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Face mask correlation with allergic rhinitis symptoms severity during COVID-19 pandemic: A cross-sectional study

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Abstract

Background: Face mask is the first line to protect the respiratory mucosa from the coronavirus particles in aerocells and droplets and without this, the exposure of the mucosa to the virus and allergens trigger the immune and inflammatory system. These lead to Allergic Rhinitis (AR) symptoms or virus infection.

Aim: This study discusses about the effects of face mask on the severity of AR symptoms using the Sino-Nasal Outcome Test (SNOT-22) in AR cases during the Corona Virus Disease 2019 (COVID-19) pandemic.

Method: In this cross-sectional study, 54 cases previously diagnosed as moderate and severe AR based on Allergic Rhinitis and its Impact on Asthma and Visual Analog Scale score referred to the tertiary allergy clinic were involved, while 5 of them were excluded. AR symptoms before and during the pandemic were compared based on the SNOT-22 questionnaire. Demographics, AR severity, and comorbidities were registered.

Results: The mean age was 31.4 ± 13.5 years with the male−female ratio of 1.4. The mean SNOT-22 score was 36.1 ± 20.3 before and 29.5 ± 16.8 during the pandemic. Although 36.7% (*n*: 18) of all participants had severe symptoms before the pandemic, 10.2% (*n*: 5) had severe AR symptoms during the pandemic. 53.0% (*n*: 26) of patients had moderate AR symptoms, and 36.7% (*n*: 18) had mild AR symptoms in the pandemic. There was no significant difference between each paired subgroup in AR symptom changes but the symptom improvement was significant in most of the subgroups when compared to the pre-pandemic period. Smoking had an adverse effect on AR symptoms (*p*: 0.034).

Conclusion: Face mask affects the quality of life in AR patients and improves the severity of AR symptoms during COVID-19 pandemic. Smoking worsens this severity. Age, gender, pet ownership, underlying conditions, and previous COVID-19 infection were not associated with AR symptoms severity and alteration in the AR individuals' quality of life during the COVID-19 pandemic.

KEYWORDS

allergic, rhinitis, COVID-19, face mask, Sino-Nasal Outcome Test, SNOT-22

1 | INTRODUCTION

Rhinitis is defined as an inflammation of the nasal mucosa, affecting about 40% of people worldwide. Allergic rhinitis (AR) is the most common form of chronic rhinitis which affects 10%–20% of individuals, while its prevalence is rising.[1] The diagnostic criteria of AR are based on having two or more following symptoms: watery rhinorrhea, sneezing, nasal blockage, and nasal pruritus persisting for ≥1 h on most days.[2] Major symptoms include sneezing, rhinorrhea, nasal itching, obstruction, and conjunctivitis.[3]

According to current published articles, AR can manifest symptoms of systemic airway disease in addition to local upper airway complaints. Stimulating the upper airways with indoor (mites, dust, animal hair) or outdoor (pollens, air pollution) allergens triggers inflammation in the upper and lower airway tracts mediated by IgE, T-helper cells, and interleukins (IL-3, 4, 5, 13).[4,5]

The diagnosis of AR is usually based on clinical history and diagnostic tests such as skin prick test, immunocap, or allergen provocation tests.[6] Restricting the allergen exposure to the mucosa is the first step in managing the symptoms, especially in those with seasonal patterns.[7] Face masks can cause a significant decrease in allergen exposure to the nasal and orbital mucosa; thus, using them is suggested to protect patients against allergens.[8]

In late December 2019, an unusual respiratory tract infection appeared in Wuhan, China, signaling the onset of the coronavirus disease 2019 (COVID-19) pandemic. This disease presented with fever, cough, dyspnea, and nonspecific symptoms; as it can be transmitted easily between people, it is essential to maintain social distancing, remain in quarantine, and follow hygiene protocols, especially using face masks to prevent mucosal exposure to the virus nanoparticles.[9] The prevalence of AR decreased after the onset of this first pandemic wave due to a probable decrease in allergens and pollution exposure during the lockdown period and a rise in face mask usage.[10]

Since using the face mask plays a vital role in managing and preventing COVID-19 aerial transmission, this study evaluates the severity of AR symptoms during the COVID-19 pandemic compared to the pre-pandemic situation to assess the efficacy of hygiene protocols, especially face masks, in managing patients with AR.

