensional valves which provide to uncouple the oropharynx and nasopharynx during speech and swallowing. The muscle which is primarily responsible for velar motion and velopharyngeal closure is the levator veli (Peterson, Hardin & Karnell, 2001). Fine motor control of velar position may also be governed by the palatoglossus and palatopharyngeus. The velum lifts posteriorly and superiorly during velopharyngeal closure in normal individuals. The normal junction with the posterior pharyngeal wall is situated approximately three-quarters of the way back on the velum from the posterior nasal spine. The location of velopharyngeal closure is usually at or just inferior to the palatal plane, but velar height, as well as the extent of velopharyngeal contact, varies systematically depending upon the phonetic context (Moll, 1962; Karnell, Linbille & Edwards, 1988). The individual with or without cleft palate varied in the contribution of lateral pharyngeal wall movement to velopharyngeal closure but as for velar movement, it varies with the phonemic task. At the level of velopharyngeal contact the maximal lateral pharyngeal wall displacement usually occur.

Three basic patterns of velopharyngeal closure observed in normal subjects have been described by Skolnick et al.,(1975)and Croft et al.,(1981*)* i.e. (1) coronal, in which closure is effected primarily by velar elevation; (2) circular (with or without Passavant’s ridge), in which medial movement to the velum; and (3) sagittal, in which closure is damaged primarily by medial movement of the lateral pharyngeal walls and the velum contacts the lateral walls rather than the posterior wall. Of these, the coronal pattern of closure is observed most generally in both normal individuals and in patients with VPD. In various activities Velopharyngeal closure occur other than that of speech. Non-pneumatic activities which include swallowing, gagging and vomiting required the elevation of velum very high in the pharynx and the lateral pharyngeal walls so that it closes tightly along their entire length. As viewed through videofluoroscopy, this Closure appears to be almost exaggerated and is very firm .This type of closure is required because the purpose of closure in these cases is to allow substances to pass through the oral cavity while preventing nasal regurgitation. Velopharyngeal closure is further assisted in swallowing by the back of the tongue, which rises against the velum, thus pushing the velum up and back (Flowers & Morris, 1973).



**Figure 1: Types of velopharyngeal closure pattern. (Adapted from *Comprehensive Cleft Care* by Losee & Kirschner, 2015)**

Velopharyngeal closure may be complete for non - pneumatic actions, but insufficient for speech or other pneumatic activities (Shprintzen et al., 1975). In Pneumatic activities that utilize air pressure (both positive and negative) as a result of velopharyngeal closure is also important. Positive pressure is necessary for blowing, whistling, singing, and speech whereas the Negative pressure is needed for sucking and kissing.

During speech, voice onset and Velopharyngeal closure must be closely coordinated, velar movement for oral sounds must begin prior to the onset of phonation so that the Velopharyngeal valve is completely closed when phonation begins. The hypernasal resonance may be noted before activation of the sound source if complete closure is not achieved ( Ha, Sim, Zhi, & Kuehn, 2004). Hyponasality is another feature characterized by reduced nasal resonance in speech. Due to common cold or due to anatomical condition such as deviation of nasal septum it may result from the conditions such as blocked nose associated with nasal congestion. Both hypernasality and hyponasality may be clinically significant as they can interfere with the clarity of speech. However hyponasality is generally considered to have less of an impact on speech as it primarily affects only the nasal class of consonants (speech sounds) in English speakers i.e. /m/, /n/ and //. Hypernasality on the other hand affects all vowel sounds, results in weak consonants ( Harding & Grunwell, 1996) and has been reported as more negatively perceived by the listener. The timing of closure for an oral sound has been found to be somewhat based on the type of phoneme.

By the movement and height of the tongue during articulation of the sound the height of velar closure is affected, and also by the phoneme’s requirements for intraoral air pressure (Tom, Titze, Hoffman, & Story, 2001). In normally, velar heights are slightly greater for consonants than for vowels. High pressure consonants (plosives, fricatives, and affricates), especially those that are voiceless, have the greatest heights when contrast to other consonants. Due to the elevation of the tongue during the production of these sounds, high vowels have a higher velar height than low vowels (Moll, 1962; Moon & Kuehn, 1997). The interaction of a number of variables, including vowel height and the type of consonant (Lubker, 1975; Seaver & Kuehn, 1980) cause changes in the velar position. Thus, velar position must be changed and coordinated with each syllable production (Karnell, Linville, & Edwards, 1988).

