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Improvement in symptom severity, asthma control, and quality of life in pediatric patients with seasonal allergic rhinitis

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ABSTRACT

Objectives: To evaluate the allergic rhinitis (AR) symptoms, asthma control, and quality of life (QoL) outcomes following treatment in children with seasonal allergic rhinitis (SAR), with and without asthma.

Methods: Children diagnosed with SAR and presenting during the pollen season were included in the study. Symptom severity of SAR was assessed using the Total Nasal Symptom Score (TNSS), Total Ocular Symptom Score (TOSS), and Visual Analog Scale (VAS). Asthma control was measured using the Childhood Asthma Control Test (C-ACT), Asthma Control Test (ACT), and CARATkids. Quality of life (QoL) was evaluated using the Pediatric Rhinoconjunctivitis Quality of Life Questionnaire. Data were collected at admission, the first month, and the second month of treatment.

Results: Fifty-five children aged 5-16 years with SAR were evaluated of whom twenty three (42%) had asthma. Sensitivities to grass, tree, and weed allergens were observed in 74.5%, 50.9%, and 80% of patients, respectively. During the study period, TNSS, TOSS, and VAS scores significantly decreased ($P<0.05$ for all). Significant improvements were also observed in CARATkids, C-ACT and ACT scores among SAR patients with asthma ($P<0.05$ for all). All domains of QoL score showed significant improvement ($P<0.001$ for all), and positively correlated with TNSS, TOSS, and VAS scores. In SAR patients with asthma, ACT and C-ACT scores demonstrated a positive correlation with QoL scores, while CARATkids scores showed a negative correlation.

Conclusions: Treatment for SAR in children significantly reduces symptom severity, improves asthma control, and enhances QoL. Effective management of SAR is crucial for alleviating the disease burden and improving patients' overall well-being.

Keywords: Allergic rhinitis, asthma, children, pollen, quality of life

Allergic rhinitis (AR) is a common chronic disease in children with an incidence rate reaching as high as 20% in some regions [1]. Seasonal allergic rhinitis (SAR) is triggered by airborne allergens such as grass, tree, and weed pollens, and is characterized by symptoms including nasal con-

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gestion, rhinorrhea, nasal itching, sneezing, ocular itching, and tearing. Furthermore, approximately, 30% of the patients with AR also suffer from asthma [2].

The symptoms of SAR can be especially challenging for children. They can experience disturbances in their daily activities, including reduced concentration in school, sleeping disturbances, and avoidance of physical exercise during peak allergy seasons, which can negatively impact social interactions with a noticeable decline in their quality of life (QoL) [3]. Limitations in outdoor activities may result in social withdrawal and emotional stress [4]. Academic performance is also frequently affected, as SAR symptoms can interfere with a child's ability to focus and learn effectively [5]. Sleep disturbances caused by nasal congestion and other symptoms also contribute to daytime tiredness and impaired cognitive function [6]. The emotional impact of SAR can be profound, as children may feel self-conscious about their symptoms, leading to anxiety, frustration, and difficulties in social situations.

Recognizing the profound impact of SAR on children's lives, this study aims to investigate the correlation between AR scores, asthma scores, and quality of life following treatment in pediatric patients with SAR.

METHODS

Patients aged 5-16 years diagnosed with SAR and presenting during the pollen season were included in the study. In this study, total nasal symptom score (TNSS), total ocular symptom score (TOSS), Visual analog scale (VAS), Childhood Asthma Control Test (C-ACT), Asthma Control Test (ACT), Control of Allergic Rhinitis, and Asthma Test for Children (CARATkids), and QoL scores in children diagnosed with SAR±asthma was evaluated by comparing their condition at admission, after the first month, and the second month of the treatment. Patients with missing data or comorbid chronic conditions were excluded from the study. The study was approved by the Clinical Research Ethics Committee of Ankara Atatürk Sanatorium Training and Research Hospital.

Seasonal Allergic Rhinitis Scores

The total nasal symptom score was calculated as the sum of four nasal symptom scores: nasal congestion, rhinorrhea, nasal itching, and sneezing, from 0 (none) to 3 (severe), with a maximum possible score of 12. Similarly, the Total Ocular Symptom Score was determined as the sum of three ocular symptoms (itching, redness, and tearing) on a 4-point scale, from 0 (none) to 3 (severe), with a maximum possible score of 9.

