Prevalence of unified airway disease in Saline Water Conversion Corporation Society

Osama A Elsayad[a], Ayman Khater[b]

[a]Department of otolaryngology, Benha University, Benha 13111, Egypt, [b]Pulmonology, Department, dr. Samir Abbas Hospital, Jeddah 23411, KSA

Correspondence to Osama A Elsayad , MD, Department of Otolaryngology, Benha University, Benha, 13111. Egypt.
e-mail: drsayado@yahoo.com

Received 05 December 2020
Revised 22 January 2021
Accepted 18 May 2021
Published 31 March 2022

Pan Arab Journal of Rhinology
2021, 11:105–109

Background
Saline Water Conversion Corporation (SWCC) is the main source of water in the Red Sea coast in Jeddah, KSA, the workers and their families are exposed to vapor and chemicals that affect their upper respiratory tract.

Aim
Our aim was to study the prevalence of unified airway disease [allergic rhinitis (AR) and bronchial asthma] in SWCC Society accommodations, serum immunoglobulin E (IgE) level and its relation to the duration of bronchial asthma, and duration of living in the accommodations.

Patients and methods
This randomized study included 400 patients with bronchial asthma, the included patients comprised two groups: group I (GI) (*n*=200) from SWCC Society accommodations and group II (GII) (*n*=200) patients from outside the accommodations.
Both groups were classified according to Allergy Classification of allergic rhinitis and its impact on asthma and blood samples for IgE taken from them.

Results
According to the classification of allergic rhinitis and its impact on asthma, the persistent and moderate–severe allergy were more common in GI (80%) and the intermittent allergy and mild severity was 20%, while the persistent and moderate–severe allergy were less common in GII (22%) and the intermittent allergy and mild severity was 78%.
GI patients experienced a significantly high IgE level compared with GII, higher in males than females, and increases with the duration of living in the accommodations and duration of bronchial asthma.

Conclusion
Unified airway disease is common in SWCC Society with a high level of IgE compared with outside the accommodations.

Keywords:
allergic rhinitis, bronchial asthma, environmental diseases, serum total immunoglobulin E

Pan Arab J Rhinol 11:105–109

Introduction

Allergic rhinitis (AR) is affecting 10–20% of the population, and evidence suggests that the incidence of the disorder is increasing [1,2]. Severe AR has been associated with significant impairments in quality of life, sleep, and work performance [3].

Occupational rhinitis

Occupational rhinitis is understood as inflammatory disease of the nose with intermittent or persistent symptoms than nasal obstruction, nasal secretion, sneezing, and pruritus when exposed to a particular work environment and not to stimuli outside the workplace [4]. The prevalence of occupational rhinitis is hidden maybe due to high-risk professions, including laboratory or food-processing workers, farmers, and workers in various industries [5]. Occupational rhinitis commonly occurs in the first 3 years of employment. It is to be immunoglobulin E (IgE)-mediated due to allergen sensitization, or due to exposure to respiratory irritants. Some studies suggest that occupational rhinitis will progress to occupational asthma with time of exposure [6,7].

Occupational bronchial asthma

Workers in various industries and occupations are at risk for work-related asthma [8]. Data from the 2005 to 2008 adult Asthma Call-Back Survey, in asthma survey conducted with respondents who report an asthma diagnosis, from 35 states, indicated that up to 49% of adult current asthma might be related to work

and could be prevented [9]. At the time of the survey, they were employed or had been out of work for less than 14 months. Among these respondents, 7.8% had current asthma; based on the Asthma Call-Back Survey results, optional asthma modules can be used to identify industries and occupations to assess for asthma among workers, identify workplace exposures, and guide the design and evaluation of effective work-related asthma prevention and education programs [10].

Unified airway disease, the one-airway, one-disease hypothesis proposes that the upper and lower airways share the same physiology and histomorphology [11].

Saline Water Conversion Corporation (SWCC) could be a Saudi Company Corporation to blame for desalinating ocean water, for offering of potable water to cities within the kingdom [12,13].

