

Medical Science

pISSN 2321-7359; eISSN 2321-7367

To Cite:

Al-Rasheedi AN, Ghazy AA, Almusayyab RB, Almajed OA, Aljarid MY, Alabid AMS, Alruwaili SHH, AL-Jarallh MF, Alnosair AO, Alruwaili ASD. Prevalence, clinical characteristics and allergen sensitization patterns of allergic rhinitis and its impact on daily activities among the general population of Al-Jouf province, Saudi Arabia. *Medical Science* 2022; 26:ms307e2384. doi: <https://doi.org/10.54905/disssi/v26i125/ms307e2384>

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Peer-Review History

Received: 05 July 2022

Reviewed & Revised: 06/July/2022 to 20/July/2022

Accepted: 22 July 2022

Published: 26 July 2022

Peer-review Method

External peer-review was done through double-blind method.

URL: <https://www.discoveryjournals.org/medicalscience>



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Prevalence, clinical characteristics and allergen sensitization patterns of allergic rhinitis and its impact on daily activities among the general population of Al-Jouf province, Saudi Arabia

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ABSTRACT

Background: Allergic rhinitis (AR) has a major global health impact on all age groups, with a global increase in its annual morbidity and mortality rate. It is common among children and adults in many regions of Saudi Arabia. In spite of its increasing incidence and its great impact on the family, the precise risk factors and the level of awareness on AR in Aljouf region are still unclear. **Methodology:** This is a questionnaire-based cross-sectional study to identify the common risk factors and their impact on individuals' daily activities. An online questionnaire was disseminated among residents (Saudi and non-Saudi) in Al-Jouf provinces in Saudi Arabia in the period from January to March, 2022. **Results:** The prevalence of AR among participants was 67.4%, and dust, weather changes, smells, fumes, cold air, perfumes, animal dander, and pollens were the common risk factors. Almost all participants have reported that the manifestations were intermittent (less than 4 weeks, 86.5%), seasonal, and more common during Jumada Al-Thani, Jumada Al-Awwal, Rabi Al-Thani, Rabi Al-Awwal, and Rajab, respectively. Many patients with allergic rhinitis had sleep disturbances, and their daily activities affected. **Conclusion:** There is high prevalence of AR in Al-jouf region, Saudi Arabia. Thus health education programs are essential to raise community awareness about the risk factors and how to avoid them.

Keywords: Allergic rhinitis, Allergens, clinical characters, Al-Jouf region, Saudi Arabia.

1. BACKGROUND

Allergic rhinitis (AR) has a major global health impact on all age groups. Globally, about 400 million people have AR with increasing annual morbidity and mortality rate (Alqahtani, 2020). It is manifested by many agonizing symptoms such as nasal congestion, rhinorrhea, sneezing, redness of the eye and tearing (Almehizia, 2019; Kar, 2019; Alruwaili et al., 2021). Allergic rhinitis can be triggered by several factors as domestic animals, mites, mold, pollens, tobacco smoke, some medications and/or occupational exposure to latex, sulfur or nitrogen oxides (Alanazy et al., 2021). In allergic person, any of these factors can induce an immunoglobulin E (IgE)-mediated inflammatory response in the nasal membranes leading to mast cell and basophil degranulation resulting in the release of histamine and other mediators. At the nasal sensory nerve endings, histamine will act on H1 receptors causing sneezing, pruritus, and reflex secretory responses. At the mucosal blood vessels, it interacts with H1 and H2 receptors leading to nasal congestion and plasma leakage (Almehizia et al., 2019).

AR can occur during specific seasons (seasonal AR) or throughout the year (perennial AR). According to the duration of manifestations, AR can be classified into intermittent AR (less than 6 months) or persistent AR (symptoms continue throughout the year). These manifestations vary between mild, moderate, or severe (where sleep and daily activity are affected). AR has a major burden on the patients as it negatively affects their quality of sleep, social life, school performance, and work productivity (Alanazy et al., 2021).

It is well known that Saudi Arabia is usually exposed to many sandstorms in all over the year with different strengths in the different regions. These sandstorms can trigger or exacerbate many allergic diseases such as AR (Alanazy et al., 2021). Knowing the common inhaled allergens, current attitude, and self-care practices regarding AR in our local community will be inevitably reflected on our public health initiatives and strategies. Higher levels of awareness are needed because of its indirect impact on early seeking medical attention in time-critical illness.

