



# Application of SNOT-22 Test and Visual Analogue Scale in Quality of Life Evaluation in Patients with Allergic Rhinitis

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## Abstract

**Introduction:** Chronic nasal congestion in patients with allergic rhinitis can lead to sleep disorders and to sleep apnoea which, in combination with fatigue, can induce systemic effects, including irritability, weakness, malaise, and decreased appetite, growth retardation in adolescents, resulting in severe worsening of quality of life. Also, allergic rhinitis can affect social life, school performance, and productivity, especially in patients with severe disease.

**Aim:** The aim of the present case-control study was to investigate the impact of quality-of-life impairment and the main contributing symptoms in patients with allergic rhinosinusitis.

**Materials and methods:** During the survey from January to December 2018, 139 participants (111 with allergic rhinitis and 28 controls) were enrolled in the study. Participants in the clinical and control groups were invited to complete a quality-of-life questionnaire for patients with sino-nasal pathology (SNOT-22). For results, a comparison in terms of eye affecting itching, burning, redness, and tearing sensation, a 10-grade visual analogue scale table was presented.

**Results:** Comparing the clinical and control groups of healthy patients in the first SNOT-22, the value was significantly elevated as expected. The mean score (SNOT-22 total score) of the twenty-two symptom scores in patients was  $2.52 \pm 0.93$  (0-5); by comparison, the value in the control group was only  $0.64 \pm 0.11$ , with the difference being statistically significant ( $p=0.001$ ). The results of the visual analogue scale for which the patients were asked to note the level of eye impairment: redness, burning, itching, and tearing that contributed to their negative sense of the quality of life, were eloquent. A statistically significant difference was found between participants with intermittent and persistent forms ( $6.06 \pm 0.20$  vs.  $3.00 \pm 0.25$ ,  $p=0.001$ ), and between the entire clinical group with AR and the healthy controls included in the study ( $4.48 \pm 0.22$  versus  $0.21 \pm 0.03$ ,  $p=0.000$ ).

**Conclusions:** Summarising the results of our study and the available literature, we have concluded that nasal congestion and the abundance of secretions are symptoms that disrupt mostly the quality of life in AR patients and significantly affect the quality of sleep and are inevitable consequences of both daytime tone and productivity.

The rich palette of symptoms that lead to deterioration of the mental and physical well-being of those affected by AR necessitates the need to sharpen the attention of professionals working for this type of pathology in order to strive to detail and differentiate the specific complaint and degree of quality of life deterioration.

## Keywords

allergic rhinitis, quality of life, SNOT-22, VAS

## INTRODUCTION

Allergic rhinosinusitis (AR) is a symptomatic nasal disease provoked by exposure of nasal mucosa to allergens, resulting in IgE-mediated inflammation.<sup>1</sup>

The allergic runny nose is characterised by a specific constellation of symptoms in the nose, eyes, ears, throat, and palate. Particularly significant symptoms include difficulty in nasal breathing, rhinorrhoea, coughing, and secretions to the pharyngeal cavity (postnasal drip), causing irritation and cough reflex, itching, and sneezing. In combination with local symptoms, many patients with AR also experience systemic effects, such as headache, fatigue, sleep disturbance, anosmia, and cognitive impairment, some of which are mainly due to nasal obstruction.<sup>2</sup> Chronic nasal congestion can lead to sleep disorders, as well as sleep apnoea which, combining with fatigue, are capable of inducing systemic effects, including irritability, weakness, malaise and decreased appetite, and growth retardation in adolescents resulting in severe worsening of quality of life.<sup>3</sup> Also, allergic rhinitis affects social life, school performance, and productivity<sup>4</sup>, especially in patients with severe disease<sup>5</sup>.

## AIM

The aim of the present case-control study was to investigate the impact of quality-of-life impairment and the main contributing symptoms in patients with allergic rhinosinusitis.

## MATERIALS AND METHODS

The study was conducted in the Prof. Dr S. Kirkovich University Hospital and Medical University, Stara Zagora, Bulgaria. During the survey from January to December 2018, 139 participants (111 with allergic rhinitis and 28 controls) were enrolled in the study. In the group of patients, 54 (48.65%) had intermittent allergic rhinitis (IAR) and 57 (51.35%) had persistent allergic rhinitis (PAR). The mean age of patients with AR was  $45.59 \pm 16.37$  years (22–84) and in the control group:  $42.96 \pm 15.06$  years (19–63). The patient's group consisted of 72 women (53.7%) and 62 men (46.3%). Sex distribution in controls was 18 (62.1%) women and 11 (37.9%) men. Patients with both forms of AR did not take any anti-allergic, anti-histamine, topical or systemic corticosteroid drugs, and NSAIDs at least one month before the study.

Participants in the clinical and control groups were invited to complete a quality-of-life questionnaire for patients with sino-nasal pathology (SNOT-22). For results, a comparison in terms of eye affecting itching, burning, redness, and tearing sensation, a 10-grade visual-analogue scale table was presented.

The control group of participants was strictly selected – all individuals were healthy, without an acute or chronic inflammatory process. Persons with an allergic family history

were excluded from this group.

## Statistical analysis

Statistical analyses were performed using SPSS 16.0 for Windows (SPSS Inc.). Continuous variables with normal distribution were compared between 2 or more independent groups by Student t-test or one-way ANOVA test with LSD post hoc analysis, while those variables with non-normal distribution were compared using the Mann-Whitney U test or Kruskal-Wallis H test, respectively. The non-parametric Spearman rank correlation test and linear correlation analysis were used to determine the correlation between the quantitative variables. The results were evaluated at 95% confidence interval, and significance was assessed at  $p < 0.05$ .

## RESULTS

The mean value of the SNOT-22 test performed in the clinical group was  $2.52 \pm 0.93$ , whereas in the control group of healthy subjects with missing subjective and objective data on sino-nasal pathology, the mean SNOT-22 total score was  $0.64 \pm 0.11$  ( $p < 0.001$ ) (Fig. 1).