Patients and methods

The present randomized study was conducted at a private hospital in Jeddah, Kingdom of Saudi Arabia. The study protocol was approved by the local ethical committee and all patients gave informed consent before participation. The study included group I (GI) (n=200) patients diagnosed as bronchial asthma, from SWCC Society accommodations, and group II (GII) (n=200) patients diagnosed as bronchial asthma outside the SWCC Society accommodations.

Inclusion criteria: the patients were diagnosed as bronchial asthma after clinical examination and pulmonary function test, including forced expiratory volume in 1 s, forced vital capacity, peak expiratory flow, and airway hyperresponsiveness, without any other pulmonary diseases.

All the patients were subjected to complete history and examination to exclude any other types of allergy, except for nasal symptoms for AR.

The clinical history of AR includes continual excessive sneezing, nasal itching, nasal discharge, or nasal congestion or obstruction.

Exclusion criteria: enclosed current steroids and/or antihistamine ingestion and the presence of skin-allergic reaction.

Fibro-optic examination is done for all patients demonstrating pale and edematous nasal mucosa, watery nasal discharge, and swollen inferior turbinates. The patients diagnosed as AR are classified according to allergic rhinitis and its impact on asthma (AIRA) classification (Table 1).

Blood sample collection: an ELISA kit, Human Diagnostics (Germany, catalog number # 51005, Jeddah), was used for total IgE measurement. The test used the WHO IgE standards to be a benchmark.

In our study, we will compare the IgE level in both groups according to different durations of occupational exposure and those of asthma.

Statistical analysis

The results of the present study were presented as number and percent or mean and SDs. Numerical data were compared using t test, while categorical data were compared using χ^2 test. All statistical calculations were achieved using SPSS 25 (IBM, Chicago, Illinois, USA). P value less than 0.05 was considered statistically significant.

Results

The present study includes 400 patients with bronchial asthma; GI from SWCC Society accommodations were 200, their age ranged from 16 to 59 years, 72 females and 128 males (test group) and GII, 200 patients outside accommodations had bronchial asthma with AR with age that ranged from 17 years up to 60 years, 78 females and 122 males (control group), both groups diagnosed as AR according to AIRA classification.

Figure 1 showed the prevalence of unified airway in GI (64.31%), while in GII was 31.84%.

Table 2 showed values for total IgE plasma levels (IU/ml) between the studied groups according to AIRA classification; in test GI, was significant, intermittent patients (162.3±92.0), persistent (283.9±133.9), and mild severity (412.3±231.6) and moderate/severe (609+338.5) versus control GII intermittent patients (76.6±47.2), persistent (158±86.8), and mild severity (215.7±135) and moderate/severe (325.0±195.0) (P<0.0001) [Table 2].

Figure 2 showed that males are superior to females as regards mean total IgE (IU/ml) level in both

Table 1 Classification of allergic rhinitis and its impact on asthma

Classification	Definition
Intermittent	Symptoms <4 days/week or <4 consecutive weeks
Persistent	Symptoms >4 days/week or >4 consecutive weeks
Mild severity	No sleep disturbance, no impairment of daily activities, and symptoms present but not troublesome
Moderate/severe	Sleep disturbance, impairment of daily activities, and troublesome symptoms

Table 2 Mean values of total immunoglobulin E plasma levels in patients with allergic rhinitis according to allergic rhinitis and its impact on asthma classification

	Group I [*n* (%)]	Mean IgE	Group II [*n* (%)]	Mean IgE	*P*
Intermittent	12 (6)	162.3±92.0	72 (36)	76.6±47.2	<0.0001
Persistent	100 (50)	283.9±133.9	16 (8)	158±86.8	<0.0001
Mild severity	28 (14)	412.3±231.6	88 (44)	215.7±135.1	<0.0001
Moderate/severe	60 (30)	609 + 338.5	24 (12)	325.0 ± 195.0	<0.0001

IgE, immunoglobulin E.

