

# Research Paper: Determining Normative Nasalization Scores Among Persian-speaking Adults



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## ABSTRACT

**Introduction:** Awareness of the nasality norm condition in normal people's speech (children and adults) is very important for assessment and treatment of nasality disorders. The main goal of this study was to determine normative nasalance scores among Persian-speaking adults.

**Material and Methods:** In this descriptive-analytical cross-sectional study, nasalance value of 152 adults (54 males and 98 females) older than 18 years was examined by access method. Nasality test which included vowels (front/back, high/low), syllables (with oral and nasal consonants), words (with oral and nasal consonants), and sentences (with oral and nasal consonants) was done using Nasometer II model 6450. The data were then analyzed using paired t- test and Wilcoxon statistical test.

**Results:** The results indicate that the nasalance mean score for back vowels is significantly higher than front vowels. Also, the amount of nasalance mean score for low vowels is significantly higher than that in high vowels. The results also indicate that the nasalance mean scores for syllables, words, and sentences with nasal consonants is significantly higher than those with oral consonants ( $P < 0.001$ ).

**Conclusion:** The results of the present study have provided the mean scores of nasalance for vowels, syllables, words, and sentences separately with oral and nasal consonants in normal Persian-speaking adults. Also, the data obtained in this study can be used to compare the function of the resonance system in people with suspected resonant disorders.

## 1. Introduction

Speech is the common and most important way of communication between humans. The systems involved in speech production process are respiration, phonation,

resonant, and articulation systems. The resonant system modifies and enhances the sound energy. Oral-nasal cavities balance is a determining factor in resonance quality of human voice. Factors that disturb this balance includes cleft palate or soft palate inefficiency, palatopharyngeal incompetence, nasal entrance closure and nasal septum

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deviation, also the role of velopharyngeal sphincter is very important [1]. Voice resonance due to nasalization is one of the factors affecting speech intelligibility. Nasalization refers to sound producing while the velum is down, so that some air escapes through the nose during the sound production by the mouth. Nasalization may occur depending on two factors; hypernasality or hyponasality, and its assessment is of particular importance [2, 3].

The amount of nasalization is evaluated by objective and subjective (acoustic and perceptual) measures. Because of different reasons, a perceptual judgment is not error-free. Factors such as individual criteria of judgment, different scoring systems, and unique characteristics of sound, impair nasalization diagnosis. Therefore, using an objective tool for diagnosing nasalization is more appropriate. Some types of objective tools include Nasometer, Nasal view, Visipich, and SNORS. Because of its gold standards, the Nasometer has many applications in clinical research [4, 5].

Nasalization patterns are reported in different languages and different age groups. Lee and Browne [6] evaluated the norm of nasalization in English-speaking adults with an Irish accent. Sixteen sentences of nasalization evaluating with Irish accent protocol, zoo passage and rainbow passage, were read by 30 normal males and 30 normal females. Speech samples were evaluated by Nasometer 6400 and the results indicated no difference in terms of gender. The amounts of nasalization in sentences which contained high pressure consonants were more than sentences with low pressure consonants. English-speaking adults with an Irish accent had less nasalization compared to English-speaking children with an Irish accent. Okalidou et al. [7] found normal nasalization in Greek adults by using SNAP1 test. A total of 80 adults (40 males and 40 females) with an average age of 21 years were tested by using Nasometer 6200. Layton et al. [8] obtained the norm of nasalance value for Ugandan-speaking (the English for Eastern Africa) children. The subjects were 69 children (35 boys and 34 girls) in the age range of 7.2 to 13.5 years.

The tasks, which were presented, were repeating 4 phonemes, repeating 14 syllables, 15 sentences (12 oral and 3 nasal), and two passages (rainbow and zoo passages). The obtained information was analyzed with respect to age and gender. The average nasalance score for normal Ugandan children was 17, so that for oral and nasal sentences, it was 64% and for oral and oral-nasal sentences 33.14%. By Brunnegard and Van Doorn [9] obtained the norm of

nasalance in Swedish children. A total of 220 normal children in the age range of 4 to 5 years, 6 to 7 years, and 9 to 11 years were tested. The task contained 4 speech stimuli. There was significant difference between small children and two other groups with regard to nasal sentences.

Karakoc [10] evaluated norm of nasalization in Turkish-speaking adults and children. The subjects were 35 normal children in the age range of 7 to 13 years and 125 adults in the age range of 18 to 69 years. The presented task contained repeating 3 nasal passages which were classified based on consonant amounts (oral, oral-nasal, and nasal). These scores for children on 3 passages (oral, oral-nasal, and nasal) were 15.14, 37.76, and 49.23, respectively and for adults were 13.46, 37.84 and 50.28, respectively. Abou-Elsaad et al. [11] compared the collecting normative values of nasalance in different age groups by using Arabic samples from patients with nasalization disorders. The subjects were 300 normal people classified in 3 age groups: 92 children (in the range of age 3 years and 3 months to 9 years), 76 adolescents (in the range of age 9 to 18 years) and 132 adults (above 18 years). The speech examples were analyzed by Nasometer 6400.