Regarding the feeling of itching and burning, based on the VAS (Fig. 2), we found sensitive differences between patients in both forms of allergic rhinitis – in patients suffering from IAR, the value was doubled against the patients with PAR ( $6.06 \pm 0.20$  vs.  $3.00 \pm 0.25$ , respectively) ( $p < 0.001$ ).

The distribution of all 22 quality-of-life impairing symptoms in patients with nasal allergy is shown in Fig. 3.

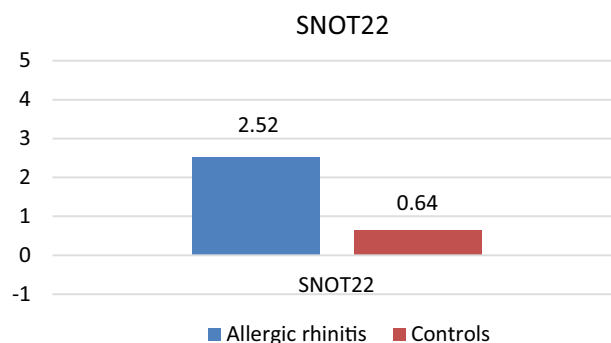


Figure 1. SNOT-22. Total score in the AR group and controls.

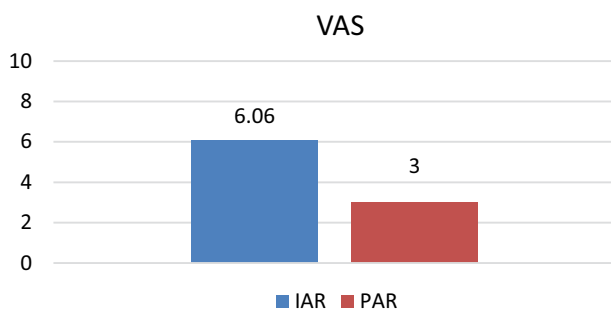
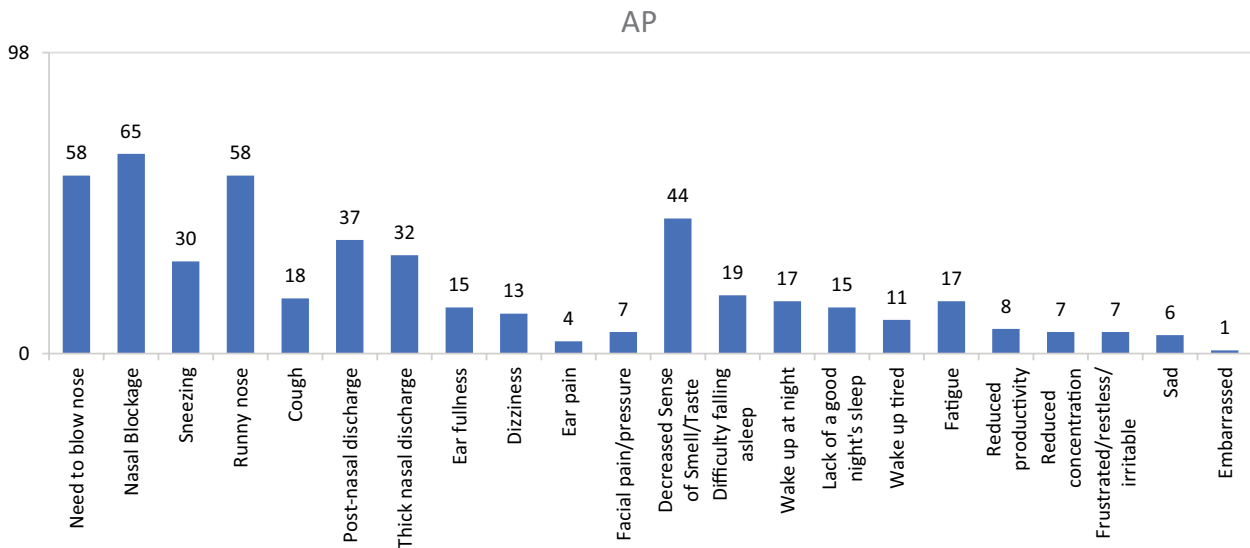


Figure 2. VAS in the AR group and controls.

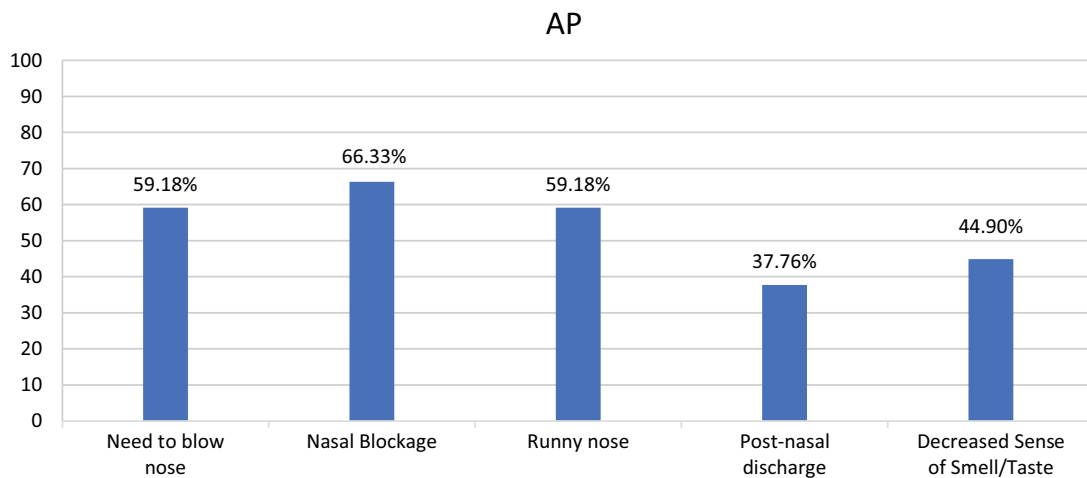
As seen in **Figs 3 and 4**, the five distinct symptoms of subjective feeling of poor quality of life are the need for nose blowing, nose obstruction, nasal secretion, secretion of the throat, and reduction of the sense of smell and taste.