The mechanism of velopharyngeal is a very important because inadequate closure may result in nasalized speech or the inability to impound air pressure within the oral cavity for the production of consonants and in this precision movement it plays a consequential role. One of the most common consequences of an inadequate velopharyngeal mechanism is nasality. Nasal resonance is not only seen in speech disorders but even the normal speech also consist some amount of nasality. Resonance is an important characteristic of speech. The resonance of speech is measured by the Nasometer in numerical form with high objectivity and reproducibility (Seaver et al.,1991). Nasalance measures are widely used diagnostic supplement for the speech evaluation of patients with resonance disorder resulting from cleft palate and other craniofacial disorder. Speech-Language pathologist uses the nasalance scores to confirm a perceptual assessment and to provide further quantitative measures.

Over 100 million native speakers worldwide spoke Gurumukhi which is an [Indo-Aryan language](https://en.wikipedia.org/wiki/Indo-Aryan_language), thereby making it the [10th most widely spoken language (2015)](https://en.wikipedia.org/wiki/List_of_languages_by_number_of_native_speakers) in the world. It is the native language of the [Punjabi people](https://en.wikipedia.org/wiki/Punjabi_people) who has lived in the historical [Punjab region](https://en.wikipedia.org/wiki/Punjab_region) of [Pakistan](https://en.wikipedia.org/wiki/Pakistan) and [India](https://en.wikipedia.org/wiki/India). It is the 11th most widely [spoken in India](https://en.wikipedia.org/wiki/List_of_languages_by_number_of_native_speakers_in_India) and the third-most spoken native language in the [Indian Subcontinent](https://en.wikipedia.org/wiki/Indian_Subcontinent). The language of Gurumukhi is written in the [Shahmukhi](https://en.wikipedia.org/wiki/Shahmukhi) and [Gurumukhi](https://en.wikipedia.org/wiki/Gurumukhi) scripts which makes it one of the comparatively few languages written in more than one script.

Gurumukhi was developed from Sanskrit through Prakrit language and later Apabhraṃśa.The official language of the Indian states of Punjab, Haryana and Delhi is Gurumukhi and some of its major urban centres in northern India are [Ambala](https://en.wikipedia.org/wiki/Ambala), [Ludhiana](https://en.wikipedia.org/wiki/Ludhiana), [Amritsar](https://en.wikipedia.org/wiki/Amritsar), [Chandigarh](https://en.wikipedia.org/wiki/Chandigarh), [Jalandhar](https://en.wikipedia.org/wiki/Jalandhar), and [Delhi](https://en.wikipedia.org/wiki/Delhi). It is one of the 22nd [scheduled languages of India](https://en.wikipedia.org/wiki/Scheduled_languages_of_India). Gurumukhi is the first official language of the [Indian State of Punjab](https://en.wikipedia.org/wiki/Punjab,_India) and also it is the second official status in [Delhi](https://en.wikipedia.org/wiki/Delhi) along with Urdu, [Haryana](https://en.wikipedia.org/wiki/Haryana). Either the North-western group of Indo-Aryan (together with [Lahnda](https://en.wikipedia.org/wiki/Lahnda) & [Sindhi](https://en.wikipedia.org/wiki/Sindhi_language)) or to the Central group (together with [Hindi](https://en.wikipedia.org/wiki/Hindi)) Gurumukhi has been variously assigned. There are three phonemically different [tones](https://en.wikipedia.org/wiki/Tone_%28linguistics%29) in the Gurumukhi language that developed from the lost [murmured](https://en.wikipedia.org/wiki/Breathy_voice) (or "voiced aspirate") series of consonants. The tones are rising or rising-falling contours phonetically and they can span over one syllable or two, but as high, mid, and low they can be distinguished phonemically. Gurumukhi speech sound can be classified into two major categories, namely suprasegmental and segmental sounds. Suprasegmental sounds consist of Tones, Stress, and Intonation. In deciding the meanings of the words the tone plays a significant role. Tone language is a language which having lexically significant, contrastive but relative pitch on each syllable and it is also described as a language in which pitch is used to contrast individual lexical items or words.

High, low and level tone are the two or three tones which contains in the Gurimukhi where only the high tone is marked, which plays an important role. Segmental sounds consist of vowel and consonants. Out of these phonetic sounds, three are definitely nasal phonemes viz. /m/ (bilabial voiced), /n/ (alveolar voiced), and /ng/ (velar voiced). All these nasal phonemes are capable of occurring in the Initial, Medial, and Final positions.

