EJMA

DOI: 10.14744/ejma.2023.08379
EJMA 2023;3(3):140–143


Research Article

# Peak Nasal Inspiratory Flow Values and Visual Analog Scale in Snoring Patients

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## Abstract

**Objectives:** Nasal congestion is a common symptom in nasal disease. There are objective and subjective methods for the evaluation of nasal patency. Acoustic rhinometry, rhinomanometry, and peak nasal inspiratory flow (PNIF) can be counted as objective methods. In this study, the correlation between PNIF measurement and the subjective perception of nasal obstruction measured with the method of the visual analog scale (VAS), was investigated.

**Methods:** Our study was carried out with participants who applied to Adnan Menderes University Otorhinolaryngology Clinic Snoring Polyclinic between 2021-2022 and volunteered to participate in the study. Patients with lung diseases were excluded from the study. All patients were examined in the same environment. PNIF measurements were made. For nasal obstruction, the patients were asked to indicate their VAS score, the most severe of which was 10 points.

**Results:** The study was carried out with 92 participants. The mean age of the patients was 38±11, the mean PNIF was 128±42 L/min, and the mean VAS score was 5.2±2. When the mean distribution of PNIF values according to age, gender, BMI, smoking habits, regular sports habits, presence of rhinitis findings, and presence of septum deviation was examined, no statistically significant difference was found between the groups. There was a weak negative correlation between PNIF and VAS score values.

**Conclusion:** PNIF is a low-cost, easy-to-use method for the objective evaluation of nasal obstruction. The VAS score can also be used for the preliminary evaluation of nasal obstruction before objective tests. We recommend using both methods together, if possible.

**Keywords:** Nasal obstruction, patient with snoring, peak nasal inspiratory flow, visual analog scale

***Cite This Article:*** *Altıner Hİ. Peak Nasal Inspiratory Flow Values and Visual Analog Scale in Snoring Patients. EJMA 2023;3(3):140–143.*

Nasal obstruction is the most common symptom reported by patients affected by nasal diseases.[1] Disruption of nasal airflow causes symptoms of nasal congestion. When we look at the pathological causes of nasal obstruction; rhinitis and related turbinate hypertrophy, rhinosinusitis, septum deviation, nasal valve insufficiency, nasal polyps, nasal masses, and adenoid tissue hypertrophy especially in children can be counted.

It is thought that nasal obstruction due to nasal congestion causes an increase in airway resistance and contributes to the development of obstructive sleep apnea syndrome (OSAS).[2] There are objective and subjective evaluation methods to detect a nasal obstruction and its degree. Acoustic rhinometry, rhinomanometry, and peak nasal inspiratory flow meter (PNIF) are used to objectively evaluate nasal patency. However, it is stated that acoustic rhinometry and rhinomanometry are more costly and less practical than PNIF.[3] PNIF measurement is an inexpensive, simple, and easily applicable method to evaluate nasal patency.[4] The PNIF measures total nasal flow, so it is not dependent

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**Submitted Date:** April 20, 2023 **Revision Date:** April 20, 2023 **Accepted Date:** November 01, 2023 **Available Online Date:** March 28, 2024

on the varying resistances between the left and right nostrils during the nasal cycle.[5]

This study, it was aimed to investigate the PNIF measurement values and the correlation of these values with the visual analog score (VAS), which is a subjective measurement, in our patients with snoring complaints.

## Methods

Our study was carried out with participants who applied to Adnan Menderes University Otorhinolaryngology Clinic Snoring Polyclinic between 2021-2022 and volunteered to participate in the study. Patients with significant comorbidities and lung diseases were excluded from the study. The smoking and regular sports habits of the patients were questioned. Body mass index (BMI) was calculated by questioning height and weight. Rhinological examinations of the patients were performed as anterior rhinoscopy and nasal endoscopy. Patients with active rhinosinusitis and nasal polyps were excluded from the study. The study was carried out with 92 participants. It was questioned whether the patients had complaints of nasal obstruction. A visual analog scale (VAS) was used to determine the severity of nasal obstruction subjectively. Accordingly, the patients were asked to score the severity of nasal obstruction with 10 being the highest. To evaluate nasal patency objectively, a peak nasal inspiratory flow (PNIF) meter (Clement Clark International) was used to measure nasal inspiratory peak flow. With this device, measurements are made on a scale ranging from 30-370 liters/minute. All patients were evaluated in the same polyclinic room. Measurements were made three times for each patient. The highest value among these three measurements was accepted.