Thus the current study aimed to identify the most common allergens in Al-jouf region, Saudi Arabia, and the impact of AR on individuals' daily activities.

2. RESEARCH METHODOLOGY

The current study is across-sectional study using a structured, pre-tested, well-established questionnaire. It was conducted in Al-Jouf provinces including Sakaka, Alqurayyat, Dumat Aljanal, Tabarjal, Sawyer via distribution of online questionnaire on all community sectors, including employees, university employees students, physicians, householders, and workers. Inclusion criteria include any resident in Al-Jouf region (Saudi and non-Saudi). Sample size calculation shall be carried out by an online tool ((Epiinfo TM), considering a prevalence of 20%, and it was estimated to be 300 individuals however we collected 325 questionnaire. The questionnaire included sociodemographic data (such as age, gender, residence, occupation, and level of education), general questions about the predisposing factors of allergy, and questions on allergic manifestations, their duration, how they affect their daily activity, the treatment used, and response to treatment. Participants were randomly selected.

Ethical Considerations

Ethical approval (no 20-16-9/40, 2019) was obtained from the Local Committee of Bioethics of Jouf University. The study adopts the ethical guidelines of the 1975 Declaration of Helsinki. The 1st question of the questionnaire was for the participant's consent to participate in the study. There was no risk to the participants.

Data analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). Qualitative data were described using numbers and percentages. Quantitative data were described using mean and standard deviation.

3. RESULTS

Socio-demographic data

The sociodemographic data of all participants is illustrated in table 1. The age of participants was ranging from 18 to 56 years old, and most of them (53.5%) were aged between 20 and 30 years. Female's participants were more than males (75.1% vs 24.9%, respectively). Most of the participants were non-smokers (90.8%), did not suffer from chronic diseases (84.3%), and did not perform previous surgery in the nose (92.3%). However, 85.8% have pets at home and 46.8% of participants could be considered negative smokers due to presence of smokers at home.

Table 1 Distribution of the studied cases according to general information (n = 325)

Q	I. General information	No. (%)	Q	I. General information	No. (%)
1	Age (years)		5	Marital status	
	18-20 years	62 (19.1%)		Single	181 (55.7%)
	20 – 30 years	174 (53.5%)		Married	144 (44.3%)
	31 – 40 years	38 (11.7%)	6	Smoking	
	> 40 years	51 (15.7%)		Smoker	30 (9.2%)
2	Gender			Nonsmoker	295 (90.8%)
	Male	81 (24.9%)	7	Have smokers at home	
	Female	244 (75.1%)		Yes	152 (46.8%)
3	Nationality			No	173 (53.2%)
	Saudi	314 (96%)	8	Have pets at home	
	Non-Saudi	11 (4%)		Yes	46 (14.2%)
4	Residency			No	279 (85.8%)
	Sakaka	110 (33.8%)	9	Have chronic disease	
	Qurayyat	34 (10.5%)		Yes	51 (15.7%)
	Dumat aljandal	115 (35.4%)		No	274 (84.3%)
	Tabarjal	18 (5.5%)	10	Have surgery on nose	
	Sawyer	38 (11.7%)		Yes	25 (7.7%)
	Qara	10 (3.1%)		No	300 (92.3%)

Risk factors and clinical manifestations

Risk factors and clinical manifestations of allergic rhinitis among participants are shown in Table 2, figures 1 and 2. It was apparent that the common risk factors in Aljouf region were dust (59.1%), weather changes (49.7%), smells & fumes (30.8%), cold air (26.9%), perfumes (24.8%), animal dander (20.7%), and pollens (19.6%), respectively (figure 1).

Table 2 Risk factors and clinical manifestations of allergic rhinitis among participants

Q	II. questions about allergic rhinitis	No. (%)
1	Have you suffered from allergic rhinitis during the past 12 months	
	Yes	219 (67.4%)
	No	106 (32.6%)
2	Risk factors	
	Dust	169 (59.1%)
	Weather changes	142 (49.7%)
	Smells & fumes	88 (30.8%)
	Cold air	77 (26.9%)
	Perfumes	71 (24.8%)
	Animal dander	59 (20.7%)
	Pollens	56 (19.6%)
	Grass	41 (14.3%)
	Humidity	17 (5.9%)
	Exercises	11 (3.8%)
	Nothing	66 (23.1%)
3	Duration of clinical manifestations	
	Less than 4 weeks	186 (84.9%)
	More than 4 weeks	33 (15.1%)
4	How these manifestations affect your activity?	
	Sleep disturbances	111 (38.9%)
	Affect all daily activity & buzzer me	102 (35%)