The patients marked their VAS scores, for objective measurement of the severity of AR, on a 10 cm scale, where 0 cm represented "bad" and 10 cm represented "good,". Consistent with previous studies, a VAS score greater than 6 indicates controlled disease [7, 8].

Asthma Control Measurements

All children with asthma and their parents filled in the Turkish version of the Childhood Asthma Control Test (C-ACT; 4–11 years old) or ACT (≥12 years old) [9-10]. The ACT score ranges between 5 and 25, with a score of less than 20 corresponding to uncontrolled asthma. The C-ACT score ranges from 0 to 27, and a score of <19 indicates uncontrolled asthma.

CARATkids

Children with both AR and asthma completed the Turkish version of CARATkids, a questionnaire, which assesses the control of both diseases (11). The CARATkids consist of 13 questions, of which the first 8 are answered by the children, and the remaining 5 are answered by their caregivers. Responses are based on the previous 4 weeks and answered as ''Yes'' or ''No''. A lower score indicates better disease control.

Quality of Life

The children completed the Turkish version of the Pediatric Rhinoconjunctivitis Quality of Life Questionnaire, a validated 23-item tool designed to assess the physical, emotional, and social challenges experienced by children with rhinoconjunctivitis. This questionnaire provides both an overall score and subscale scores in five areas: nasal symptoms, eye symptoms, practical issues (e.g., rubbing the nose and eyes, blowing the nose, carrying tissues), other symptoms (e.g., thirst, irritability, fatigue), and activity limitations. Lower scores indicate better QoL.

Statistical Analysis

Statistical analyses were performed using the

SPSS version 22.0 statistical software package (IBM SPSS Statistics, Philadelphia, PA, USA). First normality tests for continuous variables were performed and as all of the continuous variables were distributed non-normally the results were given as median (interquartile range [IQR]). The $\chi 2$ and Mann-Whitney U tests were used to compare nonparametric values. Statistical significance was defined as $P<0.05$. The correlation between the scores was assessed through visual analysis using line graphs. Scores for variables were plotted over three-time points (baseline, 1st month, and 2nd month). In these plots, lines representing each variable that run parallel over time suggest a positive correlation between the variables, while lines that move in opposite directions or diverge indicate a negative correlation.

RESULTS

A total of 55 patients, comprising 22 females and 33 males, were included in the study. The median ages at

Table 1. Clinical and demographic characteristics of the patients

	n=55
Female, n (%)	22 (40)
Age at onset of AR symptom (year)	7 (5-10)
Age at AR diagnosis, (year)	9 (6-12)
Comorbid atopic diseases, n (%)	
Asthma	23 (41.8)
Food allergy	6 (10.9)
Drug allergy	2 (3.6)
Atopic dermatitis	12 (21.8)
Seasonal aeroallergen positivity, n (%)	
Grass	41 (74.5)
Tree	28 (50.9)
Weed	44 (80)
Perennial allergen sensitivity, n (%)	31 (56.4)
House dust mite	13 (23.6)
Mold	5 (9.1)
Pet dander	21 (38.2)

Data are shown as median (interquartile range) or n (%). AR=Allergic rhinitis

Table 2. Comparison of total nasal symptom score (TNSS), total ocular symptom score (TOSS), and visual analog scale (VAS) scores at admission, and at the 1st and 2nd month of treatment in patients diagnosed with allergic rhinitis (AR)

	Total AR patients (n=55)				AR Patients with asthma (n=23)				AR Patients without asthma (n=32)			
	Admission	1th month	2nd month	P value	Admission	1th month	2nd month	P value	Admission	1th month	2nd month	P value
TNSS	8 (6-9)	5 (3-8)	4 (2-5)	**<0.001**	7 (6-9)	4 (3-8)	4 (3-6)	**0.001**	8 (6-9)	5.5 (3-7.8)	4 (1.3-5)	**<0.001**
TOSS	5 (3-10)	3 (1-6)	1 (0-4)	**<0.001**	5 (2-10)	2 (0-6)	0 (0-5)	**<0.001**	5.5 (3-9)	3 (1-6)	1 (0-3.8)	**<0.001**
VAS	6 (5-8)	4 (2-6)	2 (1-4)	**<0.001**	7 (4-8)	4 (2-6)	2 (1-5)	**0.004**	6 (5-8)	4 (2-6)	2 (1-4)	**<0.001**