**Method**

The research design used in this study was descriptive. A total of 40 participants were selected for the study, which was native Gurumukhi speakers within the age range of 20 to 40 years (Mean age 26.25 and Standard deviation 4.80) and were divided into two Group I; a total of 20 males (Mean age 26.65 and Standard deviation 4.46), and Group II; a total of 20 females (Mean age 25.85 and Standard deviation 25.19). The participants were considered for the study based on the following inclusion criteria. The subjects included in this study were native speakers of the Gurumukhi language who were able to read the English language fluently. The subject they have given written consent before testing. Subjects having any speech and language disorder, any perceived resonance disorder, suffering from cold or other upper respiratory tract infections, having any hearing and vision problems and menstruating female participants have been excluded.

**Instrumentation and test environment**

The Nasometer II Model 6400 (version 2.6) and Nasal View (Model T-02) connected on a desktop computer model (HCL Pentium 4) were used for the measurement of mean nasalance in this study. Both instruments comprise of a headset with a sound-separator plate and two microphones on either side which detects oral and nasal components of the speech which rest on the subject’s upper lip. The signal from each of the microphones is filtered individually and digitized by customized electronic modules. The resulting signal gave a ratio of total nasal energy nasal plus oral acoustic energy in terms of percentage (nasalance) multiplied by hundred.

**Reading stimuli**

For measurement of mean Nasalance and invariance three standardized passages were used:

1. The Zoo passage (Fletcher, 1972) excludes nasal consonants in the English language.
2. The Rainbow passage (Fairbanks, 1960) contains 11.5% nasal consonants in the English language.
3. A set of 5 Nasal sentences (Fletcher, 1978) were taken from the manual of Nasometer II,contained 35% nasal consonants in the English language.

**Procedure**

The instruments Nasometer II 6400 and Nasal View (Model T-02) connected on a desktop computer model (HCL Pentium 4) were set up in a suitable quiet recording room. Beginning of each data collection session the Nasometer and the Nasal View were calibrated based on the manufacturer's instructions. The subjects were seated in a comfortable chair in front of the computer monitor. First, the Nasometer headpiece was placed on the subject’s head such that the oral and nasal microphones are at equal distances from the mouth & nose, and the subjects were instructed before the test.

**Instruction to the participants:**

The participants were instructed verbally “Three texts will appear on the screen. You have to read the text which appears on the screen exactly as it appears, do not repeat the text or add anything which does not appear on the screen. Three trials will be taken for each passage. Best of three trials will be taken for each category allowing 10 minute’s interval”. The participants were also instructed not to add filters like /umm/ or /ah/ in between. However, they were allowed to pause in between reading but to resume reading from where they stopped. It took about 40 minutes to test each participant.

**RESULTS**

Mean and standard deviation of mean nasalance for the Zoo passage, Rainbow passage and Nasal sentences using Nasometer II 6400 and Nasal view were computed and shown in Table 1 and Table 2 respectively.

**Table 1: Mean and standard deviation of nasalance scores on Zoo passage, Rainbow passage and Nasal sentences for Group I and Group II using Nasometer II 6400.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nasometer II 6400 | Group I (Male) | | Group II (Female) | |
|  | **Mean** | **Standard deviation** | **Mean** | **Standard deviation** |
| Zoo passage | 26.55 | 6.93 | 26.75 | 16.12 |
| Rainbow passage | 32.05 | 6.57 | 36.85 | 13.55 |
| Nasal passage | 35.45 | 6.37 | 41.4 | 12.23 |

**Table 2: Mean and standard deviation of nasalance scores on Zoo passage, Rainbow passage and Nasal sentences for Group I and Group II using Nasal view.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Nasal view II | Group I (Male) | | Group II (Female) | |
|  | **Mean** | **Standard deviation** | **Mean** | **Standard deviation** |
| Zoo passage | 36.70 | 13.77 | 28.06 | 7.05 |
| Rainbow passage | 44.79 | 6.85 | 38.62 | 8.60 |
| Nasal passage | 53.45 | 3.75 | 43.85 | 4.96 |

Pearson correlation was used to measure significant correlation between the Zoo passage, the Rainbow Passage and Nasal sentences as measured on Nasometer **II 6400**. The result shows that the Zoo passage, the Rainbow passage and the Nasal sentences were highly correlated 5% level (r=0.753; p<.0001). Likewise, Pearson correlation was used to measure significant correlation between the Zoo passage, the Rainbow Passage and Nasal sentences as measured on Nasal View. The result shows highly correlated and correlation is significant at the 5% level (r= 0.338; p<.0001).