In addition, we evaluated the different common risk factors including age, smoking, having pet or not, having any comorbidities, previous COVID-19 infection, and/or hospital admission due to this infection that may affect the AR symptoms, either alleviating or aggravating them. Studying on these factors could have implications for AR individuals and may encourage them to wear mask more widespread in COVID-19 pandemic.

2 | MATERIALS AND METHODS

The current cross-sectional study evaluates the role of face masks in the quality of life associated with AR symptoms, which is based on the 22-question sino-nasal outcome test (SNOT22) in moderate to severe AR patients referred to tertiary asthma and allergic clinic between March 2020 to 2021 in the southwest of Iran.

The Shiraz University of Medical Sciences Ethics Committee approved the study protocol, which was adhered to the Helsinki Declaration.

The inclusion criteria were as follows:

- Cases of moderate and severe persistent AR based on Allergic Rhinitis and its Impact on Asthma (ARIA) classification and Visual Analog Scale (VAS) score and confirmed by serology and skin prick test.
- Use of face masks more than four-fifths of their out-door work times; while they were outdoors and had exposure to pollution at least two times a week.

Exclusion criteria were: inability to complete the questionnaire (due to dissent from participating, change of residence so change of the allergens exposure), case of AR less than 1 year, cases of non-AR, cases of either mild or intermittent AR, failure to use any of the three specific types of face masks (three-layer surgical mask, FFP2 non-filtered mask, or N95 filtered mask) most of the times during the COVID-19 pandemic.

Participants, who were previously diagnosed with AR based on the clinical symptoms and paraclinical tests, with moderate and severe AR symptoms according to the ARIA classification and VAS score were enrolled in this study. In addition, the participants were told not to change their medications and dosage if they were taking any for their AR symptoms.

ARIA and the VAS are two common scales to evaluate the severity of AR symptoms. ARIA classification determines if the AR is intermittent (duration less than 4 days/week or 4 weeks/year) or persistent and how severe the AR symptom is. According to the VAS, the score range more than 5 shows poorly controlled AR, 2–5 shows partially controlled AR, and less than 2 shows controlled AR.[11,12]

SNOT-22 questionnaire evaluates 22 symptoms in AR participants and is related to sleep problems, nasal, otology, and behavioral/emotional symptoms. Each item is scored from 0 to 5. The total score range is between 0 and 110, and a total score of 0 to 20 is considered mild, 20–50 moderate, and greater than 50 severe AR symptoms.

We established the AR diagnosis with the skin prick test, serology test, and clinical symptoms (the skin wheal lesions greater than 3 mm), flare greater than 10 mm, and total IgE titer greater than 100 IU/mL confirmed that the participant was sensitive to the allergens).

Since the lack of cooperation and compulsion in wearing the face mask in younger participants, the pediatric age range was 4–18 years old and the adult age was 18 years old and older in this study. Furthermore, the participants didn't use face masks for their AR symptoms before the pandemic and the usage was only limited to individuals with contagious common respiratory diseases, occasionally.

After explaining the aim of this study and obtaining informed consent, the patient or clinical assistant filled out two validated

Persian SNOT-22 questionnaires[13] (related to before and during COVID-19 period AR symptoms). Data were gathered at the patient's initial visit concerning age, sex, underlying conditions, history of COVID-19, hospital admission due to COVID-19, having any pets, smoking history, mask usage, and SNOT-22 questions. All results were recorded and interpreted in modified scores. The underlying conditions included diabetes mellitus type 1 and 2, thyroid disease, hypertension (cut-off point: 140/90), atopic dermatitis, and asthma.