In the group of patients with PAR, the results show slightly elevated SNOT-22 values (**Fig. 5**), most likely due to the presence of symptoms throughout all seasons, in

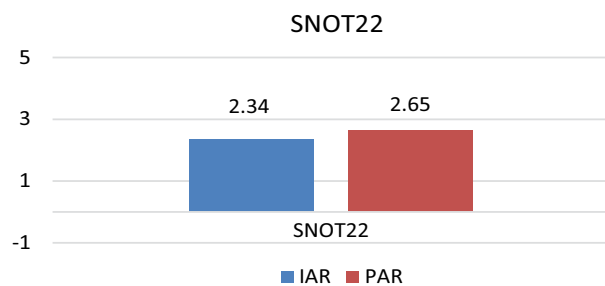
contrast to those with IAR (**Fig. 6**) and limited duration of clinical manifestations allowing partial mental welfare. On the other hand, despite these mildly elevated SNOT-22 values in patients with persistent allergic rhinosinusitis ( $2.65 \pm 0.88$ ), we did not find a statistically significant difference compared to the results of IAR participants ( $2.34 \pm 0.95$ ,  $p=0.081$ ).



**Figure 3.** SNOT-22 in AR patients.



**Figure 4.** Distribution of the most debilitating symptoms in AR patients.



**Figure 5.** SNOT-22 values in the two main clinical subgroups.

In analysing the data, identification of differences across symptoms expressed during the periods of clinical manifestations within the two clinical subgroups has led to dissimilarity between the two groups' sense of subjective feeling and quality of life.

While the most disturbing symptom in patients with IAR was nasal secretion (**Fig. 7**), those with PAR experienced nasal congestion and the "stuffy nose" symptom (**Figs 8, 9**) as the most debilitating symptom.

To determine whether body weight had an impact on

the severity of the disease and to what extent, the participants were divided into groups based on body mass index (BMI). In the groups with normal (18.5–24.9), underweight (<18.5), and overweight (25.0–29.9) BMI, indicators objectively affecting the quality of life remain similar. In patients with obesity, however, the SNOT-22 score and values were significantly increased (Fig. 10).

Fig. 11 shows the increase of the duration of daily air-conditioning exposure, results in a decreased subjective feeling of quality of life.

The presence of a concomitant allergic disease has some influence on the clinical course of allergic rhinitis with a  $2.68 \pm 0.84$  SNOT-22 score, in contrast to the patients without accompanying allergic pathology (SNOT-22 –  $2.04 \pm 0.91$ ), where bronchial asthma is the most significant deteriorating quality of life disease (Figs 12, 13) even without statistical significance ( $p=0.032$ ).

In patients with sino-nasal allergy, we found that the prematurity factor resulted in the subsequent clinical manifestation (Fig. 14). Thus, for those born earlier than

the intended term, the clinical course is significantly more intense than those born at the normal gestational age ( $p=0.005$ ).

Another determining factor, not only for the occurrence of allergic pathology but also for the severity of clinical manifestation, is the duration of natural nutrition within early childhood. Consumption of breast milk for less than 3 months results in increasing the severity of the disease manifestation. If the duration of breastfeeding is between 3 and 6 months, quality of life improves and when this period exceeds 6 months, clinical symptoms are remarkably reduced (Fig. 15).

It is evident in the SNOT-22 test that patients with AR and nasal polyposis found within the nasal cavity, the quality of life is more affected than in patients without polyposis ( $2.97 \pm 0.66$  vs.  $2.32 \pm 0.81$ ,  $p=0.002$ ). The results of the VAS test are reciprocal, most probably because the nasal polyposis accompanies very often chronic allergic rhinosinusitis, with the symptoms of burning and itching observed being much less frequent (Fig. 16).

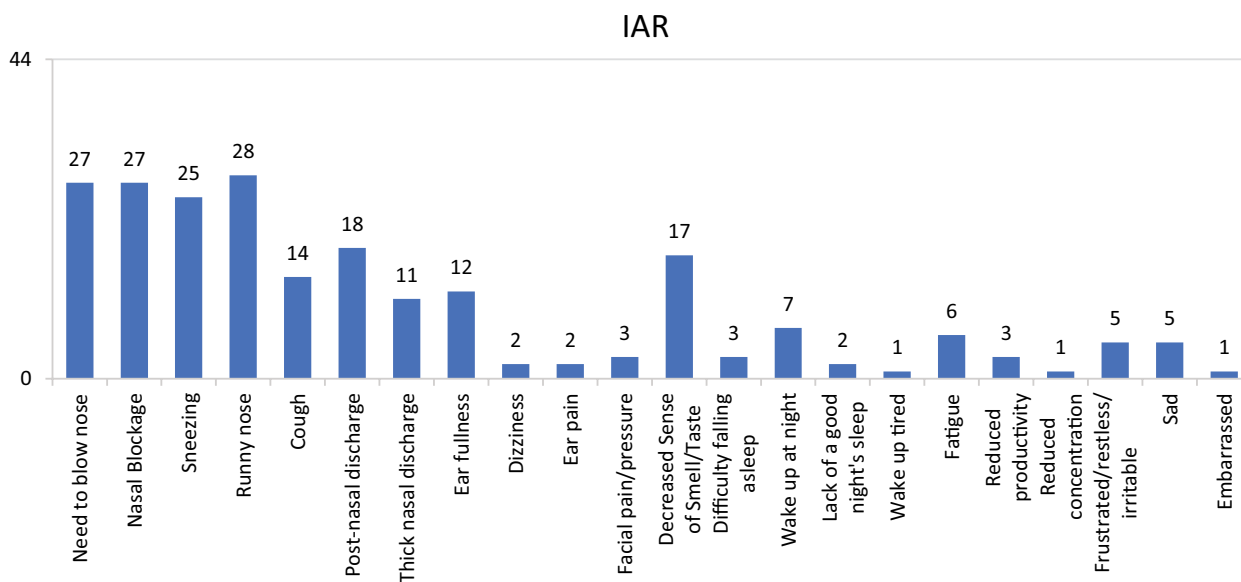


Figure 6. SNOT-22 in patients with IAR.

