Original Article / Çalışma - Araştırma

The effects of dust storms on quality of life of allergic patients with or without asthma

Kum fırtınalarının astımı olan veya olmayan alerjik hastaların yaşam kalitesi üzerindeki etkileri

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ABSTRACT

Objectives: This study aims to investigate the quality of life of allergic patients with or without asthma during dust storms.

Patients and Methods: A total of 148 allergic patients (66 males, 82 females; mean age 35.7±15.5 years; range 18 to 65 years) were classified as those with (group 1, n=80) or without (group 2, n=68) concomitant asthma between January 2012 and January 2013. The quality of life [Short Form-36 (SF-36)] scores, Rhinoconjunctivitis Quality of Life Questionnaire (RQLQ), nasal symptom and visual analog scale (VAS) scores at the time of diagnosis were obtained. The particulate matter (PM10) and sulfur dioxide (SO_2) values of that day from the General Directorate of Meteorology were recorded. The day of dust storm and PM10 and SO_2 measurements along with SF-36, RQLQ, nasal symptom and VAS scores were recorded again.

Results: The absolute change in the RQLQ subparameters including eye and nasal symptoms, practical problems and global scores was statistically significant (p=0.022, p=0.036, p=0.026 and p=0.032, respectively). There were statistically significant changes in the SF-36 subgroups of general health, physical functioning, vitality, and mental health (p=0.026, p=0.042, p=0.008 and p=0.026, respectively). In the multivariate logistic regression model, specific and general quality of life was 4.6 times worse in RQLQ and 3.8 times in SF-36 after the dust storm in patients with asthma, while 2.1 times worse in RQLQ and 1.9 times in SF-36 in patients with pure allergic rhinitis. The attributable risk of asthma was found to be 2.5 times higher in RQLQ and 1.9 times higher in SF-36.

Conclusion: Dust storms may deteriorate the quality of life of patients with allergic rhinitis and asthma and lead to related personal and societal problems.

Keywords: Allergic rhinitis; asthma; dust storm; particulate matter; quality of life.

ÖZ

Amaç: Bu çalışmada kum fırtınaları sırasında astımı olan veya olmayan alerji hastalarının yaşam kalitesi araştırıldı.

Hastalar ve Yöntemler: Ocak 2012 - Ocak 2013 tarihleri arasında toplam 148 alerjik hasta (66 erkek, 82 kadın; ort. yaş: 35.7±15.5 yıl; dağılım 18-65 yıl), eşlik eden astımı olan (grup 1, n=80) veya olmayanlar (grup 2, n=68) olarak sınıflandırıldı. Tanı esnasında yaşam kalitesi [Kısa Form-36 (KF-36)] skorları, rinokonjonktivit yaşam kalitesi anketi (RQLQ), nazal semptom ve görsel analog ölçeği (GAÖ) skorları hesaplandı. Meteoroloji Genel Müdürlüğü'nden o güne ait parçacıklı madde (PM10) ve sülfür dioksit (SO_2) değerleri kaydedildi. O güne ait kum fırtınası ve PM10 ve SO_2 ölçümleri, KF-36, RQLQ, nazal semptom ve GAÖ skorları ile birlikte tekrar kaydedildi.

Bulgular: Göz ve burun semptomları, uygulama sorunları ve global skorlar dahil RQLQ'nin alt parametrelerinde görülen mutlak değişiklik istatistiksel olarak anlamlı idi (sırasıyla p=0.022, p=0.036, p=0.026 ve p=0.032). Kısa Form-36'nın genel sağlık, fiziksel fonksiyon, canlılık ve mental sağlık alt gruplarında istatistiksel olarak anlamlı değişiklikler vardı (sırasıyla p=0.026, p=0.042, p=0.008 ve p=0.026). Çok değişkenli lojistik regresyon modelinde, kum fırtınası sonrasında astım hastalarının spesifik ve genel yaşam kalitesi RQLQ'de 4.6 kat ve KF-36'da 3.8 kat daha kötü iken, sadece alerjik riniti olan hastalarda RQLQ'de 2.1 ve KF-36'da 1.9 kat daha kötü idi. Atfedilebilir astım riski, RQLQ'de 2.5 kat, KF-36'da 1.9 kat daha yüksek bulundu.