**Differences of mean nasalance between the passages in Nasometer II 6400**

Independent sample t-test was done to compare the mean and standard deviation betweens Zoo passage and Nasal sentences, Rainbow passage and Nasal sentence, and Zoo passage and Rainbow passage. The results depicted significant difference in mean nasalance scores across Zoo passage and Nasal sentence at (t= -489; p<.0001), Rainbow passage and Nasal sentence at (t= -1.701; p>0.093). Zoo passage and Rainbow sentence at (t= 0.3224; p<.0002) respectfully.

**Differences of mean nasalance between the passages in Nasal view**

Independent sample t-test was done to compare the mean and standard deviation betweens Zoo passage and Nasal sentences, Rainbow passage and Nasal sentence, and Zoo passage and Rainbow passage. The results depicted significant difference in mean nasalance scores across Zoo passage and Nasal sentence at (t= -7.706; p<.0001), Rainbow passage and Nasal sentence at (t= -4.165; p<.0001). Zoo passage and Rainbow sentence at (t= -4.165; p<.0001) respectfully.

**Nasalance scores along with Gender Differences in Nasometer**

All the subjects were asked to read all three passages and the observations were combined for Group I (Male) and Group II (female) separately for normal Gurumukhi speakers and mean and standard deviation of male and female were tabulated shown in table 3.

**Table 3: Mean and Standard deviation of gender differences, the degree of freedom and t-value.**

|  |  |  |  |
| --- | --- | --- | --- |
| Gender | Mean | | SD |
| Female | 34.63 | | 15.38 |
| Male | 31.35 | | 7.49 |
| N | 60 | | 60 |
| Diff | 3.28 | | 16.06 |
| VARIANCES | | | |
|  | df | t- Value | Pr>/t/ |
| Equal | 118 | 1.486 | .140 |
| Unequal | 85.530 | 1.486 | .140 |

Independent sample t-test was done to compare the mean and standard deviation for Group I (Male) and Group II (Female). The result depicted insignificant difference in mean nasalance scores across Male and Female (t= 1.486; p>.140).

**Nasalance scores along with Gender Differences in Nasal view**

All the subjects were asked to read all three passages and the observations were combined for Group I (Male) and Group II (female) separately for normal Gurumukhi speakers and mean and standard deviation of male and female were tabulated shown in table 4.

**Table 4: Mean and Standard deviation of gender differences and the degree of freedom and t-value of comparison of means of gender differences.**

|  |  |  |  |
| --- | --- | --- | --- |
| Gender | Mean | | SD |
| Female | 36.84 | | 9.57 |
| Male | 44.98 | | 11.32 |
| N | 60 | | 60 |
| Diff |  | |  |
| VARIANCES | | | |
|  | df | t- Value | Pr>/t/ |
| Equal | 118 | -4.248 | <.001 |
| Unequal | 114.822 | -4.248 | <.001 |

Independent sample t-test was done to compare the mean and standard deviation for Male and Female. The result depicted significant difference in mean nasalance scores across Male and Female (t= -4.248; p<.001).

**5.8 Comparison of nasalance scores across Nasometer II 6400 and Nasal view**

Paired t-test was done to compare the mean nasalance score for Nasometer II 6400 and Nasal View. The result depicted significant difference in mean nasalance scores across the instrument for the Zoo passage at (t= -2.731; p<.009), the Rainbow passage at (t= -4.401; p<.0001) and Nasal sentences at (t= -6.844; p<.0001)

**DISCUSSION**

Nasometry is now accepted as an objective method for quantitative measurement of nasalance. Speech Pathologist and Medical professionals dealing with management of resonance disorders are increasingly making use of Nasometry to confirm perceptual judgments of abnormal levels of nasality and to evaluate velopharyngeal insufficiency. In different nasalance studies, researchers have used three standard English Passages (Anderson, 1996; Fletcher et al., 1979; Hutchinson et al., 1978; Leeper et al., 1992; MacKay & Kummer, 1994; Seaver et al., 1991).

Review of literature showed that even though the nasal sounds are limited in all language, the nasalance measured in different language, dialect, sex and age may not be same (Anderson, 1996; Mayo et al., 1996; Van Droon and Purcell, 1998; Seaver et al., 1991; Leeper et al., 1992; Hutchinson et al., 1978).