Data are shown as median (interquartile range). AR=Allergic rhinitis

Table 3. Comparison of CARATkids and ACT scores at admission, and at the 1st and 2nd month of treatment in patients diagnosed with asthma and allergic rhinitis (AR)

	Admission	1st month	2nd month	P-value
CARATkids	8 (7-11)	5 (3-8)	3 (2-4)	**<0.001**
C-ACT (n=11)	18 (15.3-22)	22.5 (18-24)	24 (22.3-25.8)	**0.001**
ACT (n=12)	17 (8-21)	19 (18-20)	23 (22-25)	**0.02**

Data are shown as median (interquartile range). CARATkids=Control of Allergic Rhinitis, and Asthma Test for Children, C-ACT=Childhood Asthma Control Test, ACT=Asthma Control Test

the onset of AR symptoms were 7 years (range: 5-10), and the median age at diagnosis was 9 years (range: 6-12).

Among the patients, 42% had coexisting asthma, 21.8% had atopic dermatitis, and 11% had food allergies (Table 1). Sensitivities to seasonal allergens such as grass, tree, and weed were observed in 74.5%, 50.9%, and 80% of patients, respectively.
Sensitivities to perennial allergens were also recorded, with 23.6% reacting to house dust mites, 9.1% to mold, and 38.2% to pet dander.

At admission, 44 patients (80%) were given intranasal corticosteroids (Supplementary 1). Intraocular antihistamines were prescribed to 29 patients (53%), while 17 patients (30.9%) received systemic antihistamines. Additionally, leukotriene receptor antagonist (LTRA) therapy was given to 6 (10.9%) patients. Intranasal antihistamines were initiated in 3 patients (5.5%), and combination therapy with LTRA and systemic antihistamines was given to 2 patients (3.6%).

The asthma treatments of the patients at admission were as follows: Inhaled corticosteroids (ICS) were started to 10 patients, combination therapy of ICS and long-acting-beta-agonist (LABA) started to eight patients, leukotriene receptor antagonists (LTRA) were started in three patients, combination therapy of ICS and LABA and LTRA was started to one patient (Supplementary 2). Two patients were instructed to use short-acting beta-agonists (SABA) as needed.

Nasal and Ocular Symptoms

During the treatment period, TNSS at admission in the asthma+AR group was 7 (6-9), which significantly decreased to 4 (3-8) in the first month, and remained at 4 (3-6) in the second month (P=0.001). Similarly, in the AR without asthma group, the TNSS