Sonuç: Kum fırtınaları alerjik rinit ve astım hastalarının yaşam kalitesini kötüleştirebilir ve ilişkili kişisel ve toplumsal sorunlar yaratabilir.

Anahtar Sözcükler: Alerjik rinit; astım; kum fırtınası; parçacıklı madde; yaşam kalitesi.

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Rhinitis is a very prevalent chronic disease that compromises quality of life (QoL). The most prominent signs of rhinitis are itching in the nasal cavity, sinusal stuffiness, and sneezing that lasts for at least one hour.[1] The incidence of allergic rhinitis varies among populations, but 10-25% of subjects are generally thought to be affected. Association with asthma is not unusual. In allergies occurring with or without asthma, one of the most important factors triggering rhinitis is exposure to allergens and/or air pollution. Particles released into the atmosphere via natural and artificial (anthropogenic) means cover long distances spread by prevailing winds, and affect regional and global air quality.

Every year, desert dust storms disperse 2.2 billion cubic meters of soil into the atmosphere. Dust "rains" in Europe and West Asia originate in the Sahara Desert.[2] Thus, not only the living environment, but atmospheric movements of allergens (increasing allergen variety) can aggravate symptoms in atopic patients, negatively affecting QoL including physical, social, and emotional activities.[3,4] These effects trigger ever-higher economic burdens caused by expenditures on therapeutic and diagnostic procedures, loss of work productivity, and poor school performance.[5,6]

In the present study, we aimed to investigate the effects of dust storms, which are common worldwide, on the QoL of patients with allergic rhinitis with or without asthma.

PATIENTS AND METHODS

This prospective study was approved by Dr. Behçet Uz Children Hospital Institutional Review Board with the number: B-10-4-ISM-4-35-65-72. Written informed consent was obtained from each patient, and the study was conducted in accordance with the principles of the Declaration of Helsinki. One hundred forty-eight allergic patients (66 males, 82 females; mean age 35.7±15.5 years; range 18 to 65 years) who presented between January 2012 and January 2013 to our Ear Nose and Throat Clinic outpatient clinics with symptoms of allergic rhinitis (as confirmed by the skin prick test and the ARIA 2012 treatment guidelines)[7] at least three years in duration were included. All patients had moderate to severe conditions, based on the ARIA guidelines. All patients were evaluated in our Department of Chest Diseases for concomitant asthmatic disease. Patients with allergic rhinitis were subdivided into those with (group 1, n=80) or without concomitant asthma (group 2, n=68).

Asthma diagnoses were made by a specialist in chest diseases based on physical findings and respiratory function test (RFT) results (www.ginastma.org; update of 2010). An increase of more than 120 mL in the FEV_1 value after use of a bronchodilator inhaler, compared to the pre-treatment level, indicated that asthma was present. In the same patients, FEV_1/FVC ratios >70% after symptom reversal were considered to indicate the presence of an obstruction. All patients were interviewed and data on age, gender, annual income, RFT results, educational level, smoking status, and the presence of past and/or current depression and atopic dermatitis, were recorded. Quality of life [short form 36 (SF-36)] scores, rhinoconjunctivitis QoL questionnaire (RQLQ) scores, and nasal symptom visual analog scale (VAS) scores were recorded at the time of diagnosis. The atmospheric PM10 and sulfur dioxide (SO_2) values on the days of diagnosis were obtained from the General Directorate of Meteorology.

In collaboration with the Directorate of Meteorology, days on which dust storms would occur were predicted and patients were asked to visit again on the second day of each dust storm. At these times, PM10 and SO_2 values obtained from the General Directorate of Meteorology were recorded, as were QoL, RQLQ, and nasal symptom scores. All patients were examined after both of the two dust storms that occurred during the period of the study and the two sets of data were evaluated.

Patients who had received immunotherapy, who had undergone nasal surgery, who lacked a chronic condition, who were pregnant, or for whom follow-up data were lacking, were not included. In addition, patients with upper respiratory tract infections at the times of dust storms were also excluded.