Data were recorded, converted to sequential codes (to maintain anonymity), and analyzed using the IBM Statistical Package for the Social Sciences (v. 22; SPSS Inc.). The missing data were defined as missing data in SPSS.

We considered the $p < 0.05$ significant. Data were expressed as numbers and percentage (%) for nominal or mean ± standard deviation for quantitative variables. The Pearson's χ^2 test to compare two qualitative variables. If the normality assumption was upheld, the nominal ANOVA test was used to evaluate the nominal variables. Furthermore, the sample size calculation was according to the Primov-Fever et al.'s study[14] and based on the following formula:

$$N = Z^2_{1\text{-a}/2} \times P\times(1\text{-}P)/E^2 Z = 1.96,\ P = 0.1,\ E = 8\%.$$

3 | RESULTS

Fifty-four participants between 9 and 63 years old were included. Four of them were excluded due to incomplete questionnaire and one refused to attend the study. The mean age was 31.4 ± 13.5 with the male-to-female ratio of 1.4 (29:20). According to the SNOT-22 score, 51.0% of the patients had moderate AR symptoms, 10.2% had severe AR symptoms, and 36.7% had mild AR symptoms during the pandemic, although they were 34.6%, 36.7%, and 28.5%, respectively, before the pandemic.

The total SNOT-22 score ranged from 2 to 67, with a mean score of 29.5 ± 16.8 during and 36.1 ± 20.3 before the COVID-19 pandemic.

Despite significant improvements in AR symptoms in male and female groups compared before to after the pandemic (p: 0.008 and 0.001, respectively), the mean SNOT-22 score did not differ significantly between genders (p: 0.53 vs. 0.54; Table 1).

The majority of the studied population was adults with significant symptom improvement throughout the pandemic (p: 0.001). Plus that, based on the SNOT-22 score during the pandemic, most adults (71%) had moderate and severe AR symptoms, while children had mild AR symptoms. Additionally, the adults' mean SNOT-22 score was higher before and during the pandemic compared with pediatrics (Table 1).

Table 1 demonstrates that with face masks, the mean SNOT-22 score fell for both smokers and nonsmokers (p: 0.001 and 0.01) and that nonsmokers had lower SNOT-22 score before the pandemic (p: 0.03).

Most of the smokers' AR symptoms (77%) scored moderate and severe according to SNOT-22 during the pandemic. Moreover, only two of the 27 nonsmokers presented with severe AR symptoms and the rest had mostly mild AR symptoms with mask usage.

Non-pet owners had lower mean SNOT-22 scores before and throughout the pandemic. Compared to pre-pandemic, both pet and non-pet owners' AR symptoms improved dramatically during the pandemic (p: 0.018 and 0.001).

Owning a pet had no noticeable impact on the severity of the symptoms compared to non-pet owners (p Value before and during the pandemic: 0.27 and 0.71). One percent of the pet owners and 10.5% of the non-pet owner had severe AR symptoms, with mild and moderate AR symptoms being dominant during the pandemic (Table 1).

After applying the face masks, there was a significant improvement in participants with and without underlying conditions (p: 0.043 and 0.001). Those with underlying conditions scored higher on the SNOT-22 than the other group. Moreover, the SNOT-22 scores before and after the outbreak did not alter significantly between these two groups (p: 0.24 and 0.29). Plus that, most participants with the underlying conditions (75%) had moderate AR symptoms (Table 1).

In Table 1, both participants with and without past COVID-19 infection had significant improvement in symptoms compared to the pre-pandemic period, and the former had a higher mean SNOT-22 score than the latter (p: 0.015 and 0.001). Additionally, past COVID-19 infection was not associated with severe AR and SNOT-22 scores (p: 0.26 and 0.26). Only 20% with a history of COVID-19 had severe AR symptoms.