Restrict my daily activity	45 (15.8%)
Did not affect my activity or sleep	27 (9.5%)

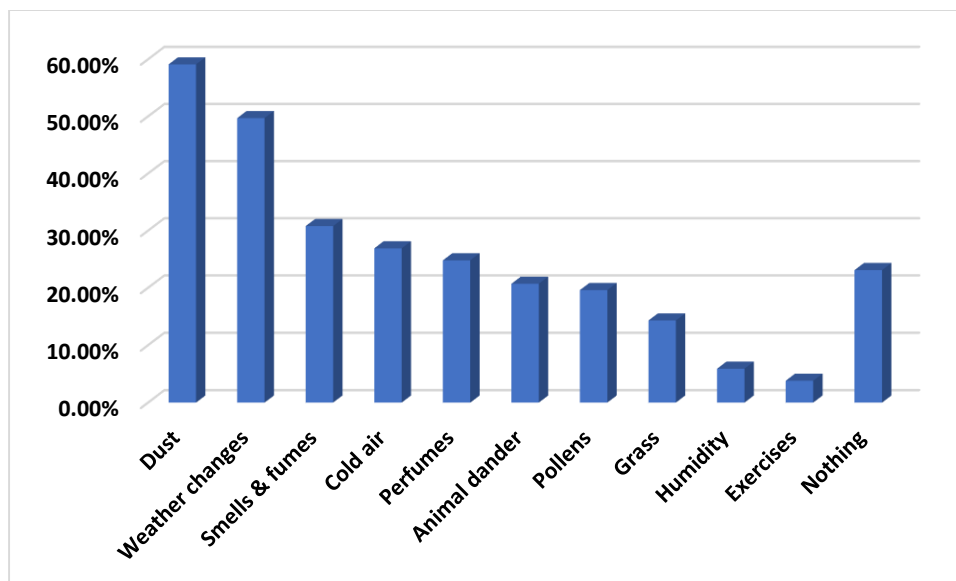


Figure 1 Risk factors for allergic rhinitis

Regarding the clinical manifestations, 67.4% of participants have suffered from allergic rhinitis during the past 12 months with multiple manifestations; particularly frequent sneezing (62.2 %), runny nose (49.1 %), itchy nose (42.6 %), headache (36.4 %), nasal congestion (29.2 %), snoring (21.6%), and cough (21.6%) (Figure 2). Furthermore, almost all participants have reported that the manifestations were intermittent (less than 4 weeks, 84.9%), seasonal, and more common during Jumada Al-Thani, Jumada Al-Awwal, Rabi Al-Thani, Rabi Al-Awwal, and Rajab, respectively. In addition, 38.9% of those suffering from AR had sleep disturbances, and 35% of them had their daily activities affected (figure 3).