Data of atmospheric dust concentrations were obtained from the Ministry of the Environment and City Planning.

PM10 and Meteorological Data: PM10 measurements were performed at Air Quality Control Stations of the Laboratories of Air Quality Control and Research, Ministry of

Environment and Forestry, on March 7 and October 18, 2013; on these days, dense Sahara desert dust-derived storm drift occurred in our country. Dust transport events were observed in real time, via satellite. Quality of life scores and climatic conditions in regions almost devoid of industrial activity were compared on the days of dust storms.

Statistical analysis

Data were analyzed using the Windows statistical package of SPSS version 16.0 (SPSS Inc., Chicago, IL, USA). Changes in QoL scores were calculated for all patients. The normal distribution of RQLQ scores was verified using the Kolmogorov-Smirnov test. The *p* value was higher than 0.05, indicating that there was no significant between-group difference in data distribution. One-way analysis of variance (ANOVA) was used to analyze repeated variables. The differences between RQLQ estimates obtained pre-dust storms (PrDS) and post-dust storms (PoDS) were also compared. The matched pairs t-test was used to analyze intragroup differences between PrDS and PoDS values. To compare intergroup differences between values estimated after dust storms (the PoDS values), we first corrected the data using pre-storm values and evaluated the results via covariance analysis. The effect of asthma was studied in RQLQ subtypes that were significantly different in ANOVA analyses. The applicability of the SF-36 test in various subgroups was evaluated using the Kolmogorov-Smirnov test. As normality of distribution was not an issue, non-parametric methods were preferred when analyzing SF-36 data. The Mann-Whitney U-test was used to perform intergroup comparisons of PoDS values. In each SF-36 subgroup, changes between pre- and post-dust storm values were analyzed using Wilcoxon's test. In addition, intergroup differences in the PrDS-minus-PoDS values of each SF-36 subgroup were calculated and their significance was evaluated using

Table 1. Comparison of the demographic characteristics, clinical, and social findings in the two groups (n=148)

Variables	Group 1 (n=80)			Group 2 (n=68)			*p*
	n	%	Mean±SD	n	%	Mean±SD	
Demographics							
Age (years)			34.28±18.14			36.42±16.08	0.485
Gender							
Female	46			36			0.872
Male	34			32			
Education (years)			10.46±3.45			11.35±2.88	0.726
Yearly income							
0-10000 $	32			29			0.472
10001-20000 $	22			23			
20001-30000 $	19			10			
30001$<	7			6			
Body mass index (kg/m^2)							
<25	44	55		32	47		0.186
>25	36	45		36	53		
Clinical findings							
Atopic dermatitis	13			7			0.345
Social findings							
Cigarette (packs/days)							
Yes	26		0.8±0.56	32		1.0±0.42	0.688
No	54			34			
Alcohol (gram/week)							
Yes	8		12.45±8.36	9		13.28±7.02	0.562
No	72			59			

Group 1: Allergic rhinitis with asthma; Group 2: Allergic rhinitis without asthma; p<0.05 statistically significant; SD: Standard deviation.

Table 2. Mean pre- and post-dust storm values of visual analog scale scores for each group and p-values between and within groups

	Group 1		Group 2		
	Mean value	*p*	Mean value	*p*	*p*
Pre-dust storms	3.86	0.0001	3.42	0.0001	0.321
Post-dust storms	8.72	0.0001	7.15	0.0001	0.042

Group 1: Allergic rhinitis with asthma; Group 2: Allergic rhinitis without asthma; p<0.05 is statistically significant.

the Mann-Whitney U or Kruskal-Wallis tests. A clinically significant improvement (reflected by a change in RQLQ and SF-36) was taken to be a change of at least 0.5 SD of the baseline QoL scores. With this construct the improvement of each patient's general and specific QoL were determined. Risk factors influencing RQLQ and SF-36 were analyzed by univariate and multivariate logistic regression modeling.