According to Table 1, hospital admission due to COVID-19 didn't significantly affect the AR symptom improvement (p: 0.68 and 0.72). After utilizing the face masks, AR symptoms improved significantly in nonhospital admitted patients ($p < 0.001$). Overall, none of the admitted COVID-19 patients had severe AR symptoms.

79.5% of the research participants with AR symptoms used simple three-layer face masks. Individuals who used non-filtered FFP2 masks had the lowest SNOT-22 scores, whereas those with surgical masks and N95-filtered masks were more likely to suffer moderate AR symptoms (Table 2).

According to the SNOT-22 scoring chart, the most common complaint among patients wearing surgical masks was fatigue, followed by irritation and sleepiness upon awakening. Patients who used FFP2 face masks had more nasal discharge, embarrassment, and postnasal discharge (Figure 1).

4 | DISCUSSION

The AR symptoms, whether respiratory, emotional, or rhinological can vary in severity amongst individuals and affect the quality of life. We evaluated the effect of utilizing face masks and their various forms on the severity of AR symptoms and participants' quality of life

TABLE 1 The correlation of demographics and related variables with SNOT-22* classified score during COVID-19* pandemic.

Variable	Number (N%)	SNOT score (mean ± SD) before the pandemic	SNOT score (mean ± SD) during the pandemic	*p* Value
Gender				
- Male	29 (59.2%)	34.6 ± 19.5	30 ± 17.7	0.008
- Female	20 (40.8%)	38.4 ± 21.7	28.8 ± 15.9	0.001
p Value between		0.532	0.540	
Age group				
- Adult	38 (77.6%)	38.2 ± 19.5	31.6 ± 16.2	0.001
- Pediatric	11 (22.4%)	29.0 ± 22.2	22.1 ± 17.8	0.066
p Value between		0.186	0.158	
Smoking				
- Smoker	22 (44.9%)	42.9 ± 17.7	34.4 ± 15.5	$p < 0.001$
- Nonsmoker	27 (55.1%)	30.6 ± 20.9	25.4 ± 17.1	0.011
p Value between		0.034	0.180	
Pet ownership				
- Positive	11 (22.4%)	42.1 ± 21.1	32.6 ± 17.0	0.018
- Negative	38 (77.6%)	34.4 ± 20.0	28.6 ± 16.9	0.001
p Value between		0.271	0.718	
Underlying conditions				
- Positive	8 (16.3%)	43.8 ± 15.7	36.1 ± 14.8	0.043
- Negative	41 (83.7%)	34.6 ± 20.9	28.2 ± 17.1	$p < 0.001$
p Value between		0.294	0.294	
Past COVID-19 infection				
- Positive	15 (30.6%)	41.0 ± 20.5	34.4 ± 17.0	0.015
- Negative	34 (69.4%)	34.0 ± 20.1	27.3 ± 16.5	0.001
p Value between		0.269	0.269	
Past COVID-19 hospitalization				
- Positive	5 (10.2%)	32.6 ± 21.4	21.4 ± 15.5	0.109
- Negative	44 (89.8%)	36.5 ± 20.4	30.4 ± 16.9	$p < 0.001$
p Value between		0.682	0.728	

Note: Underlined *p* values are statistically significant at $p < 0.05$.

Abbreviations: COVID-19, coronavirus disease 2019; FFP2, filtering facepiece 2; SNOT-22, sino-nasal outcome test-22.

using the SNOT-22 questionnaire. We should note that studies about the effects of face masks on AR symptom severity are few.

4.1 | Related works

Although the mean SNOT-22 score was greater in females before the pandemic, it decreased after using face masks and the female group had better results after using face masks. In contrast, Primov-Fever et al., evaluated the quality of life during COVID-19 pandemic in participants wearing face mask. They declared that females had higher total SNOT-22 scores than males. We think that females insist on wearing a mask outside more frequently than males do; this lowers the allergen exposure.[14]

Mengi et al. evaluated the AR symptoms of participants with isolated pollen allergy in 2019–2020 based on the SNOT-22 questionnaire. At the end of the study, they found that the mean SNOT-22 score decreased after the use of face mask. In this study, the mean SNOT-22 score before and during the pandemic was 36.1 ± 20.3 and 29.5 ± 16.8, respectively. Similarly, Mengi et al. found the decline of moderate-severe AR symptoms in 93% of participants to 56% during pandemic, the significant nasal symptoms after mask

TABLE 2 Distribution of AR symptom severity related to face mask usage among patients with AR, *N* (%).