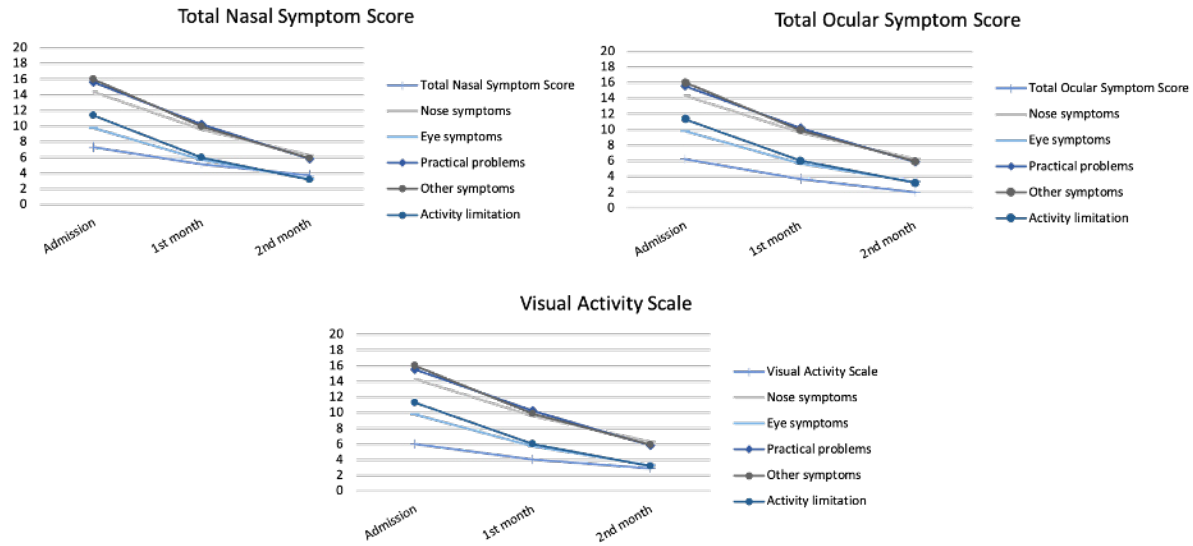

Fig. 1. Results of the test assessing the correlation of TOSS, TNSS, and VAS scores with quality of life over time (admission, 1st month, and 2nd month).

decreased from 8 (6-9) at admission to 5.5 (3-7.8) in the first month, and 4 (1.3-5) in the second month, respectively (P<0.001) (Table 2).

Total ocular symptom score for asthma+AR group decreased significantly from 5 (2-10) at admission to 2 (0-6) in the first month and 0 (0-5) in the second month (P<0.001). In the AR without asthma group, TOSS scores also decreased from 5.5 (3-9) at admission to 3 (1-6) in the first month and 1 (0-3.8) at the second month (P<0.001).

During the study period, the VAS scores decreased from 7 (4-8) at admission to 4 (2-6) in the first month and 2 (1-5) in the second month in the AR and asthma group (P=0.004). Similarly, in the AR without asthma group, the score improved from 6 (5-8) at admission to 4 (2-6) in the first month and 2 (1-4) in the second month (P<0.001).

CARATkids and Asthma Control Tests in AR+Asthma Patients

The median CARATkids admission score of the patients with AR+asthma improved from 8 (7-11) to 5 (3-8) in the first month and 3 (2-4) in the second month (P<0.001) (Table 3). Similarly, C-ACT scores increased from 18 (15.3-22) at admission to 22.5 (18-24) in the first month, and 24 (22.3-25.8) in the second month (P=0.001). ACT scores also improved from 17 (8-21) at admission to 19 (18-20) at in the first month, and 23 (22-25) in the second month.

Quality of Life Scores

Significant improvements in QoL were observed across all domains (Fig. 1). The nose symptom score of QoL improved from 15 (12-18) at admission to 9 (5-14) IQR in the first month and 5 (2-10) in the second month (P<0.001). The eye symptom score of QoL decreased significantly from 9 (5-15) at admission to 3 (1-11) in the first month and further to 1 (0-5) in the second month (P<0.001). Practical issues scores improved from 16 (12–20) at admission to 9 (5-16) in the first month and 5 (2-10) in the second month (P<0.001). Similarly, other symptoms' scores of QoL showed a decrease from 16 (11-22) at admission to 9 (3-15) after one month and 5 (1-10) by the second month (P<0.001). Additionally, activity limitations score from 10 (6-17) at admission to 5 (1-10) in the first month and 2 (0-5) in the second month (P<0.001).

A positive correlation was found between QoL and

Table 4. Comparison of quality of life in patients diagnosed with allergic rhinitis (AR) at admission, and during the 1st and 2nd months of treatment.

	Total AR patients (n=55)				AR Patients with asthma (n=23)				AR Patients without asthma (n=32)			
	Admission	1th month	2nd month	P value	Admission	1th month	2nd month	P value	Admission	1th month	2nd month	P value
Nose symptoms	15 (12-18)	9 (5-14)	5 (2-10)	**<0.001**	15 (13-19)	8 (5-13)	7 (3-12)	**<0.001**	15 (11.2-17.7)	10.5 (4.2-14.7)	4 (2-9)	**<0.001**
Eye symptoms	9 (5-15)	3 (1-11)	1 (0-5)	**<0.001**	9 (5-16)	2 (0-9)	1 (0-5)	**<0.001**	9 (4.25-14.75)	3.5 (1.-12.)	1 (0-4)	**<0.001**
Practical problems	16 (12-20)	9 (5-16)	5 (2-10)	**<0.001**	17 (13-21)	11 (5-17)	6 (3-12)	**<0.001**	15.5 (11-18)	9 (4.2-16)	3.5 (1-6.7)	**<0.001**
Other symptoms	16 (11-22)	9 (3-15)	5 (1-10)	**<0.001**	20 (12-24)	10 (3-21)	6 (1-13)	**0.001**	15 (9-19)	8.5 (3-14.7)	3 (0-9.5)	**<0.001**
Activity limitation	10 (6-17)	5 (1-10)	2 (0-5)	**<0.001**	14 (6-18)	6 (2-10)	3 (1-7)	**<0.001**	10 (6-15)	4.5 (1-10.5)	2 (0-3)	**<0.001**