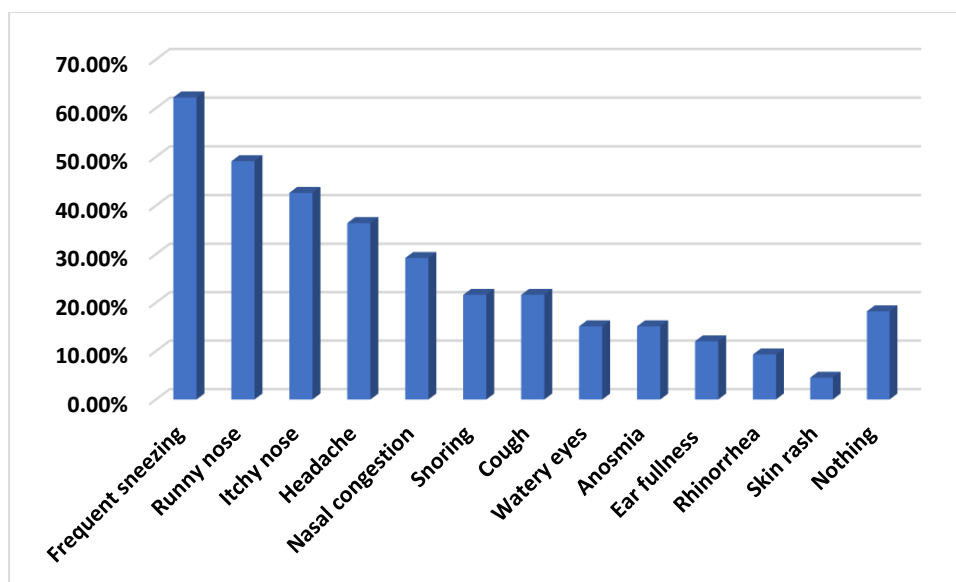


Figure 2 Clinical manifestations of allergic rhinitis

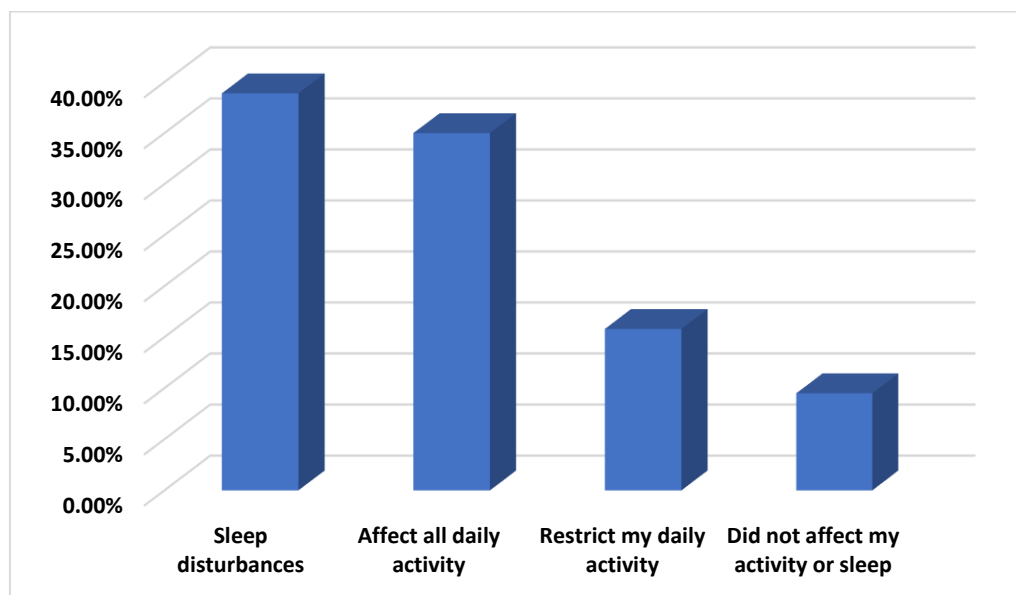


Figure 3 How these manifestations affect the daily activities of participants

4. DISCUSSION

Allergic rhinitis (AR) is a worldwide health problem that may seem of a little significance to non-sufferers, however, its clinical manifestations (sneezing, nasal congestion, rhinorrhea) have a negative impact on daily productivity, sleep quality, and can incur substantial economic costs (Seidman et al., 2015; Lin et al., 2018). It is estimated that AR affects 10- 40% of general population worldwide with a global increase in its annual morbidity and mortality rate (Brožek et al., 2017; Alqahtani, 2020). This common disorder is triggered by a variety of aeroallergens such as dust mites, pollen, molds, and insects (Badran et al., 2016). Exposure to these allergens results in inflammation of the upper respiratory passage with an IgE mediated type 1 hypersensitivity reaction in the nasal mucosa (Krouse et al., 2002; Salo et al., 2011; Stevens et al., 2016). Exposure to allergen (as dust mite and cockroach residues, animal dander, pollens, molds, etc) initiates infiltration of inflammatory cells (asmast cells, eosinophils), T-helper, B lymphocytes, and macrophages into the nasal lining (Small et al., 2018). Nasal congestion is caused by mucosal edema and it is associated with obstructive sleep apnea (Cao et al., 2018).

In spite of its increasing incidence and its great impact on the family, the exact prevalence of AR in Al-jouf region is still unknown. Moreover, there remains a paucity of evidence about the impact of AR and its association with obstructive sleep apnea. Thus we aimed to investigate the risk factors of allergic rhinitis in al-jouf region and its impact on individuals' daily activities through the distribution of online questionnaire in all sectors of the community. Filling such a gap of knowledge and correlating it with socio-demographic factors will help to set baseline data for health education programs to reduce self-care related misconceptions. The current study included 325 participants (96% Saudi and 4% non-Saudi) live in Al-jouf region, Saudi Arabia involving 24.9% males and 75.1% females and their ages ranged between 18 and 56 years old, 44.3% were married and 55.7% were single.