Mask type	Number (*N*%)	SNOT score (mean ± SD)	Symptoms severity		
			Mild	Moderate	Severe
- Surgical face mask	39 (79.5%)	30.4 ± 17.1	13 (34.2%)	21 (55.3%)	4 (10.5%)
- FFP2 non-filtered face mask	7 (14.2%)	24.5 ± 17.4	4 (57.1%)	2 (28.6%)	1 (14.3%)
- N95-filtered face mask	3 (6.1%)	29.3 ± 14.4	0 (0.00%)	3 (100%)	0 (00.0%)

Abbreviations: AR, allergic rhinitis; FFP2, filtering facepiece 2; SNOT−22, sino-nasal outcome test-22.

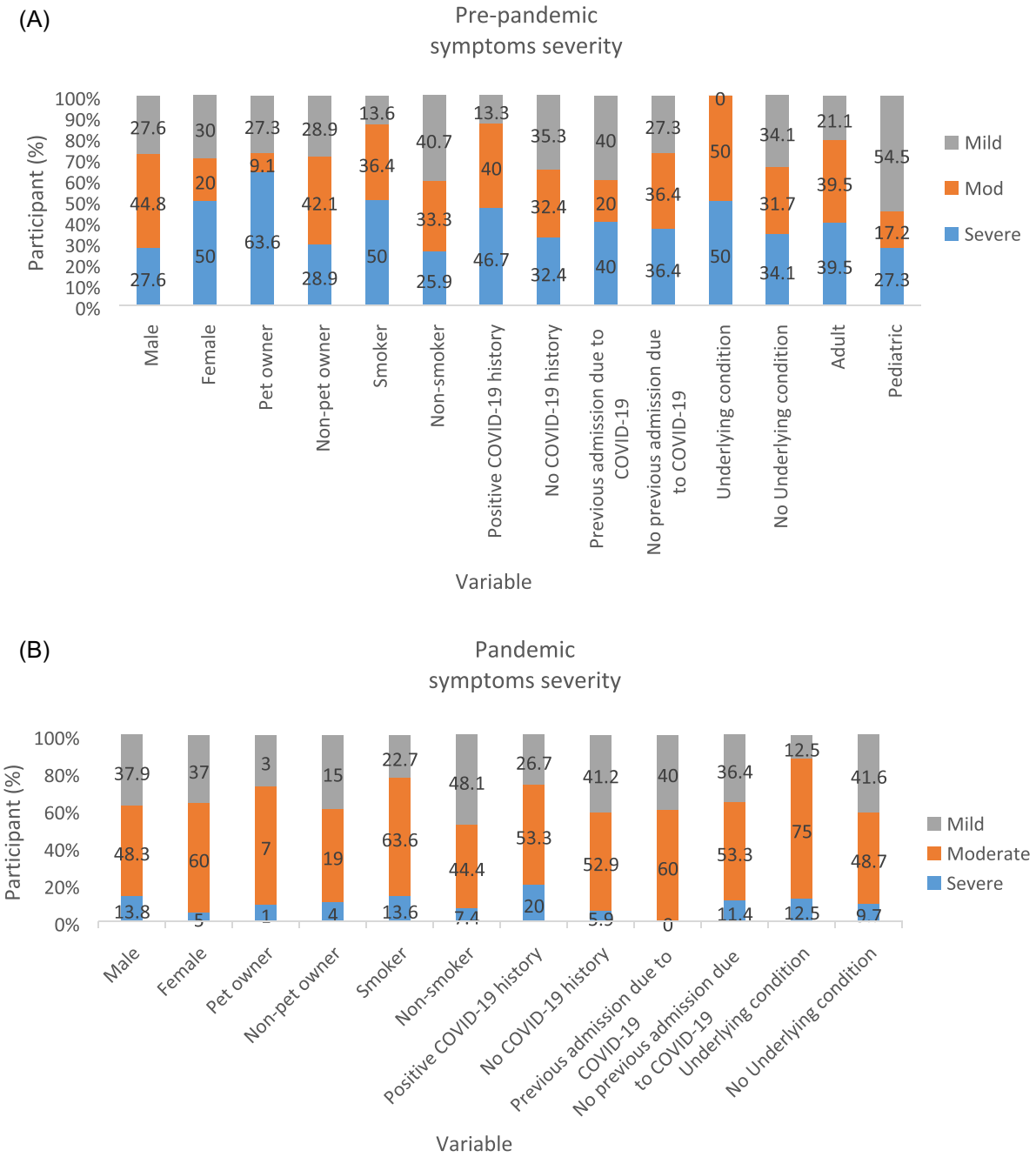

FIGURE 1 The comparison of pre-pandemic (A) and pandemic (B) variables and the percentage of patients having mild, moderate, and severe AR symptoms in each group (in a total of 49 participants). AR, allergic rhinitis; COVID-19, coronavirus disease 2019.

usage, and 16% reduction in sneezing plus 14% reduction in nasal discharge. We both assume the decrease in the AR symptoms severity is due to the protective effect of face masks against mucosa exposure to allergens.[15]

In our study, the majority of the participant used a surgical face mask. Most of them, based on the SNOT-22 score, had mild and moderate AR symptoms during the pandemic, which is more identical to Dror et al.[16] when they assessed the nurses with reported AR using both surgical face mask and N95. They found that with surgical face mask, the mild AR symptoms were improved, while with FFP2 face masks, the severe AR symptoms had improved toward mild, though there was no improvement in mild AR symptoms, overall. In another study by Bergmann et al. during the COVID-19 pandemic, participants with allergic rhino-conjunctivitis symptoms were exposed to outdoor allergens while they were using medical face mask or FFP2 face mask. They found the well-being and improvement in the severity of their symptoms compared to the pre-pandemic period and the times without face-mask.[17]