RESULTS

Of all patients, 13.5% had atopic dermatitis (n=20). Demographic, clinical, social, and diagnostic data are shown in Table 1. When data from days with and without (control) dust storms were compared, only changes in PM10 values were significant (p=0.0001).

No significant difference was found between baseline VAS scores of groups in PrDS (p=0.321). However, in the PoDS comparison, group 1 VAS scores were significantly higher than those of group 2 (p=0.042) (Table 2).

When we analyzed nasal symptom scores (NSS) of patients during the PrDS period, nasal obstruction, rhinorrhea and pruritus were more frequently seen in group 1 patients with nasal obstruction (p=0.045, p=0.015, and p=0.006, respectively). However, during the pods period, the incidence of nasal obstruction, rhinorrhea, and sneezing were significantly higher in group 1 patients (p=0.038, p=0.044, and p=0.025, respectively). The rates of change in the NSS of groups 1 and 2 during the pre- and post-storm periods did not differ significantly (Table 3).

The RFT values revealed that pulmonary function was impaired to a greater extent in group 1 patients during the PrDS period. In addition, changes in the forced expiratory volume in 1 second (FEV_1)/forced vital capacity (FEV) ratio and the FEV_1 value in this group were statistically significant (p=0.044 and p=0.034, respectively). Absolute changes in intergroup RFT values were evaluated and significant differences were evident in both the FEV_1/FVC ratios and the FEV_1 values (p=0.036 and p=0.025, respectively).

All patients were evaluated in terms of specific QoL (RQLQ) scores during the PrDS and PoDS periods. The RQLQ subparameters of group 1 patients during both periods were poorer than those of group 2 patients. During PoDS periods, the highest RQLQ scores reflected nasal and eye symptoms (groups 1 and 2: 5.25 and 4.15; and 4.94 and 4.34, respectively). The RQLQ scores of group 1 patients with more serious nasal symptoms during PoDS periods were higher than those of group 2 (Table 4). The absolute changes in intergroup RQLQ subparameters (eye symptoms, nasal

Table 3. Mean pre- and post-dust storm values of symptom scores

Symptoms	Pre-dust storms			Post-dust storms			PrDS vs. PoDS
	Group 1	Group 2	Group 1 vs. group 2	Group 1	Group 2	Group 1 vs. group 2	
			p			*p*	*p*
Nasal obstruction	1.88	1.65	0.045	2.65	2.44	0.038	0.325
Sneezing	1.85	0.96	0.051	2.48	2.35	0.044	0.442
Rhinorrhea	1.15	1.02	0.015	2.56	2.42	0.025	0.275
Itching	1.74	1.56	0.006	2.45	2.54	0.062	0.348

Group 1: Allergic rhinitis with asthma; Group 2: Allergic rhinitis without asthma; p<0.05 is statistically significant; PrDS: Pre-dust storms; PoDS: Post-dust storms.

Table 4. Mean PrDS, PoDS and change in disease-specific outcome measures for patients group 1 and group 2 (n=148)

RQLQ domains	PrDS			PoDS			Absolute change
	Group 1	Group 2		Group 1	Group 2		
	Mean	Mean	*p	Mean	Mean	*p	**p
Emotions	4.02	3.74	0.0001	4.46	4.22	0.026	0.084
Eye symptoms	3.86	3.60	0.0001	5.25	4.15	0.012	0.022
Nasal symptoms	3.94	2.72	0.005	4.94	4.34	0.005	0.036
Non nasal symptoms	3.22	2.75	0.0001	4.52	4.14	0.002	0.444
Activities	3.12	2.74	0.013	3.85	3.64	0.005	0.332
Practical problems	3.28	2.56	0.0001	4.63	4.02	0.0001	0.026
Sleep	4.12	3.16	0.0001	4.82	3.96	0.0001	0.142
Global scores	3.65	3.03	0.002	4.63	4.09	0.005	0.032

RQLQ: Rhinoconjunctivitis quality of life questionnaire; PrDS: Pre-dust storms; PoDS: Post-dust storms; Group 1: Allergic rhinitis with asthma; Group 2: Allergic rhinitis without asthma; * Between PrDS and PoDS within the group 1 and group 2; ** Between the groups within the absolute change.

symptoms, practical problems, and global scores) were statistically significant (p=0.022, p=0.036, p=0.026, and p=0.032, respectively).