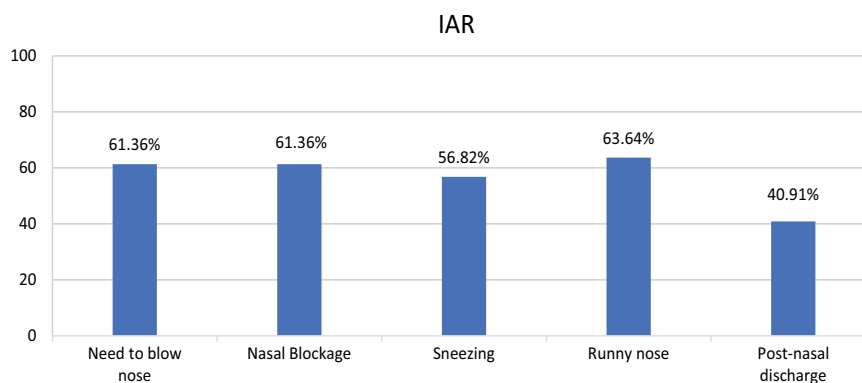


Figure 7. Distribution of the most severe life-threatening symptoms in patients with IAR.

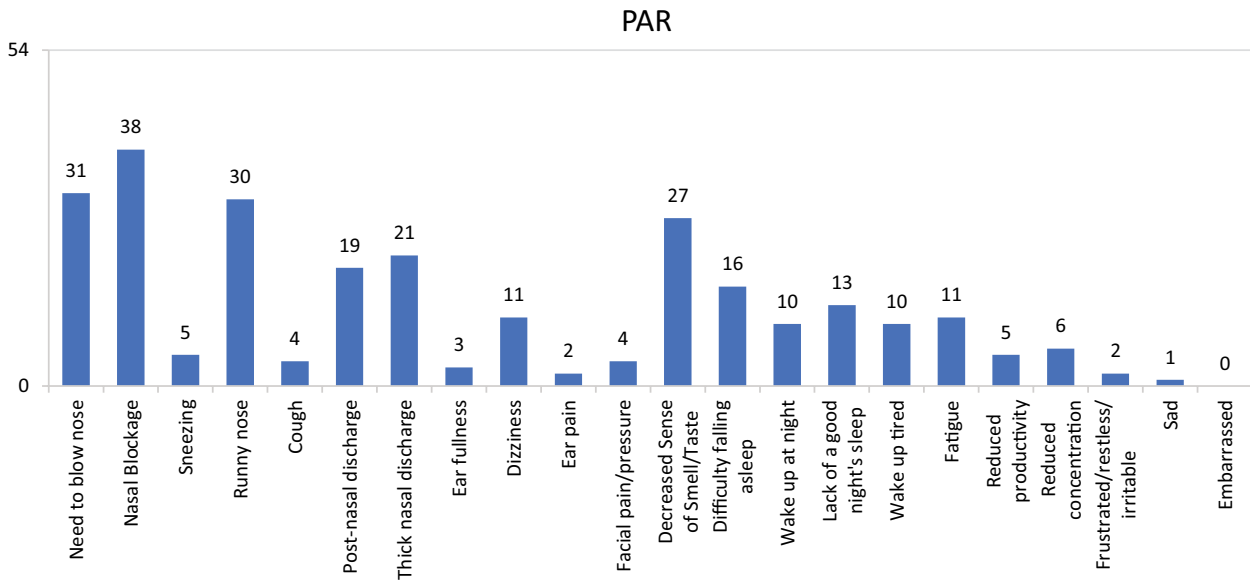


Figure 8. SNOT-22 in patients with PAR.

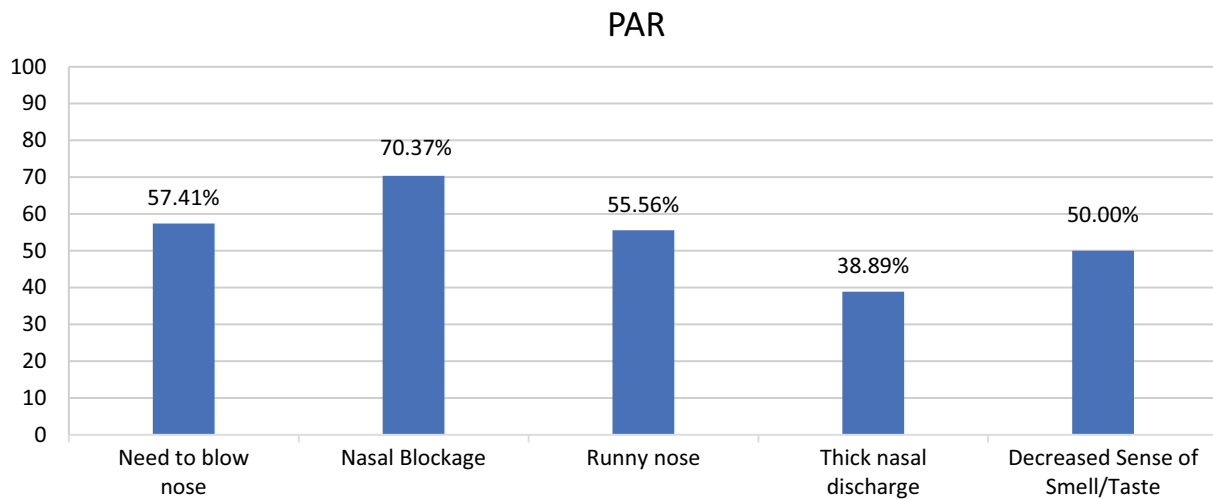


Figure 9. Distribution of the most debilitating symptoms in patients with PAR.