Based on the SNOT-22 score, moderate AR symptoms were dominant in smokers. Even though smoking worsened AR individuals' quality of life before the pandemic, there was no association between smoking and improved life quality during the pandemic. A similar result was found by Bousquet et al. during the non-pandemic period in two cross-sectional studies on patients with moderate to severe AR symptoms. They found that mild AR symptoms were mostly seen in non-smokers compared with smokers and ex-smokers, but smoking didn't alter the severity of AR symptoms.[18]

During the pandemic, both pediatric and adult SNOT-22 scores improved, with the former group showing a significant improvement. There was no correlation between age and improvement in AR symptoms after using a face mask. Although in the non-pandemic period, Izquierdo-Domínguez et al. declared that, by using ARIA score, the moderate/severe AR symptoms are more frequent in children than adults and are more sensitized to allergens.[19]

Our study found that in those with underlying conditions, especially asthma, moderate and severe AR symptoms were prevalent but we noticed no significant relation between underlying conditions and worsening of AR symptoms severity. In contrast, Greiner et al. found that asthma and other underlying conditions are associated with the AR symptom severity.[20]

According to the study by Du et al. and assessing the clinical manifestations of COVID-19 in AR participants with different severity, there wasn't any association between AR and COVID-19 infection, and allergy was not a risk factor for the severity of COVID-19. Similarly, we found that in those with or without a history of COVID-19 infection, most patients had moderate AR symptoms, without a significant difference between them.[21]