Table 3 Mean values of total immunoglobulin E plasma levels in patients with allergic rhinitis according to bronchial asthma duration

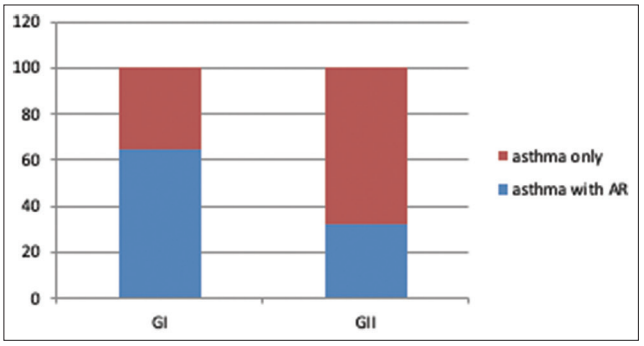
Bronchial asthma duration	Group I	Group II	*P*
1-2 years	261.0±152.0	160.1±115.0	<0.0001
2-4 years	488.0±190.0	201.7±123.0	<0.0001
4-6 years	543.0±0.310.0	250.2±144.0	<0.0001
Above 6 years	609.7 ± 385.0	292.6 ± 186.0	<0.0001

groups (413.0±143.0 vs. 293.9±108.0) (*P*<0.0001), and also as regards the group of age up to 30 years and group above 30 years in both groups (*P*<0.0001), while there was no significant difference in the mean age (32.2±22.8 vs. 39.2±27.8) (*P*>0.05).

Table 3 showed mean values of total IgE plasma levels (IU/ml) in patients with AR according to bronchial asthma duration. In patients with bronchial asthma (1–2 years), GI was 160.1±115.0 versus 261.0±152.0, in GII, in patients with bronchial asthma 2–4 years, GI 201.7±123.0 versus 488.0±190.0 in GII, and in the group with duration 4–6 years, GI was 250.2±144.0 versus GII 543.0±0.310.0 and in duration above 6 years, GI 292.6±186.0 versus 609.7±385.0 in GII, the difference between GI and GII was significant (*P*<0.0001).

Figure 3 showed that there is a significant increase in IgE level in the test group with more years living in accommodations of the SWCC Society (231.0±132.0, 428.0±180.0, and 513.0±0.298.0 vs. 590.7±375.0) (*P*<0.0001).

Figure1



Prevalence of unified airway disease in both groups.

Discussion

The relation between AR and asthma has been reported in the literature [14]. There is a considerable variation in the observed prevalence of AR in patients with asthma globally, with a nearly 55% prevalence being reported in the United States and Europe. Also, there was high prevalence in the International Study of Asthma and Allergies in Childhood conducted in 56 countries [15].

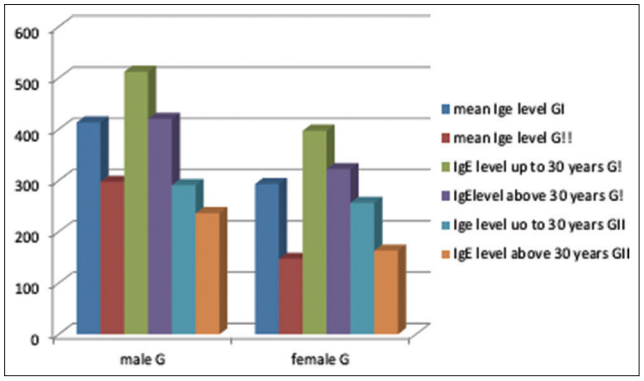
Our study showed that males have a higher prevalence of unified airway disease as compared with females in all patients. Similar results were seen in a Finnish study [16], where the risk of AR was significantly higher in males than in females, which agrees with Tsao *et al.* [17] who concluded the same results due to exposing to pollution in industries more in males.

The aim of this study was to determine whether total IgE plasma levels differed between bronchial asthma patients with AR from SWCC accommodations and the control group outside the accommodation. Antibodies belonging to the test group are produced in response to allergenic environmental stimuli and their concentrations and specificities are strongly associated with various manifestations of allergies; our results are in agreement with other studies that evaluated IgE level in Brazilian people according to age and environmental effects [18].