**BMI AND QUALITY OF LIFE**

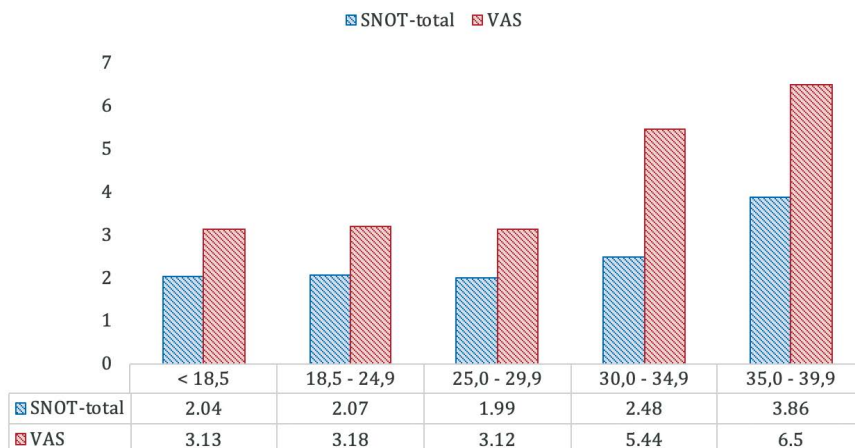
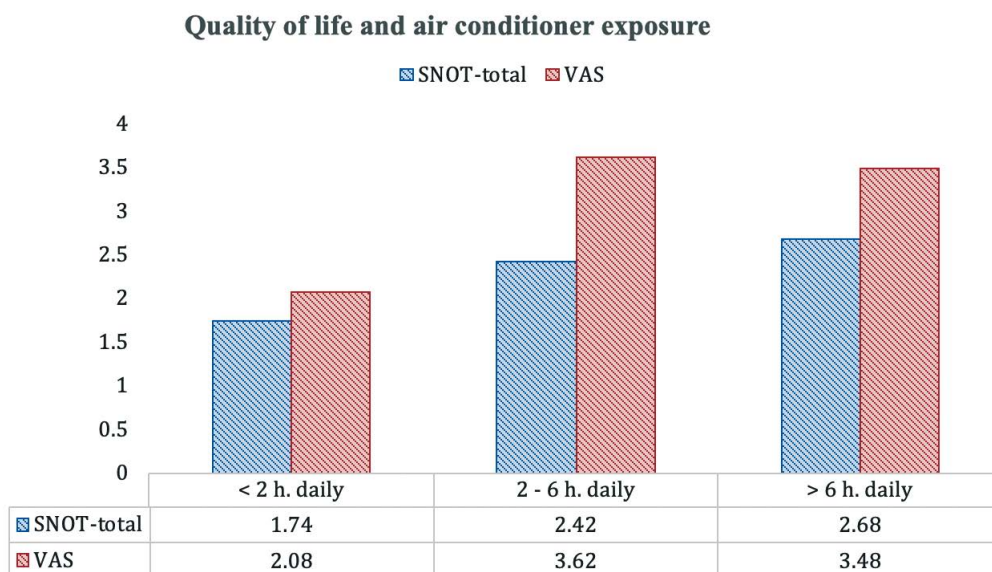
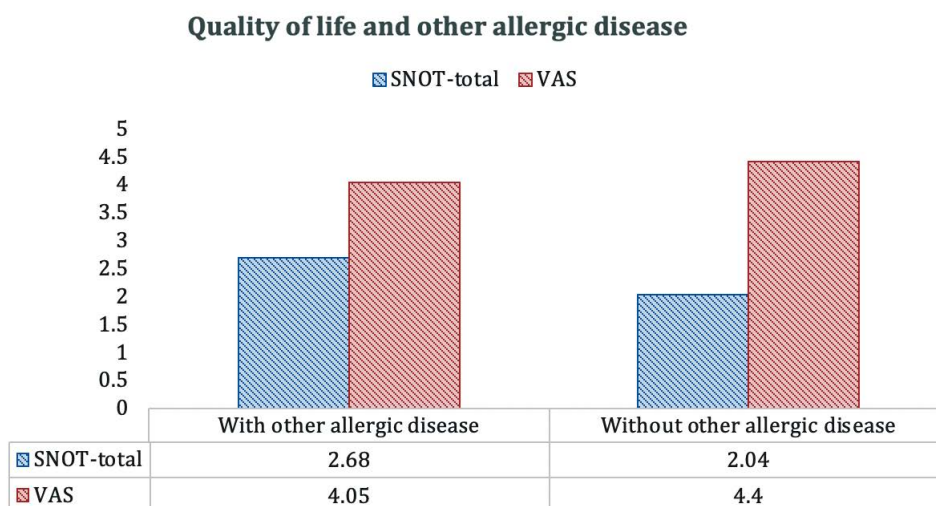


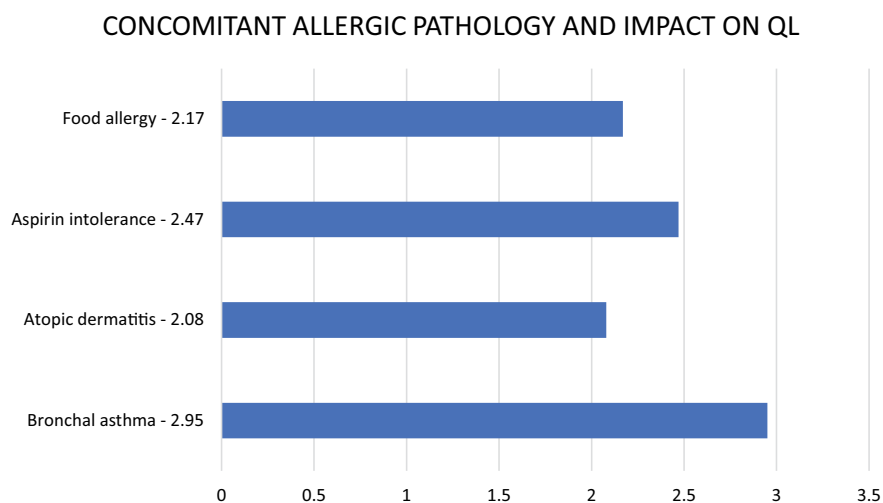
Figure 10. Quality-of-life deterioration in patients with AR according to BMI.