### Statistical Analysis

Statistical analysis of the data was done in IBM SPSS Version 26 program. Since NPIF values were not normally distributed (Kolmogorov Smirnov $p<0.05$), Mann Whitney U statistical analyzes were used for comparisons between two groups, and Kruskal Wallis H statistical analyzes were used for comparisons between more than two groups. The relationship between NPIF values and other variables was evaluated with Pearson and Spearman's rho correlation analyses. $p<0.05$ was considered statistically significant.

Permission was obtained from the Adnan Menderes University Ethics Committee for this study.

## Results

The mean age of the patients participating in the study was 38±11, the mean PNIF was 128±42 L/min, and the mean VAS score was 5.2±2. The general characteristics of the patients participating in the study are shown in Table 1.

**Table 1.** General specifications

| | n | % |
|---|---|---|
| Age | | |
| 18-30 years | 23 | 25.0 |
| 31-40 years | 30 | 32.6 |
| 41-50 years | 22 | 23.9 |
| 50 over age | 17 | 18.5 |
| Gender | | |
| Male | 69 | 75.0 |
| Female | 23 | 25.0 |
| BMI | | |
| Normal | 13 | 14.1 |
| Fat | 44 | 47.8 |
| Obese | 35 | 38.0 |
| Smoke | | |
| Yes | 41 | 44.6 |
| No | 51 | 55.4 |
| Regular sport | | |
| Yes | 12 | 13.0 |
| No | 80 | 87.0 |
| Rhinitis | | |
| Yes | 28 | 30.4 |
| No | 64 | 69.6 |
| Septum deviation | | |
| Yes | 69 | 75.0 |
| No | 23 | 25.0 |
| | **Mean±SD** | **Median (Min.-Max.)** |
| PNIF | 128.64±42.12 | 130 (30-240) |
| Age | 38.85±11.13 | 38 (18-61) |
| BMI | 28.88±4.06 | 28.9 (18-41) |
| VAS Score | 5.29±2.85 | 6 (0-10) |

When the mean distribution of PNIF values according to age, gender, BMI, smoking habit, regular sports habit, presence of rhinitis sign, and presence of septum deviation was examined, no statistically significant difference was found between the groups ($p>0.05$) (Table 2).

A negative direction, weak level, and a statistically significant correlation were found between PNIF values and VAS score values. ($p<0.05$) (Table 3, Fig. 1). There was no correlation between PNIF and age, between PNIF and BMI.

## Discussion

Nazal congestion is a problem reported by approximately one-third of the population.[6] In our study, this rate was found to be much higher, which may be because only a group formed by snoring patients was handled.

In the retrospective study that was made by Raghavan et al., on patients who underwent rhinoplasty; the mean pre-

**Table 2.** Average distribution of PNIF values by groups

| | NPIF | | $X^2$/Z | p |
|---|---|---|---|---|
| | Mean±SD | Median (Min.-Max.) | | |
| Age | | | | |
| 18-30 years | 118.04±51.58 | 115 (30-230) | 1.825 | 0.609 |
| 31-40 years | 130.33±30.99 | 130 (65-190) | | |
| 41-50 years | 130.23±40.25 | 125 (60-215) | | |
| 50 over age | 137.94±47.99 | 140 (80-240) | | |
| Gender | | | | |
| Male | 125.8±41.03 | 125 (30-230) | -0.998 | 0.318 |
| Female | 137.17±45.1 | 130 (60-240) | | |
| BMI | | | | |
| Normal | 123.08±38.43 | 120 (30-170) | 0.378 | 0.828 |
| Fat | 131.93±39.08 | 130 (70-230) | | |
| Obese | 126.57±47.6 | 130 (40-240) | | |
| Smoke | | | | |
| Yes | 127.56±39.89 | 125 (40-230) | -0.197 | 0.844 |
| No | 129.51±44.21 | 130 (30-240) | | |
| Regular sport | | | | |
| Yes | 136.25±51.22 | 140 (30-230) | -0.836 | 0.403 |
| No | 127.5±40.85 | 127,5 (40-240) | | |
| Rhinitis | | | | |
| Yes | 121.25±42.64 | 127,5 (30-190) | -0.786 | 0.432 |
| No | 131.88±41.82 | 130 (40-240) | | |
| Septum Deviation | | | | |
| Yes | 124.86±38.94 | 125 (30-230) | -1.179 | 0.238 |
| No | 140±49.73 | 135 (50-240) | | |

**Table 3.** Correlation of NPIF values with other variables

| | PNIF | |
|---|---|---|
| | r | p |
| Age | 0.159 | 0.130 |
| BMI | 0.007 | 0.946 |
| VAS Score | -0.269 | 0.010 |

operative VAS score was 8.2, and the postoperative mean was 2.4.[7] The mean VAS score of the patients participating in our study was found to be 5.2.