The SF-36 scale was used to measure overall QoL. The SF-36 scores were not comparable between groups and were thus evaluated via non-parametric testing. Correlations between SF-36 scores and patient grouping are summarized in Table 5. To evaluate absolute differences between groups, we calculated SF-36 scores of all subgroups. Significant differences in SF-36 scores of the general health, physical functioning, Vitality, and mental health subgroups were evident (p=0.026, p=0.042, p=0.008, and p=0.026, respectively).

Although statistically significant values were obtained in multiple parameters, the effect of asthma on worsening QoL could not be determined. To determine this, a logistic regression model was applied on one and multiple predictive factors that could possibly affect RQLQ and SF-36. On univariate analyses, logistic regression significant improvement in QoL was found in patients with atopic dermatitis and patients both with and without asthma (pure allergic rhinitis). (RQLQ: p=0.034, p=0.018, p=0.042) (SF-36: 0.028, p=0.044, p=0.008). After that, multivariate logistic regression was done with these three variables. With this model, worsening in the specific and general QoL was worse by 4.6 times in RQLQ and 3.8 times in SF-36 PoDS in patients with asthma; and worse by 2.1 times in RQLQ and 1.9 times in SF-36 in patients without asthma. Table 6 (RQLQ-asthma presence; 95% CI, 4.202-4.908; p=0.018,

Table 5. Mean pre-dust storms, post-dust storms and change in general health related quality of life domains for patients group 1 and group 2 (n=148)

	Pre-dust storms			Post-dust storms			Absolute change		
	Group 1	Group 2	*p*	Group 1	Group 2	*p*	Group 1	Group 2	*p*
SF-36 GH	58.6±22.5	54.2±24.5	0.144	44.1±28.4	49.1±22.7	0.562	14.5±26.5	5.1±22.6	0.026
SF-36 PF	71.2±16.5	76.2±17.6	0.652	55.1±25.6	67.2±18.9	0.442	16.1±15.8	9.0±14.2	0.042
SF-36 PR	52.5±28.9	60.6±28.1	0.186	35.5±28.8	49.2±23.2	0.248	17.0±35.1	11.4±26.4	0.088
SF-36 ER	75.6±23.2	78.1±15.4	0.442	57.2±20.4	64.9±18.7	0.174	18.4±32.1	13.2±38.1	0.069
SF-36 SF	73.4±22.9	75.8±16.8	0.254	60.8±17.7	67.4±18.2	0.142	12.6±22.5	8.4±27.2	0.235
SF-36 BP	68.2±21.8	70.6±25.4	0.128	62.7±19.7	73.8±15.6	0.328	5.5±26.3	3.2±24.2	0.156
SF-36 VT	54.2±30.2	60.8±21.9	0.294	34.5±26.8	49.6±26.4	0.701	19.7±22.5	11.2±16.6	0.008
SF-36 MH	74.1±23.6	72.1±20.9	0.098	55.1±24.9	63.8±25.7	0.542	19.0±14.3	8.3±25.8	0.026

Group 1: Allergic rhinitis with asthma; Group 2: Allergic rhinitis without asthma; SF-36: Short Form-36; GH: General health subscale; PF: Physical functioning subscale; PR: Physical role subscale; ER: Emotional role subscale; SF: Social functioning subscale; BP: Bodily pain subscale; VT: Vitality subscale; MH: Mental health subscale.

Table 6. Multivariant logistic regression analysis of the factors worsening RQLQ and SF-36 after dust storms

	p	OR	95% CI
RQLQ			
Atopic dermatitis	0.785	0.7	0.524-1.073
Asthma presence	0.018	4.6	4.202-4.908
Asthma absence	0.042	2.1	1.992-2.225
SF-36			
Atopic dermatitis	0.289	1.1	0.875-1.386
Asthma presence	0.026	3.8	3.446-4.084
Asthma absence	0.034	1.9	1.692-2.086

OR: Odds ratio; CI: Confidence interval; RQLQ: Rhinoconjunctivitis quality of life questionnaire; SF-36: Short Form-36.