**Figure 11.** Quality of life in patients with AR according to air conditioning exposure.



**Figure 12.** Quality-of-life impairment and concomitant allergic pathology.



**Figure 13.** Quality-of-life impairment according to concomitant allergic pathology.

### QUALITY OF LIFE AND PREMATUREITY

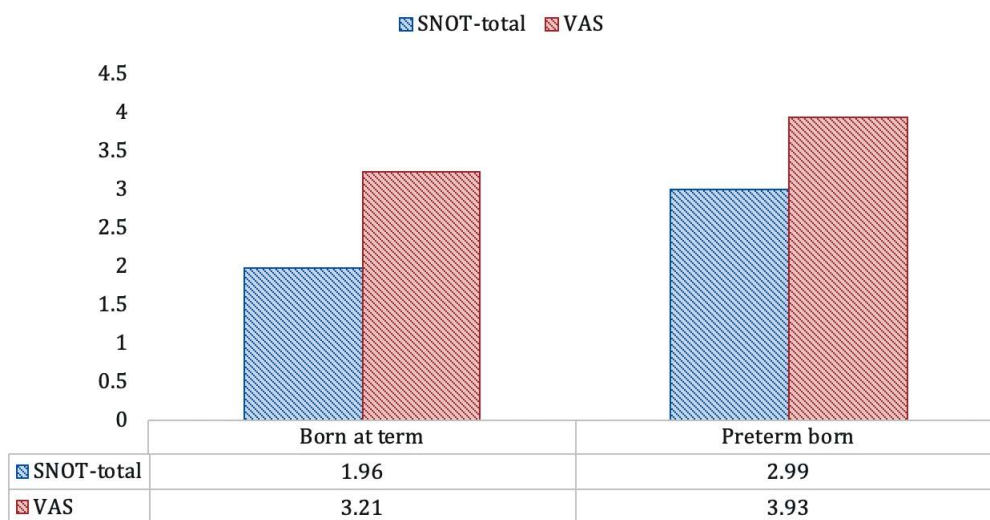


Figure 14. Quality-of-life impairment according to birth period.

### QUALITY OF LIFE AND BREASTFEED DURATION

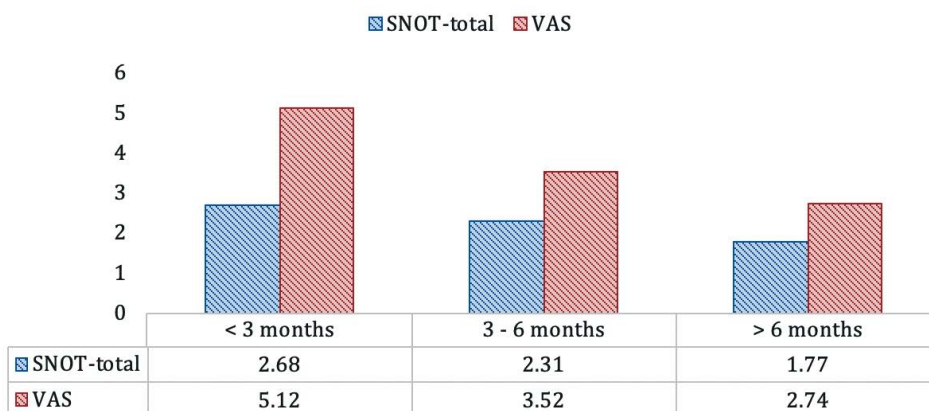


Figure 15. Quality-of-life impairment according to breastfeed duration.

### QUALITY OF LIFE AND NASAL POLYPOSIS

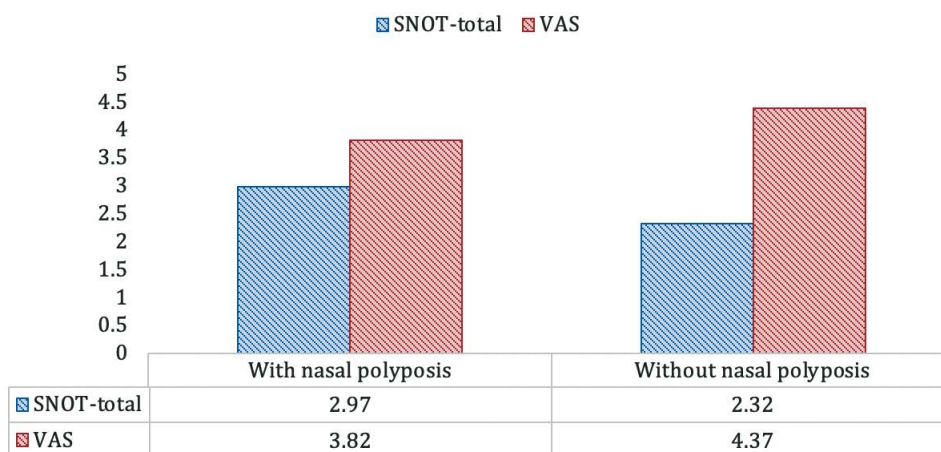


Figure 16. Quality-of-life impairment according to nasal polyposis presence.