Data are shown as median (interquartile range). AR=Allergic rhinitis

Table 5. Comparison of quality-of-life scores in allergic rhinitis patients with and without asthma

QoL domains	Admission			1st month			2nd month		
	Patients with AR and Asthma	AR Patients without asthma	P value	Patients with AR and Asthma	AR Patients without asthma	P value	Patients with AR and Asthma	AR Patients without asthma	P value
Nose symptoms	15 (13-19)	15 (11.2-17.7)	0.313	8 (5-13)	10.5 (4.2-14.7)	0.993	7 (3-12)	4 (2-9)	0.148
Eye symptoms	9 (5-16)	9 (4.25-14.75)	0.669	2 (0-9)	3.5 (1.-12.)	0.218	1 (0-5)	1 (0-4)	0.738
Practical problems	17 (13-21)	15.5 (11-18)	0.084	11 (5-17)	9(4.2-16)	0.732	6 (3-12)	3.5 (1-6.7)	0.087
Other symptoms	20 (12-24)	15 (9-19)	**0.019**	10 (3-21)	8.5 (3-14.7)	0.388	6 (1-13)	3 (0-9.5)	0.112
Activity limitation	14 (6-18)	10 (6-15)	0.166	6 (2-10)	4.5 (1-10.5)	0.406	3 (1-7)	2 (0-3)	0.080

Data are shown as median (interquartile range). AR=Allergic rhinitis

TNSS, TOSS, and VAS scores, with the largest reductions noted in patients with the most severely affected QoL at admission.

Improvement in QoL scores was observed in both the AR+asthma and AR-only groups (Table 4). Comparison of QoL scores of these groups did not show statistically significant differences in all domains but other symptoms (Table 5).

Furthermore, ACT and C-ACT scores positively correlated with QoL in AR+asthma patients, whereas CARATkids scores were showed a negative correlation (Fig. 2).

DISCUSSION

The treatment of SAR leads to significant improvements in nasal, ocular, and VAS scores. Several studies have reported a significant reduction in nasal and ocular symptom scores, as well as VAS scores following SAR therapy in children [12-14]. Consistent with these findings, our study demonstrated substantial improvements in nasal and ocular symptoms as well as VAS scores during the first two months of treatment.

Our results revealed significant improvements in TNSS, TOSS, and VAS scores throughout the treatment period, with a positive correlation with QoL scores. These findings indicate that the intervention effectively reduced symptom severity and improved QoL in patients with SAR. By the second month of treatment, patients experienced noticeable relief, particularly in nasal and ocular symptoms, which contributed to better daily functioning. Similar to our results, Devillier *et al*. reported that SAR treatment led to significant improvements in QoL in children, particularly alleviating nasal and ocular symptoms, which had a direct positive impact on daily activities and emotional well-being [12]. Wilson *et al*. [13] also reported that patients with SAR experienced an improved QoL after receiving intranasal corticosteroids.

When comparing SAR patients with and without asthma, there was no significant difference in nasal and ocular symptom scores, VAS, or QoL suggesting that appropriate treatment effectively managed symptoms and improved QoL, regardless of asthma status. It is well-established that patients diagnosed with both rhinitis and asthma often suffer from a more severe disease, which is more difficult and costly to manage