Yang et al.[22] observed the association between AR and asthma and the severity of COVID-19 in patients with positive test and found that length of hospital stay due to coronavirus infection and severity of the infection has been increased (which increased the likelihood of hospital admission and needing of intensive care services), while we noticed that both patients with and without a history of hospital admission due to COVID-19 had improvement in AR symptoms severity when coexisting with mucosal protection. Although non-hospitalized participants due to the COVID-19 had significant improvement in SNOT-22 scores, there wasn't a relation between hospital and nonhospital COVID-19 admitted participants and symptom improvement. Eggert et al. also discovered that allergic/asthmatic patients with positive COVID-19 test and high serum eosinophil count are less likely to be hospitalized due to COVID-19.[23]

Bousquet et al. studied the AR and discussed its risk factors. They stated that pets and smoking, whether maternal or paternal, are allergens that cause AR symptoms in patients.[24] We evaluated these risk factors in our study because they could affect the AR symptoms and so affect the mean SNOT-22 score. There was a significant improvement in AR symptoms among subgroups of gender, smoking, pet ownership, previous COVID-19 infection, underlying condition, and adult and nonhospitalized COVID-19 patients when compared to pre-pandemic levels. We believe this is due to face masks' protection against outdoor and indoor allergen exposures, the comparison of humidity and heat inside the face mask, and the reduction in allergen stimulation of ocular and nasal mucosa. This supports Dror and Mengi et al. about the protective role and efficiency of face mask on AR symptoms during the COVID-19 period and is in contrast with Primov-Fever et al., as they found that wearing face mask had negative and even plateau effects on quality of life in participants with acute and chronic sinonasal diseases.[14–16] The disparities in the studies discussed could be attributed to differences in the studied populations and allergen types. Inflammation caused by allergies and virus infection can exacerbate each other. This worsening condition is influenced by a history of severe immune system involvement and remaining antibodies against the virus.

It is possible that some limitations influenced the results obtained. The sample size was limited due to the participants' concerns about the new onset pandemic, the lockdown situation, and social distance. The length of the study was the other factor. Aside from that, this study was single-centered. In addition, we were not able to evaluate the indoor AR symptoms' severity due to indoor dust and mites. The last limitation is the availability and cost of the FFP2 and N95 filtered masks.

We compared pre-pandemic and pandemic AR symptoms severity by SNOT-22 questionnaire, which is a standardized questionnaire, in people who had previously been diagnosed with AR. This study contributes to a better understanding of the effects of face masks on AR symptoms. Further evaluation of the AR population can increase the study's accuracy; concerns about COVID-19 may decrease, so more participants may be available for future studies.

5 | CONCLUSION

We conclude that most patients with AR who use face masks had improvement in AR symptoms, with fatigue being the most common complaint. Smoking has a negative impact on AR symptoms, but gender, age, pet ownership, underlying disease, and prior COVID-19

infection/hospitalization were not associated with any significant improvement in the quality of life of AR participants during the pandemic.

AUTHOR CONTRIBUTIONS

Hossein Esmaeilzadeh: Formal analysis; funding acquisition; methodology; project administration; supervision; validation; writing—review and editing. **MReza Goodarzian**: Software; supervision; writing—original draft; writing—review and editing. **Alireza Abbasi**: Writing—original draft. **Mohammad Alamdari**: Writing—original draft. **Negar Mortazavi**: Formal analysis; methodology; resources.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

The manuscript has been approved by all authors and is neither published nor under consideration for publication elsewhere. All figures/tables are original and created by authors. We guarantee that all authors listed on the title page have read the manuscript and attest to the validity and legitimacy of the data. We would also like to undertake that we have read the plagiarism policy and are submitting the article with complete responsibility. This study was done in compliance with the Declaration of Helsinki and was approved by the university's ethics committee. Participants under 18 were asked to answer the questions with their parents following the informed consent, while adults gave their informed consent before their inclusion in the study.

TRANSPARENCY STATEMENT

The lead author M. Reza Goodarzian affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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