Establishing normative nasalance scores for native speakers of Gurumukhi language for the Zoo passage, the Rainbow passage and Nasal sentences between the Nasometer II 6400 and Nasal view. The nasalance score for Nasal sentences is higher than the Zoo passage and the Rainbow passage. This is supported by previous research finding which showed a significant difference across passages using Nasometer ( Seaver et al., 1991; Kavanagh et al., 1994; Anderson, 1996; Whitehill, 2001) and for Nasal View by Kuttner et al. (2003). In Indian languages also it has found that there is a significant difference across nasal and oral stimuli using Malayalam, Hindi and Bangla languages ( Ravindran, 2009; Arya, 2009; Kumar, Chakrabarty, Shailat & Singh, 2012; Kumar, Sinha, Chatterjee, Hota, & Shatakshi, 2016).

Seaver et al., (1991) studied on Nasometric values for normal nasal resonance of normal 148 English speaking adult subjects, included 92 females and 56 males in the age range of 16.17 years to 63.33 years with the mean age of 33.07 years. Reading passages, nasal sentences, the Rainbow passage, and the Zoo passage were used as a stimuli. The result indicated that mean nasalance scores for nasal sentences ranged from 57% to 66%; mean nasalance scores for the Rainbow passage was ranging from 32% to 41%; mean nasalance for the Zoo passage was ranging from 11% to 22%. There was a significant difference across the nasalance scores of the three passages. Nasal sentences showed higher nasalance scores than the Rainbow passage and Zoo passage.

Kuttner et al., (2003) conducted a study to measure the normal nasalance for German language using Nasal View system. A total of 50 normal subjects (11-20 yrs) were participated in the study. The tone materials used comprised the vowels /a:/, /e:/, /i:/, /o:/, /u:/, sentences S1: “ This chocolate is very tasty”, and “Call my mummy Mimmi” and the text passages of LT (1): “ Northwind and the Sun”, LT(2): “ A child’s birthday party” and LT(3): “A popular song”. Result revealed were as mean nasalance for vowels was 35.9% (8.4); for S1 (containing no nasal consonants) 24.9% (5.3) and for S2 (with many nasal sounds) 69.6% (5.5), the results for the text passages were 42.1% (4.2) for Lt(1), 36..9% (4.3) for LT(2) and 38.2% ( 4.4) for LT(3). Results showed that the mean nasalance value obtained by nasal stimuli was higher than mean nasalance obtained by oral stimuli and also concluded that there is a significant difference across stimuli.

The observed variation in mean nasalance score across oral and nasal stimuli could be attributed to the influence of phonetic nasal content of individual stimuli on the nasalance values, an effect demonstrated by Fletcher, Adams and McCutcheon (1989). The main difference between nasal and oral vowels is due to the position of the soft palate. Production of nasal stimuli induces the transfer of acoustic energy into the nasal cavity through the open Velopharyngeal port and during the production of oral sounds, the Velopharyngeal port is closed which accounts for the reduction in transfer of acoustic energy into the nose and an increase in oral acoustic energy.

**Figure 2: Comparative mean nasalance scores measured by Nasometer and Nasal View within same gender for all three passages. X-axis represents gender and Y- axis represents mean nasalance scores (%).**

Paired t-test was done to compare the mean nasalance score for Nasometer and Nasal View Zoo Passage, Rainbow Passage and nasal sentences. This finding was supported by researches which have suggested that Nasal View produce higher mean nasalance scores than Nasometer (Awan, 1998; Bressman et al., 2000). Awan (1998) study reported that, mean nasalance scores measured with the Nasal View were higher for non - nasal stimuli and lower for nasal stimuli in comparison to the Nasometer. Presumably the difference in nasalance scores is related to the different acoustical filtering used in the Nasometer versus the Nasal View. The Nasometer measures sound intensity in a 300-Hz band around a centre frequency of 500 Hz. Thus, most of the acoustic energy measured by the Nasometer would be associated with vowels, and primarily just the first formant of vowels. The Nasal view measures sound intensity across the entire speech spectrum, so it is measuring and summing all of the acoustic energy associated with both vowels and consonants. The finding was also consistent with the findings of Bressman et al. (2000) with reference to specificity and sensitivity for patient with different degree of hypernasality. Lewis and Watterson (2003) compared nasalance scores from the Nasometer and Nasal View with 16 bit resolution for five sentences that were loaded with different vowels (Lewis et al., 2000). The authors found significant differences in nasalance scores between Nasometer and Nasal View for four of the five stimuli, but not all differences were in the same direction. Lewis and Watterson (2003) found that nasalance scores from the Nasal view are qualitatively and quantitatively different from those of the Nasometer.