The obtained results indicated that nasalization scores were different with respect to age and gender. Darouie et al. [12] evaluated palatopharyngeal function in normal people (7-10 and 20-23 years) from Mashhad and reported significant difference between age groups with regard to palatopharyngeal. As we know, speech intelligibility is a result of transferring the air and sound energy between the oral and nasal cavity by palatopharyngeal sphincter function. Nilipour et al. [13] studied laboratory applications of diagnostic tests in speech pathology using two devices; SNORS and Visipich III for Persian speakers. They reported that both devices can be used to evaluate the resonance and motor speech profile. Ghelichi et al. [14] studied the effect of phonetic contexts on the amount of nasalization in the words of 62 males and 60 females, 18-27 years old, with Nasal view device and showed that low and back vowels have the most and high and front vowels the least nasalization on phonetic context. Ghaemi et al. [15] determined the amount of nasalization in continuous speech of normal 7-11 years old boys (26 boys) using Nasometer 6450 model, and did not report any significant difference on nasalization on the basis of age.

Obviously, the more speech and language pathologists and speech reconstructive surgery know about the normal range of nasalization, the better they can manage the nasalization disorders. Therefore, It is important to have nasalization norm for each phoneme in determining treatment priority, articulation error correction, and

1. Simplified Nasometric Assessment Procedures (SNAP)

speech intelligibility. This component is useful for cleft palate, motor speech disorders, hearing impairment and functional nasality problems [16]. Although perceptual evaluation makes it somewhat possible, it has some problems which reduce its credibility. Using Nasometer as an objective and fast tool is useful in resonance disorders evaluation [17, 18]. Since no research has been done in the field of nasalization normality for Persian-speaking adults, and because of the importance of nasalization norms in educational and clinical process, the researchers decided to evaluate nasalization norms in Persian-speaking adults and matching it with other languages that have adult nasalization norm.

## 2. Materials and Methods

In this descriptive-analytical cross-sectional study, nasalance value of 152 adults (54 males and 98 females) older than 18 years was examined with access method. Adult Persian-speakers older than 18 years old were qualified to enter the study. The inclusion criteria were as follows: consciousness during the test, having intelligible, normal visual and auditory and also no history of nasal surgery, lack of obstruction and nasal septum deviation, lack of fatigue and stress and not using cigarettes and hypnotics and lack of spasms in the speech production system.

Subjective sampling was in the form of convenience sampling, which was chosen from Rofeide Rehabilitation Hospital staff, Welfare and Rehabilitation University staff, students and patients' caregivers. For this study, a valid and reliable test [14] has been used (Appendix 1). This test was composed of vowels (front/back, high/low), syllables (with oral and nasal consonants), words



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Figure 1. Putting the headset properly on the subjects' head

(with oral and nasal consonants), and sentences (with oral and nasal consonants) that is done by Nasometer II model 6450. In fact, the task of the test contained 6 vowels, sets of oral and nasal syllables, 12 oral and nasal words, and 4 sentences with oral and nasal consonants which practiced on the subject by putting the plate properly on the subjects' head (Figure 1). The researcher saved the raw data in a file marked by the subject's name. The study variables were measured numerically. One-way Kolmogorov-Smirnov test was used to check the normal distribution of data and to compare and analyze data, parametric tests (paired t-test), and non-parametric Wilcoxon test.

## 3. Results

The results showed that the amount of nasalance mean score for back vowels is significantly higher than front vowels (Table 1). Also, the amount of nasalance mean

Table 1. Comparing the mean and standard deviation of nasalization of front vowels with back vowels (/æ/, /i/, /e/ with /u/, /o/, /a/)

Variable	Mean	SD	P
Front vowels	15.21	8.51	<0.001
Back vowels	30.23	12.22	

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Table 2. Comparing the mean and standard deviation of nasalization of high vowels with low vowels (/u/, /i/ with /a/, /æ/)

Variable	Mean	SD	P
High vowels	23.92	11.18	<0.001
Low vowels	27.75	12.49	

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**Table 3.** Comparing the mean and standard deviation of nasalization of oral syllables with nasal syllables (/pa/, /ta/, /sa/, /pi/, /ti/, /si/ with /ma/, /na/, /mi/, /ni/)

Variable	Mean	SD	P
Oral syllables	21.43	8.87	<0.001
Nasal syllables	73.19	5.95	

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**Table 4.** Comparing the mean and standard deviation of nasalization of oral words with nasal words (/dad/, /did/, /daerd/, /bal/, /bil/, /bur/ with /dan/, /din/, /naerd/, /mal/, /mil/, /mur/)

Variable	Mean	SD	P
Oral words	19.43	7.45	<0.001
Nasal words	63.40	6.34	

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**Table 5.** Comparing the mean and standard deviation of nasalization of oral sentences with nasal sentences

Variable	Mean	SD	P
Oral sentences	14.83	5.51	<0.001
Nasal sentences	67.15	5.67	

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score for low vowels is significantly higher than high vowels (Table 2). The results showed that the amount of nasalance mean scores for syllables, words with consonants with nasal consonants is significantly higher than those with oral consonants (Tables 3, 4 and 5).