## DISCUSSION

A growing body of evidence in the last one or two decades suggests that patients and physicians differ in their perception of the disease. This is certainly an aspect that needs to be discussed, and its study often provides data which differs from those obtained by simply evaluating symptoms considered as objective. As a result, healthcare professionals are reorienting and becoming more attentive, with an interest in assessing the quality of life and patient satisfaction, along with evaluating other aspects of the disease or treatment.<sup>6,7</sup>

The extent of quality-of-life impairment varies mainly depending on the individual's standards of "personal well-being", the perception of the outside world, and expectations from the treatment. Interestingly, the intensity of symptoms does not necessarily correspond to the degree of impairment of quality of life, an aspect that again emphasises the individuality of each patient.

To properly evaluate and gain a clear picture of the quality-of-life impairment among selected patients with allergic rhinitis, we used a specially designed questionnaire administered to patients with sino-nasal pathology, as well as a ten-stage VAS, allowing everyone to note the impairment of subjective sensation generated by eye symptoms affecting the quality of life. Thanks to them, subjective complaints have gained objective expression. Comparing the clinical and control groups of healthy patients, in the former, the SNOT-22 value was significantly elevated as expected. The mean score (SNOT-22 total score) of the twenty-two symptom scores in patients was  $2.52 \pm 0.93$  (0-5); by comparison, the value in the control group was only  $0.64 \pm 0.11$ , with the difference being statistically significant ( $p=0.001$ ). The main complaints in the non-AR group were lack of good sleep, irritability, decreased concentration and productivity, conditions that could be provoked by several other factors. In trying to answer whether there are differences in groups affected by the two main forms of AR, we compared the same indicator between the two subgroups, outlining the tendency for more manifested subjective perceptions by patients with PAR (SNOT-22 –  $2.65 \pm 0.88$ ), than those with IAR (SNOT-22 –  $2.34 \pm 0.95$ ) ( $p=0.081$ ).

A study on the quality of life of children with AR has also been conducted by Scadding et al.<sup>8</sup> The authors explain the analogous results obtained by the fact that children with an intermittent form of AR are better informed about their health status and have developed personal strategies to achieve and maintain better symptomatic control compared to those with PAR. Additionally, they doubt that the unsatisfactory results of the therapeutic activities and the remaining feeling of dissatisfaction in the patients also contribute to these results. In our view, the fact that those affected by persistent rhinitis may have less or more severely manifested nasal symptoms all year round and the accumulation and daily involvement of their attention to the disease may contribute to the sense of worsening subjective self-feeling.

More than 50% of patients with AR indicated that the most severe deterioration in their quality of life was caused by obstruction (66.33%), the need for nose blowing (59.18%), and the presence of nasal secretion (59.18%). Our result completely overlaps with the data presented by M. Schatz<sup>9</sup>, who identified these three symptoms as the most aggravating for more than half of patients with AR. 6.31% and 5.41% become irritable or depressed, respectively, during the clinical manifestation of their illness. These results are comparable with two large-scale studies conducted in 2000 and 2001 in France, in which 4.9% of participants were or are currently in depressive periods caused by clinical symptoms of nasal allergy.<sup>10</sup>

The results of the visual analogue scale, where patients were asked to note the level of eye impairment – redness, burning, itching and tearing – that contributed to their negative sense of the quality of life, were eloquent. A statistically significant difference was found between participants with intermittent and persistent forms ( $6.06 \pm 0.20$  vs.  $3.00 \pm 0.25$ ,  $p=0.001$ ), and between the entire clinical group with AR and the healthy controls included in the study ( $4.48 \pm 0.22$  vs.  $0.21 \pm 0.03$ ,  $p=0.000$ ). The findings demonstrate that concomitant AR conjunctival symptoms, triggered predominantly by histamine liberation, are significantly more common in patients with IAR and contribute to a heightened sense of the poor quality of life.

The ratio of body weight to height, known as body mass index (BMI), showed an attitude toward the severity of allergic disease manifestation. For participants with normal (BMI=18.5-24.9), subnormal (BMI<18.5) and overweight (BMI=25.0-29.9), no significant differences in SNOT-22 test scores and VAS were observed, being in values between 1.99 and 2.07 and 3.12-3.18, respectively. It was found that significant increase occurred in people with Grade I (BMI=30.0-34.9) and Grade II (BMI=35.0-39.9) obesity, where both SNOT-22 (2.48 and 3.86, respectively) and VAS levels (5.44 and 6.50) had an increase. In addition, around half of them have impairment in their quality of life.

According to Spanish researchers who have set themselves the goal to study the effects of lifestyle factors on sleep in patients with allergic rhinitis, a BMI of 24.2 is at risk of deteriorating its quality. And when that indicator gets a numerical expression of 25.5 and above they found a poor sleep pattern.<sup>11</sup>

Although our data indicates that the next BMI-based group (BMI=30.0-34.9) is at risk, they are still indicative of an association of the problem. There is so little research to support the potential association of BMI with allergic respiratory diseases, such as atopic dermatitis and allergic rhinitis<sup>12</sup>, but at the time of this publication there is no published research that offers a logical explanation for this interconnectedness. Our interpretation of one of the possible reasons for this correlation is the additional mechanical obstruction of the upper respiratory tract, with the consequences of poor quality of sleep, the potential manifestation of sleep apnoea, and the inevitable reflection on condition and productivity during the day.



Comparing the indicators which give us an objective digital expression of patients' perceptions of quality of life, we found a direct relationship between the breastfeeding duration on the neonate period and the strength of symptom manifestation. For children breastfed 6 months and more, the mean SNOT-22 total score was  $1.77 \pm 0.12$  and for less than 3 months –  $2.68 \pm 0.16$  ( $p=0.038$ ). The corresponding values obtained using VAS were  $2.74 \pm 0.17$  for period  $>6$  months and  $5.12 \pm 0.27$  ( $p=0.018$ ) for participants who had breastfeeding time 3 months or less. In summary, we can conclude that duration of breastfeeding has an impact on the level of clinical atopic manifestations. According to our results, breastfeeding duration of 6 months could subsequently contribute to a reduction of up to 50% of the clinical intensity of symptoms in patients with allergic rhinitis.