The prevalence of AR among participants was 67.4%. Regarding risk factors in Al-Jouf region, dust was the commonest risk factor as more than half of participants have reported that their allergic manifestations were precipitated by exposure to dust. Other risk factors were listed too as weather changes (49.7%), smells & fumes (30.8%), cold air (26.9%), perfumes (24.8%), animal dander (20.7%), pollens (19.6%), grass (14.3%), humidity (5.9%), and exercise (3.8%). Previous studies in Saudi Arabia have reported that the prevalence rate of allergic rhinitis among adults is variable among the different regions and may range from 5.3% to 25% (Alqahtani, 2016; Hasnain et al., 2016; Badran et al., 2016; Alqahtani, 2020). This may be attributed to the large territory with marked variations in topographical, geographic, meteorological, and climatic conditions. In addition, genetic and cultural factors may greatly affect these variations in disease prevalence (Alqahtani, 2020). Recent studies report a growing prevalence rate of allergic diseases (Alqahtani, 2016; Hasnain et al., 2016; Hussain, 2018).

Jenerowicz et al., (2012) have reported that AR is the most common allergic disease, allergic rhinitis with a prevalence of about 28.3% among adults of Tehran, and women suffer more from the allergic symptoms than males. In China, it was demonstrated that the overall prevalence of AR was 34.3%. However, the age- and gender-adjusted prevalence of AR was highly variable, ranging

from 8.7% in Beijing to 34.3% in Chengdu, and 37.9% in Urumqi (Zhang, 2014). Kim et al., (2016) have used the Korean International Study of Asthma and Allergies in Childhood (ISAAC) questionnaires to determine the presence of symptoms of AR among 14,356 children and adolescents in Korea between 2010 and 2014. They found that the total prevalence of AR was 20.8% (16.9% girls and 24.8% boys), while the prevalence of AR-based exclusively on the questionnaire was 43.8%. Furthermore, almost all participants have reported that the manifestations were intermittent (less than 4 weeks, 84.9%), seasonal, and more common during Jumada Al-Thani, Jumada Al-Awwal, Rabi Al-Thani, Rabi Al-Awwal, and Rajab, respectively. In addition, 38.9% of those suffering from AR had sleep disturbances, and 35% of them had their daily activities affected.

Sinha et al., (2015) have conducted a community-based cross-sectional study in Mehrauli, South Delhi involving 1200 adults, selected randomly to collect information regarding symptoms, risk factors, and treatment-seeking behavior for Allergic Rhinitis. They performed multivariate logistic regression analysis to correlate risk factors and AR. They noticed that the AR prevalence was about 11% and the risk factors associated with rhinitis were mainly overcrowding, absence of cross-ventilation, occupational exposure to dust/ smoke, tobacco smoking, and family history of allergic diseases. This indicates the role of environmental factors on triggering AR. In agreement with our results, Small et al., (2018) have stated that allergic rhinitis can affect patient quality of life. They recommended the use of skin-prick tests or allergen-specific IgE tests to confirm the underlying cause of AR.

Furthermore, it was reported that untreated AR can progress to asthma (Khayat et al., 2021). Douglass et al., (2022) have performed a multicenter study to recognize risk factors for Thunderstorm (TS) asthma among adults with seasonal allergic rhinitis (SAR) in Melbourne, Australia. They noticed increased incidence of TA among AR patients and recommend patient-specific treatment for cases of AR.

Finally, by knowing the prevalence of AR, common allergens, main manifestations and their effects on the daily activities in Al-Jouf region local community can be easily reflected in the preparation of public health initiatives and strategies to help residents to avoid or overcome these risk factors. Higher level of awareness is needed because of its indirect impact on early seeking medical attention in time-critical illness.

5. CONCLUSION

Allergic rhinitis is a common illness in Al-jouf region, Saudi Arabia. It has a great impact on the patient quality of life. Health education programs are required to raise community awareness about AR risk factors and how to avoid them.

Ethical approval

The study was approved by the local committee for bioethics (LCBE) of Jouf University (LCBE No: 20-16-9/40, 2019).

Authors' contribution

All authors shared in the distribution of the questionnaire, collection of data, and statistical analysis. All authors have prepared the manuscript and shared in the manuscript's revision.

Funding

This study has not received any external funding.