#### 4. Discussion

Several studies in different countries on different languages (English, English with Irish accent, Arabic, Arabic with Egyptian accent, Spanish, German, Greek, Swedish, Korean, etc.) have been conducted to evaluate nasalization norms amount, especially in children using Nasal view software and sometimes Nasometer. These studies, albeit confirming significant differences in nasalization scores in different languages and accents, have to interpret separately [19-22]. According to the results of studies and statistical analysis, Nasometer is suitable for evaluating resonance disorders. Evaluating the nasalization scores by Nasometer is an objective, accurate and fast method which is considered a practical reference. However, studying the nasalization difference scores in natural situations, depend on many factors [23-26]. Also, based on the findings of this study, factors such as phonetic context, frequency amount, nasal phonemes, distribution of front and back vowels, distribution of high and low vowels, speech speed and loudness of subject voice

can affect the nasalization in Persian. As noted earlier, the main goal of this survey is determining normative nasalance scores among Persian-speaking adults. Therefore, the average amount of norm nasalization in speech elements (vowels, syllables, words, and sentences which contain oral and nasal consonants) was achieved by doing this study. The norm scores of oral consonant sentences and nasal consonant sentences in this study were 14.83 and 67.15, respectively which were partly different from the average nasalance scores achieved by Nasometer by the producer for Zoo passage (oral sentences) and Rainbow passage (oral-nasal sentences) and nasal sentences as 11.25, 31.47, and 59.55, respectively.

This partial difference with reference scores (for the English language) is due to the age range and Persian language. Also, the scores of the norm oral syllables and norm nasal syllables in the present study (respectively 21.43 and 73.19) with oral syllables (/pa/, /ta/, /sa/, /pi/, /ti/, /si/) and nasal syllables (/ma/, /na/, /mi/, /ni/) are partly different from reference scores (respectively 17 and 63.5). The previous claim (different scores between oral and nasal sentences) can be true for this study. Although the most nasalization studies have been conducted on children; however, we compared nasalization studies only among adults. It should be noted that nasalization

has not been compared in this study between genders (because of heterogeneity of the number).

Karakoc [10], who had compared the nasalization norm in Turkish adult and children with oral and nasal passages, found partial differences between these two groups. They reported nasalization norm for children's oral and nasal passages (respectively 15.14 and 49.23) and for adults (respectively 13.46 and 50.28). The difference between the scores of the present study with the Karakoc scores can be attributed to language differences. Lee and Browne [6], by evaluating normal nasalization of adult English-speakers with an Irish accent with Zoo passage and Rainbow passage using Nasometer 6400, pointed that adult had less nasalization compared to children in the sentences with more high pressure nasalization consonants than low pressure consonants. This study did not reveal any difference in terms of gender.

The present study results seem to be in line with Lee and Browne study about Zoo passage for adults. Abou-Elsaad et al. [11], in norm nasalization scales for normal Arabic with Egyptian accent in different ages (children, adolescents, and adults) with using Arabic speech samples and comparing with patients with nasalization disorders, claimed that nasalization scores were different with respect to age and gender. The present study did not consider the children and gender, but regarding adults its results agree with Elsaad study results. Okalidu et al. [7] obtained the normal amount of nasalization for Greek adults (40 male and 40 females) by using Nasometer 6200. They found it a useful method which corresponds to our study findings. Overall, the results of the current study are consistent with the results of Ghelichi study [14]. From then on, the Iranian speech therapists can use the nasalance norm amount of this study for adult clients in terms of diagnosis and treatment.

Our results based on descriptive statistics show that the mean scores of nasalance for /i/ and /o/ vowels are in order of the most and the least nasalization amount in Persian language. According to analytical results, the average nasalance of back vowels are significantly more than front vowels and the average nasalance of low vowels are significantly more than high vowels and also the averages of nasal syllables, words, and sentences which contain nasal consonants are significantly more than syllables, words, and sentences with oral consonants. The results of the present study have provided the mean scores of nasalance for vowels, syllables, words, and sentences separately with oral and nasal consonants in normal Persian-speaking adults. Also, the data obtained in this study can

be used to compare the function of the resonant system in people with suspected resonant disorders.

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## Conflict of Interest

The authors declared no conflicts of interest.

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