In our study, we concluded that the persistent AR and moderate–severe type according to AIRA classification are more in the bronchial asthma patients with AR from SWCC accommodations, while it was less in number in patients with AR from outside SWCC accommodation, which agrees with Park [19] who concluded that smoke and industrial pollution are known risk factors that increase the prevalence of respiratory diseases.

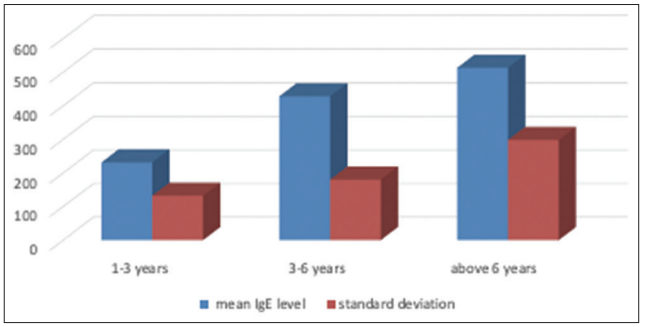
Moreover, our study concluded that in SWCC accommodations, people are exposed to air pollution as waste products of the machines use fuel to work, which predisposes to AR and bronchial asthma with duration of exposure that is higher, which agrees with studies that concluded that in China, the number of asthma cases increased rapidly since the early 2000s.

Figure2



IgE level between males and females and age groups. IgE, immunoglobulin E.

Figure3



Mean IgE levels according to duration of living in accommodations. IgE, immunoglobulin E.

Researchers have published several epidemiologic studies on the association between ambient pollutants and asthma prevalence [20].

In addition, our study noted that the effect of diesel fuel and carbon increases the rate of AR in bronchial asthma patients and total IgE level increases with the duration of living in SWCC accommodations, which agrees with studies that concluded that occupational nasal allergy with asthma (OA) is often underdiagnosed and underreported, and if unrecognized, can lead to progression of disease and increased morbidity [21]. Sensitizers to occupational asthma are of two types: high-molecular-weight compounds and low-molecular-weight compounds [22]. The most common causes of unified airway disease are agents that include floor dust, enzymes (plant-and animal-derived), gums, foods, tobacco, rubber-derived proteins, insect-derived allergens, acid anhydrides, metals, and a spectrum of chemical substances. Diagnosis of bronchial asthma has an effect on the future employment and health, but this should be considered to keep in mind that a careful history of work-related exposures is included in evaluation of a patient with chronic cough, asthma, and AR.

Conclusion

Unified airway disease is common in SWCC with a high level of IgE compared with outside the accommodations.

IgE levels are higher in males than females, increased with a long duration living in the accommodation, and increased with a long-duration history of asthma.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1 Small P, Keith PK, Kim H. Allergic rhinitis. Allergy Asthma Clin Immunol 2018; 14(Suppl 2):51.

2 Dykewicz MS, Hamilos DL. Rhinitis and sinusitis. J Allergy Clin Immunol 2010; 125:S103–S115.

3 Bourdin A, Gras D, Vachier I, Chanez P. Upper airway 1: allergic rhinitis and asthma: united disease through epithelial cells. Thorax2009; 64:999–1004.

4 Hu W, Ma L, Yang G, Zeng X, Liu J, Cheng B, *et al*. Der p2-A20 DNA vaccine attenuates allergic inflammation in mice with allergic rhinitis. Mol Med Rep 2019; 20:4925–4932,

5 Moscato G, Vandenplas O, Van Wijk RG, Malo JL, Perfetti L, Quirce S, *et al*. European Academy of Allergology and Clinical Immunolgy EAACI position paper on occupational rhinitis. Respir Res 2009; 10:16.

6 Jang JH, Kim DW, Kim SW, Kim DY, Seong WK, Son TJ, *et al*. Allergic rhinitis in laboratory animal workers and its risk factors. Ann Allergy Asthma Immunol 2009; 102:373–377.