Conflicts of interest

The authors declare that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Alanazy S, Alenezi M, Al-Quniabut I, Al-Juraifani I, Alburayh M, Altuaysi A, Alyahya Y, Al-Homaidan H, Al-Wutayd O. Patterns of allergic rhinitis among adults in Qassim region, Saudi Arabia: a cross sectional study. *Pan Afr Med J* 2021; 40:70. doi: 10.11604/pamj.2021.40.70.30719. PMID: 34804338; PMCID: PMC8590280.
2. Almezizia AA, AlEsa RK, Alwusaidi KM, Alzamil KA, AlJumah M, Aljohani S, Almutairi AF, Salam M. Allergic rhinitis: Disease characteristics and coping measures in Saudi Arabia. *PLoS One* 2019; 14(6):e0217182. doi: 10.1371/journal.pone.0217182. PMID: 31242201; PMCID: PMC6594581.

3. Alqahtani JM. Asthma and other allergic diseases among Saudi schoolchildren in Najran: the need for a comprehensive intervention program. *Ann Saudi Med* 2016; 36(6):379-385. doi: 10.5144/0256-4947.2016.379. PMID: 27920408; PMCID: PMC6074205.
4. Alqahtani JM. Atopy and allergic diseases among Saudi young adults: A cross-sectional study. *J Int Med Res* 2020; 48(1):300060519899760. doi: 10.1177/0300060519899760. PMID: 32008405; PMCID: PMC7113719.
5. Alruwaili YS, Hammad SM, Elwan A. Prevalence of allergic rhinitis among female secondary school students, in Arar city, Saudi Arabia. *Medical Science* 2021; 25(108):363-373
6. Badran HS, Hussein A, Salah M, Lotfi WT. Identification and Prevalence of Allergic, Nonallergic, and Local Allergic Rhinitis Patients in Western Area, Saudi Arabia. *Ann Otol Rhinol Laryngol* 2016; 125(8):634-43. doi: 10.1177/0003489416642785. Epub 2016 Apr 11. PMID: 27067153.
7. Brożek JL, Bousquet J, Agache I, Agarwal A, Bachert C, Bosnic-Anticevich S, Brignardello-Petersen R, Canonica GW, Casale T, Chavannes NH, Correia de Sousa J, Cruz AA, Cuello-Garcia CA, Demoly P, Dykewicz M, Etzeandía-Ikobaltzeta I, Florez ID, Fokkens W, Fonseca J, Hellings PW, Klimek L, Kowalski S, Kuna P, Laisaar KT, Larenas-Linnemann DE, Lødrup Carlsen KC, Manning PJ, Meltzer E, Mullol J, Muraro A, O'Hehir R, Ohta K, Panzner P, Papadopoulos N, Park HS, Passalacqua G, Pawankar R, Price D, Riva JJ, Roldán Y, Ryan D, Sadeghirad B, Samolinski B, Schmid-Grendelmeier P, Sheikh A, Togias A, Valero A, Valiulis A, Valovirta E, Ventresca M, Wallace D, Wasserman S, Wickman M, Wiercioch W, Yepes-Nuñez JJ, Zhang L, Zhang Y, Zidarn M, Zuberbier T, Schünemann HJ. Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines-2016 revision. *J Allergy Clin Immunol* 2017; 140(4):950-958. doi: 10.1016/j.jaci.2017.03.050. Epub 2017 Jun 8. PMID: 28602936.
8. Cao Y, Wu S, Zhang L, Yang Y, Cao S, Li Q. Association of allergic rhinitis with obstructive sleep apnea: A meta-analysis. *Medicine (Baltimore)*. 2018; 97(51):e13783. doi: 10.1097/MD.00000000000013783. PMID: 30572534; PMCID: PMC6319794.
9. Douglass JA, Lodge C, Chan S, Doherty A, Tan JA, Jin C, Stewart A, Southcott AM, Gillman A, Lee J, Csutoros D, Hannan L, Ruane L, Barnes S, Irving L, Harun NS, Lachapelle P, Spriggs K, Sutherland M, See K, McDonald CF, Conron M, Radhakrishna N, Worsnop C, Johnston FH, Davies JM, Bryant V, Iles L, Ranson D, Spanos P, Vicendese D, Lowe A, Newbiggin EJ, Bardin P, Dharmage S. Thunderstorm asthma in seasonal allergic rhinitis: The TAISAR study. *J Allergy Clin Immunol* 2022; 149(5):1607-1616. doi: 10.1016/j.jaci.2021.10.028. Epub 2021 Nov 11. PMID: 34774618.