It was detected in a recent meta-analysis, the mean NPIF value for populations with normal nasal breathing was 138.4 L/min, and the mean value for the population with nasal obstruction was 97.5 L/min.[8] In this study, which included participants with and without nasal obstruction, the mean NPIF value was found to be 128 L/min, which is close to the literature.

In the study of Ottoviano et al.,[4] it was stated that the PNIF value was higher in men than in women. In a study conducted in Sweden, the PNIF value was found to be 186 L/minute in men and 149 L/minute in women.[9] In the study of Boelke et al.,[5] the mean values of PNIF were found to be 174 L/minute in men and 126 L/minute in women. In our study, on the contrary, it was found to be 125 L/minute in men and 137 L/minute in women, and there was no statistically significant difference between the genders. We found the mean PNIF value of all our patients participating in the study to be 128 L/min, although this value is lower than the mean value in the study of Boelke et al., it is higher than the mean value Klossek et al.'s study that in the healthy French population.[5,10]

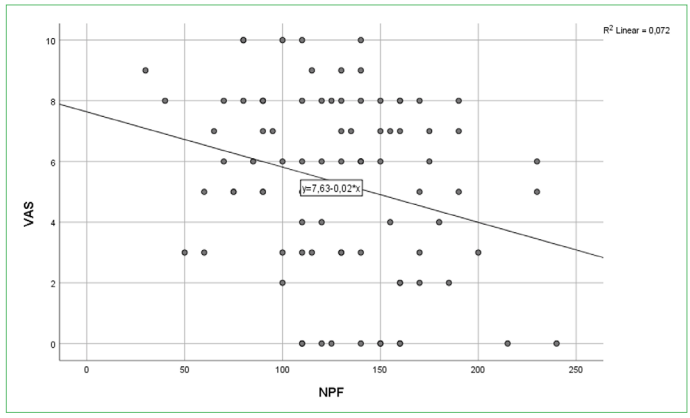


**Figure 1.** PNIF values and VAS score scatterplot.

In the study of Boelke et al., it was stated that there may be a moderate positive correlation between PNIF and body weight, and between PNIF and height.[5] In the same study, no correlation was found between PNIF and age. In our study, no correlation was found between PNIF and age. In addition, in this study, the relationship between PNIF and BMI was evaluated, but no correlation was found. In the study of Akerlund et al., a negative correlation was found between PNIF and age, a positive correlation was found between PNIF and height, but no correlation was found between PNIF and body weight.[9]

In this study, no relationship was found between PNIF and smoking habits. Some publications in the literature support our conclusion and some of them say the opposite. In the study of Akerlund et al., similar to our study, no relationship was found between smoking and PNIF.[9] However, in the study of Kjaergaard et al., the PNIF value was found to be lower in smokers compared to non-smokers.[11]

In the literature, there are different results for the relationship between PNIF value and VAS score. In a comparative study conducted on 62 patients with allergic rhinitis and 67 healthy individuals, no significant correlation was found between PNIF and VAS scores.[12] In the study conducted by Andrews et al. on patients with septum deviation, it was stated that there was no relationship between PNIF and VAS

score.[13] Likewise, in the study of Fokkens et al., it was reported that there was no reliable correlation between subjective and objective measurements of nasal obstruction.[14] Contrary to all these studies, some publications found a significant relationship between PNIF and VAS scores. Thorstein et al.'s study on asthmatic patients showed that PNIF and VAS scores were significantly correlated.[15] In the study of Teixeira et al., a significant correlation was found between PNIF and VAS scores in a mixed group of healthy and rhinitis patients.[3] Similarly, in the study of Boelke et al., an inverse correlation was found between PNIF and VAS.[5] In this study, we found a weak negative correlation between PNIF and VAS score values. It is stated that the reason for this difference in the literature may be different working environments and the multiplicity of the methods used.[16]

## Conclusion

PNIF is a low-cost, easy-to-use method for the objective evaluation of nasal obstruction. The VAS score can also be used for the preliminary evaluation of nasal obstruction before objective tests. We recommend using both methods together, if possible.

### Disclosures

**Ethics Committee Approval:** Permission was obtained from the Adnan Menderes University Ethics Committee for this study.

**Peer-review:** Externally peer-reviewed.

**Conflict of Interest:** None declared.

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