7 Yu S, Han B, Liu S, Wang H, Zhuang W, Huang Y. Ruxin, Derp1-modified dendritic cells attenuate allergic inflammation by regulating the development of T helper type 1(Th1)/Th2 cells and regulatory T cells in a murine model of allergic rhinitis. Mol Immunol 2017; 90:172–181.

8 Tunde-Ayinmode MF. Children with bronchial asthma assessed for psychosocial problems in a teaching hospital in Nigeria. Afr Health Sci 2015; 15:690–700.

9 Dodd KE, Mazurek JM. Asthma among employed adults, by industry and occupation — 21 states, 2013. MMWR Morb Mortal Wkly Rep 2016; 65:1325–1331.

10 Knoeller GE, Mazurek JM, Moorman JE. Work-related asthma among adults with current asthma in 33 states and DC: evidence from the Asthma Call-Back Survey, 2006–2007. Public Health Rep 2011; 126:603-

11 Baumann LM, Romero KM, Robinson CL, Hansel NN, Gilman RH, Hamilton RG. Prevalence and risk factors for allergic rhinitis in two resource-limited settings in Peru with disparate degrees of urbanization. Clin Exp Allergy 2015; 45:192–199.

12 Al-Ghamdi BR, Koshak EA, Omer FM, Awadalla NJ, Mahfouz AA, Ageely HM. Immunological factors associated with adult asthma in the Aseer Region, Southwestern Saudi Arabia. Int J Environ Res Public Health 2019; 16:2495.

13 Naclerio R, Ansotegui IJ, Bousquet J, Canonica W, D'Amato G. International expert consensus on the management of allergic rhinitis (AR) aggravated by air pollutants. World Allergy Organ J 2020; 13:100106.

14 Egan M, Bunyavanich S. Allergic rhinitis: the 'Ghost diagnosis' in patients with asthma. Asthma Res Pract 2015; 1:8.

15 Jaggi V, Dalal A, Ramesh BR, Tikkiwal S, Chaudhry A, Kothari N, *et al*. Coexistence of allergic rhinitis and asthma in Indian patients: The CARAS survey. Lung India 2019; 36:411–416.

16 Finnish A, Incorvaia C, Cavaliere C, Frati F, Masieri SJ. Allergic rhinitis. Biol Regul Homeost Agents 2018; 32 (1 Suppl. 1):61–66.

17 Tsao SM, Ko YK, Chen MZ, Chiu MH, Lin CS, Lin MS, *et al*. A survey of allergic rhinitis in Taiwanese asthma patients. J Microbiol Immunol Infect 2011; 44:139–143.

18 Peres de Paula Couto TA, Falsarella N, de Cássia Brandão de Mattos C, de Mattos LC. Total IgE plasma levels vary according to gender and age in Brazilian patients with allergic rhinitis. Clinics (Sao Paulo) 2014; 69:740–744.

19 Park S, Jung PK, Choi M, Seok H, Kim H, Oh SS, *et al*. Association between occupational clusters and allergic rhinitis in the Korean population: analysis of the Korean National Health and Nutrition Examination Survey data. J Occup Health 2018; 60:312–319.

20 Maoua M, El Maalel O, Kacem I, Guedri S, Ben Kacem M, Aissa S, *et al*. Quality of life and work productivity impairment of patients with allergic occupational rhinitis. Tanaffos 2019; 18:58–65.

21 Shrine N, Portelli MA, John C, Soler Artigas M, Bennett N. Moderate-to-severe asthma in individuals of European ancestry: a genome-wide association study. Lancet Respir Med 2019; 7:20–34.

22 Murrison LB, Brandt EB, Myers JB, Gurjit K. Environmental exposures and mechanisms in allergy and asthma development. J Clin Invest 2019; 129:1504–1515.

23 Magzoub AA, Musa OA, Elsony AE, Alawad AO, Dawod OY. Validation of themodifiedInternational Study of Asthma and Allergies in Childhood questionnaire: is wheeze alone enough for determination of asthma symptoms prevalence?. Int J Med Sci Public Health 2017; 6:775–779.