10. Hasnain SM, Alqassim A, Hasnain S, Al-Frayh A. Emerging status of asthma, allergic rhinitis and eczema in the Middle East. *J Dis Glob Health* 2016; 7: 128-36.
11. Hussain SM, Farhana SA, Alnasser SM. Time trends and regional variation in prevalence of asthma and associated factors in Saudi Arabia: a systematic review and meta-analysis. *Biomed Res Int* 2018; 2018:8102527. doi: 10.1155/2018/8102527. PMID: 29951546; PMCID: PMC5989288.
12. Jenerowicz D, Silny W, Dańczak-Pazdrowska A, Polańska A, Osmola-Mańkowska A, Olek-Hrab K. Environmental factors and allergic diseases. *Ann Agric Environ Med* 2012; 19(3):475-81. PMID: 23020042.
13. Kar M, Bayar Muluk N, Bafaqeeh SA, Cingi C. Consensus on the methodology for experimental studies in allergic rhinitis. *Int J Pediatr Otorhinolaryngol* 2019; 121:68-71. doi: 10.1016/j.ijporl.2019.03.009. Epub 2019 Mar 9. PMID: 30877977.
14. Khayat AM, Almalki MM, Almalki AA, Alhumyani MM, Altalhi NS, Alqurashi RD, Alqurashi AM, Alzahrani KT. Risk factors of asthma among the Saudi pediatric population between 1 and 15 years old. *Medical Science* 2021; 25(118):3242-3250
15. Kim DH, Park Y-S, Ji Jang H, Kim JH, Lim DH. Prevalence and Allergen of Allergic Rhinitis in Korean Children. *Am J Rhinol Allergy* 2016; 30(3):e72-e78. doi:10.2500/ajra.2013.27.4317
16. Krouse HJ, Davis JE, Krouse JH. Immune mediators in allergic rhinitis and sleep. *Otolaryngol Head Neck Surg* 2002; 126(6):607-13. doi: 10.1067/mhn.2002.125300. PMID: 12087326.
17. Lin J, Gao J, Lai K, Zhou X, He B, Zhou J, Wang C. The characteristic of asthma control among nasal diseases population: Results from a cross-sectional study. *PLoS One* 2018; 13(2):e0191543. doi: 10.1371/journal.pone.0191543.
18. Salo PM, Calatroni A, Gergen PJ, Hoppin JA, Sever ML, Jaramillo R, Arbes SJ Jr, Zeldin DC. Allergy-related outcomes in relation to serum IgE: results from the National Health and Nutrition Examination Survey 2005-2006. *J Allergy Clin Immunol* 2011; 127(5):1226-35.e7. doi: 10.1016/j.jaci.2010.12.1106.
19. Seidman MD, Gurgel RK, Lin SY, Schwartz SR, Baroody FM, Bonner JR, Dawson DE, Dykewicz MS, Hackell JM, Han JK, Ishman SL, Krouse HJ, Malekzadeh S, Mims JW, Omole FS, Reddy WD, Wallace DV, Walsh SA, Warren BE, Wilson MN, Nnacheta LC; Guideline Otolaryngology Development Group. AAO-HNSF. Clinical practice guideline: Allergic rhinitis. *Otolaryngol Head Neck Surg* 2015; 152(1 Suppl):S1-43. doi: 10.1177/0194599814561600. PMID: 25644617.

20. Sinha B, Vibha, Singla R, Chowdhury R. Allergic Rhinitis: A neglected disease - A community-based assessment among adults in Delhi. *J Postgrad Med* 2015; 61(3):169-75. doi: 10.4103/0022-3859.159418.
21. Small P, Keith PK, Kim H. Allergic rhinitis. *Allergy Asthma Clin Immunol* 2018; 14: 51. doi: 10.1186/s13223-018-0280-7
22. Stevens WW, Schleimer RP, Kern RC. Chronic Rhinosinusitis with Nasal Polyps. *J Allergy Clin Immunol Pract* 2016; 4(4):565-72. doi: 10.1016/j.jaip.2016.04.012. PMID: 27393770; PMCID: PMC4939220.
23. Zhang Y, Zhang L. Prevalence of allergic rhinitis in China. *Allergy Asthma Immunol Res* 2014; 6(2):105-13. doi: 10.4168/aair.2014.6.2.105.