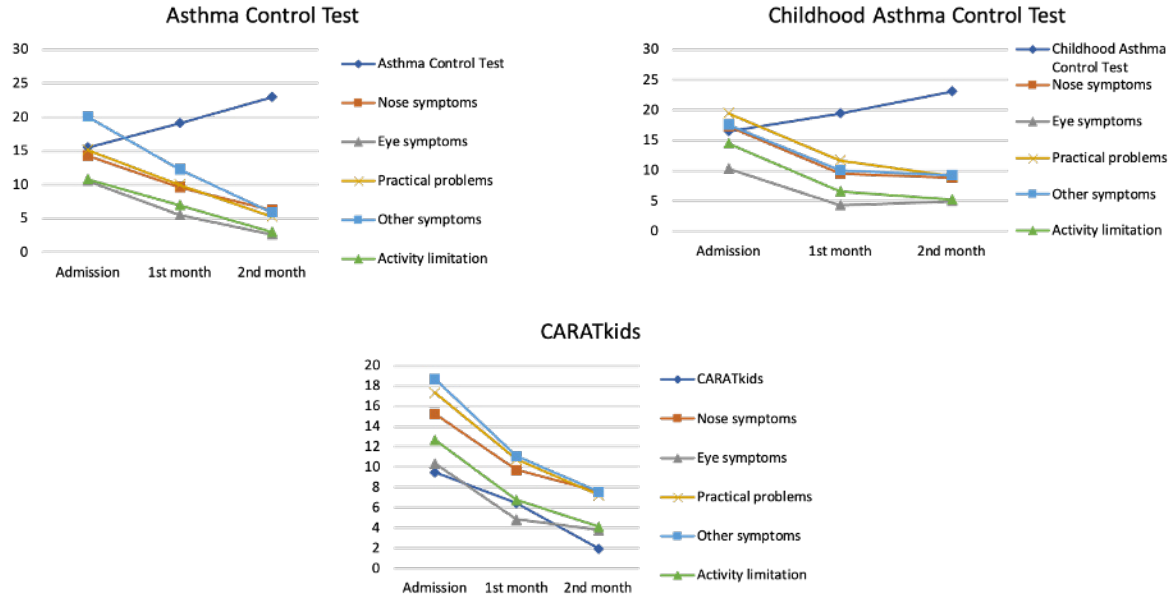

Fig. 2. Results of the test assessing the correlation of ACT, C-ACT, and CARATkids scores with quality of life over time (admission, 1st month, and 2nd month).).

than having only one of these conditions [14]. In contrast to our findings, Ginis *et al*. reported lower nasal symptom scores in SAR patients with asthma [15]. Price *et al*. [16] also concluded that SAR patients without comorbid asthma displayed greater improvements in VAS score and QoL scores after treatment compared to those with asthma. However, both groups showed significant improvements following treatment in our study. A possible explanation for this discrepancy could be the higher adherence to asthma medications during the COVID-19 pandemic, leading to better asthma control. Additionally, the relative sample size and better asthma control observed in our study may also account for the differences compared to other studies.

This study showed marked improvements in ACT, C-ACT, and CARATkids scores in the AR+asthma group, with a positive correlation with QoL scores across multiple domains, including nasal and ocular symptoms, practical challenges, and activity limitations. These findings underscore the effectiveness of combined AR and asthma treatment, demonstrating its ability not only to control asthma symptoms but also to enhance overall QoL in pediatric patients.

The strengths of this study include its comprehensive approach to evaluating both SAR and asthma control in a pediatric population. By utilizing validated instruments such as the CARATkids and C-ACT tests, this study robustly assessed the impact of comorbid conditions on both disease control and QoL. However, several limitations must be acknowledged. The relatively small sample size may limit the generalizability of the findings, and the lack of a control group introduces potential biases in interpreting the results.

CONCLUSION

In summary, we conclude that treatment of SAR in children resulted in significant improvements in SAR and asthma symptom control, as well as QoL. Future studies with larger sample sizes and control groups are necessary to strengthen the evidence and evaluate long-term outcomes. Physicians should take into account the impact of AR on QoL, and implement safe and effective treatments to reduce the burden of the disease and to improve patient outcomes.

Ethics Committee Approval

The study was approved by the Clinical Research Ethics Committee of Ankara Atatürk Sanatorium Training and Research Hospital (Date of Approval: 14.08.2004; Protocol No: 129).

Authors' Contribution

Study Conception: SÖ, ESA; Study Design: SÖ,

AEG, ESA; Supervision: SÖ ; Funding: ESA, HYB; Materials: HYB, AEG; Data Collection and/or Processing: HYB, EUS, ESA, AEG, AE; Statistical Analysis and/or Data Interpretation: ESA, SÖ; Literature Review: ESA, SÖ; Manuscript Preparation: ESA, SÖ and Critical Review: SÖ, EUS, AE, ESA.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

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