**Correlation between the Zoo passage, the Rainbow passage and Nasal sentences as measured on Nasometer and Nasal View.**

In different nasalance studies, researchers have used three standard English Passages (Anderson, 1996; Fletcher et al., 1989; Hutchinson et al., 1978; Leeper et al., 1992; MacKay & Kummer., 1994; Seaver et al., 1991). Prathanee, Thanaviratananich, Pongjunyakul and Rengpatanaki (2003) developed passages, Anderson, (1996) developed Spanish passages. In Indian languages nasalance scores have been measured using different stimuli in Marathi, Tamil, Kannada, Hindi, Malayalam and Bangla languages (Nandurkar, 2002; Jayakumar & Pushpavathi, 2005; Arya, 2009; Ravindran, 2009; Kumar, Chakrabarty, Shailat & Singh, 2012). Van Lierde et al., (2001), Whitehill (2001), Tachimura, Moris, Hirata and Wada, (2000), Hirschberg et al., (2006), have established normative nasalance scores in Flemish, Cantonese, Japanese and Hungarian languages, which are critical values to identify patients with Velopharyngeal impairments , hearing loss, dysarthria, resonance disorder etc. Therefore, Pearson correlation was computed to measure significant correlation between the Zoo passage, the Rainbow passage and Nasal sentences as measured on Nasometer and Nasal View. The result showed that Zoo passage, Rainbow passage and Nasal sentences were highly correlated.

**Nasalance Scores: Gender Difference**

Review of literature gives different findings when the question of gender difference was studied with respect to the mean nasalance. Study conducted by Dalston and Dalston (1991); Anderson, (1996); Seaver, Dalston, Leeper and Adams (1991); Thomas and Hixon, (1979); and Seaver et al., (1991) indicated the gender differences in the mean nasalance scores with higher nasalance scores for female. Researchers have observed that female speakers had significantly higher nasalance scores than male subjects on nasal sentences. This could be due to the nasal airflow which is higher in females. Also this may be due to the increased respiratory effort and increased nasal cross-section area. One more explanation for the gender difference in nasalance scores was the inconsistency might be due to the differences in nasal cross-section area and modal pitch. Nasal cross-section area and F0 was evaluated using modification of theoretical hydraulic principle and visipitch respectively. Seaver et al., (1991) found significant differences in nasal cross-section areas and modal pitch between male and female subjects.

There have been studies focused on sex difference in nasalance scores. Some studies reported no sex differences in nasalance scores during reading of the Zoo passage (Seaver et al., 1991; Leeper et al., 1992; Litzaw and Dalston, 1992; Mayo et al., 1996; Van Droon and Purcell, 1998), but others indicates higher nasalance scores among women during reading of the nasal passage (Seaver et al., 1991; Vallino-Napoli & Montgomery, 1997). That is although it is possible that sex differences in nasalance scores are related to the test stimulus, it is not clear whether the findings obtained among non-Japanese speakers are also valid for Japanese speakers which has different phonological characteristics from Western Languages.

Gender related difference in nasalance values have been related to basic anatomical structural and physiological differences between males and females. The resonanace of voice is influenced by the size, shape and surface of the infraglottal and supraglottal resonating structure and cavities (Sharintzen & Bardach, 1995).Various studies have reported that the function of larynx and velophayrnx is affected by a large number of anatomical, physiological, and aerodynamical gender related differences. Physical size appears to be the predominant anatomical feature that differentiates male and female larynges (Gooze’et al., 1998 & Kahane, 1983).

**CONCLUSION**

The findings of the current study will help Speech Language pathologists evaluate the nasalance of the native speaker of Gurumukhi by using English passages for those who are versed with English. The normative nasalance data will provide important reference information for several clinicians who assess resonance disorders. Speech pathologists can measure the effects of a specific therapy approach, and the plastic surgeon can evaluate the effects of different nasal and pharyngeal surgical techniques. The normative scores can be used for the assessment of different resonance disorders like cleft lip and palate, motor Speech disorders, hearing impairment, functional nasality problems, singing pedagogy.

Nasalance scores from the Nasometer and the Nasal View are qualitatively and quantitatively different. At this point, it is not certain whether the differences will be meaningful for clinical diagnosis and whether they will affect the diagnostic efficacy of the Nasal View.

REFFERENCES

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