Modern lifestyles in urban areas are considered to be potentially responsible for the development of pathological conditions of the respiratory tract, both upper and lower. One of the components of this modern lifestyle is the intensive use of air conditioners, where people are exposed to prolonged exposure to cold or warm dry air, ultimately resulting in changes in respiratory function. Inhaling cold dry air for a long period can make the smooth muscles of the respiratory tract significantly more sensitive.<sup>13</sup> Another major risk factor for the development of allergic respiratory diseases when using air conditioners is the increased amount of dust in the house and the increased concentration of mites in the air leading to increased levels of IgE molecules and increased eosinophil activity.<sup>14,15</sup>

Trying to evaluate the role of air conditioner exposition on the severity of clinical expression of symptoms in our group, we have also included a questionnaire regarding the average daily duration in air-conditioned rooms. Comparing it with the data obtained from the quality of life analysis, we found a clear tendency to worsen the perception of the symptoms of AR. Thereby, SNOT-22 score from  $1.74 \pm 0.37$  for staying less than 2 hours in air-conditioned rooms increased to  $2.68 \pm 0.44$  for participants staying 6 hours and more. With VAS, we proved an identical dependence and SNOT-22 results rose from  $2.08 \pm 0.16$  to  $3.48 \pm 0.28$ . The negative health impact of air conditioners for people with respiratory pathology seems undeniable; therefore, those who are allergic should be advised to limit their stay in rooms or vehicles with the air conditioning on.

We found no statistical relationship between concomitant atopic pathology presence and impairment of quality of life. However, patients with concomitant bronchial asthma experience the greatest subjective discomfort, followed by participants with aspirin hypersensitivity as a companion condition and those with concomitant food allergy and contact dermatitis.

## CONCLUSIONS

Summarising the results of our study and the available literature, we have concluded that nasal congestion and

the abundance of secretions are the symptoms that disrupt the quality of life in AR patients and significantly affect the quality of sleep and an inevitable consequence of both day-time tone and productivity.

The rich palette of symptoms that lead to the deterioration of the mental and physical well-being of those affected by AR necessitates the need to sharpen the attention of professionals working with this type of pathology in order to strive to detail and differentiate the specific complaint and the degree of quality of life deterioration. Apart from its diagnostic significance, the knowledge of the power of how each clinical symptom disrupts patients' productivity is also important in the therapeutic process, in designing the most appropriate treatment approach and selecting the right medication. The availability of such an approach would allow for closer monitoring of the results achieved during the treatment and for the possible dominance of another symptom.

Limitations of the study: we were not able to objectively monitor the quality of sleep with polysomnography. It would also be interesting to objectively analyze the degree of nasal congestion and the strength of the patient's olfactory involvement.

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# Применение теста SNOT-22 и визуальной аналоговой шкалы в оценке качества жизни пациентов с аллергическим ринитом

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## Резюме

**Введение:** Хроническая заложенность носа у пациентов с аллергическим ринитом может привести к нарушениям сна и апноэ во сне, которые в сочетании с утомляемостью могут вызывать системные эффекты, включая раздражительность, слабость, недомогание и снижение аппетита, задержку роста у подростков, что приводит к ухудшению качества жизни. Кроме того, аллергический ринит может повлиять на социальную жизнь, успеваемость и продуктивность, особенно у пациентов с тяжёлыми заболеваниями.

**Цель:** Целью настоящего исследования случай-контроль было изучить влияние нарушений на качество жизни и основные сопутствующие симптомы у пациентов с аллергическим риносинуситом.

**Материалы и методы:** В ходе исследования с января по декабрь 2018 г. в исследовании приняли участие 139 человек (111 с аллергическим ринитом и 28 контрольных). Участникам клинической и контрольной групп было предложено заполнить анкету качества жизни пациентов с сино-носовой патологией (SNOT-22). Для результатов сравнения глаз, связанных с зудом, жжением, покраснением и слезотечением, была представлена таблица для 10-балльной визуальной аналоговой шкалы.

**Результаты:** При сравнении клинической и контрольной групп здоровых пациентов из первой SNOT-22 значения были значительно увеличены, как и ожидалось. Среднее значение (общий балл SNOT-22) для двадцати двух симптомов у пациентов составило  $2.52 \pm 0.93$  (0-5); для сравнения, значения в контрольной группе составляли всего  $0.64 \pm 0.11$ , а разница была статистически значимой ( $p=0.001$ ). Результаты визуальной аналоговой шкалы, по которой пациентов просили отмечать степень поражения глаз: покраснение, жжение, зуд и слезотечение, которые способствовали их негативному восприятию качества жизни, были убедительными. Статистически значимая разница была обнаружена между участниками с прерывистой и стойкой формами ( $6.06 \pm 0.20$  против  $3.00 \pm 0.25$ ,  $p=0.001$ ) и всей клинической группой с АР и здоровым контролем, включенным в исследование ( $4.48 \pm 0.22$  против  $0.21 \pm 0.25$ ).  $0.03$ ,  $p=0.000$ ).

**Заключение:** Обобщив результаты нашего исследования и доступную литературу, мы пришли к выводу, что заложенность носа и обильные выделения являются симптомами, которые больше всего ухудшают качество сна, неизбежно влияют как на дневной тонус, так и на продуктивность.

Широкий спектр симптомов, которые приводят к ухудшению психического и физического состояния людей, страдающих АР, требует заострения внимания профессионалов, работающих с этим типом патологии, чтобы детализировать и дифференцировать конкретные жалобы и степень ухудшения жизни.

## Ключевые слова

аллергический ринит, качество жизни, SNOT-22, ВАШ