RQLQ-asthma absence; 95% CI, 1.992-2.225; p=0.042) (SF-36-asthma presence; 95% CI, 3.446-4.084 p=0.026, SF-36-asthma absence; 95% CI, 1.692-2.086 p=0.034).

Considering the worsening by 4.8 times in RQLQ and 3.8 times in SF-36 in patients with both asthma and allergic rhinitis, and 2.1 times in RQLQ and 1.9 times in SF-36 in patients with pure allergic rhinitis, the attributable risk of asthma could be determined as 2.5 times in RQLQ and 1.9 times in SF-36.

DISCUSSION

Although asthma and allergic rhinitis have often been considered separate conditions, the notion that these diseases affect distinct compartments of the same airway is now preferred. Allergic diseases induce local reactive responses, but systemic effects are also often at play, and they can change the clinical view of the disease. As has often been reported, allergic asthma accompanying allergic rhinitis affects QoL. An intrinsic characteristic of allergic disease is that symptoms are aggravated after exposure to dust. Particles scattered via natural and artificial (anthropogenic) routes travel far in the atmosphere, driven by the prevailing winds, and reduce air quality on both regional and global scales. In this way, allergens specific to certain geographic locations can be transported to other regions. For example, dust storms in some parts of Europe and West Asia originate in the Sahara desert, and yearly, 2.2 billion cubic meters of soil are transported in the atmosphere.[8]

Dust storms can have unfavorable effects on asthma and allergic rhinitis.[9] However, to the best of our knowledge, no study on the impact of dust storms on the QoL of allergic rhinitis patients with asthma has been performed. Dust aerosols trigger inflammation and contribute to the development of asthma and chronic obstructive pulmonary disease (COPD).[9] In the respiratory tract, the size of particles inhaled via the airway is closely associated with the region of the tract affected by such particles. Small particles penetrate deeper pulmonary structures and trigger symptoms that vary in severity. In patients with allergic rhinitis, which impairs respiratory physiology, the nose filters particles poorly and cannot perform a humidifying function because of nasal obstruction. Thus, the airstream to the lungs is inadequately filtered and poorly humidified. This promotes the accumulation of allergens and aggravates the inflammatory effects of such allergens.[10] Even very small amounts of desert dust can trigger very steep drops in FEV_1 values.[11]

We found that after dust storms, dust particles impaired QoL and reduced FEV_1 values could be indicative of acute attacks of asthma. Relative to patients in group 2, those in group 1 exhibited significant decreases in FEV_1 values after dust storms.

Morbidities associated with asthma and allergic rhinitis manifest throughout the lifetime of affected humans and have negative effects on social life, sleep, school performance, and work productivity.[12] Hospital referral rates of COPD patients increase after dust storms.[13] If poor work productivity (a major economic impact of dust storms) is viewed from the perspective of preventative health, allergic rhinitis patients with asthma should not be engaged in outdoor jobs, or should be protected from dust exposure on days of dust storms.[14] Gas-mask respirators containing activated carbon can effectively alleviate the negative effects of dust storms on respiratory functions and dramatically reduce FEV_1 levels.[9] Therefore, the use of carbon masks by those who work outdoors would ameliorate the physiological, symptomatic, and social consequences of the condition, and prevent financial loss.

To the best of our knowledge, this is the first study to explore the effects of desert dust storms

on patient QoL. Symptom-scoring systems and QoL scales are frequently used to evaluate allergic rhinitis and asthma patients. The scores yield data on the clinical condition, and can trigger appropriate treatment and be used to estimate the effectiveness of such treatment.[12] In the present study, we used the RQLQ and NSS scoring systems to specifically reveal the impact of dust storms on patient QoL. We monitored sneezing, nasal obstruction, rhinorrhea, and nasal itching. RQLQ scoring has not previously been used to evaluate the impact of allergic rhinitis, but Meltzer et al.[15] used RQLQ and SF-36 scores to show correlations between both measures in 312 patients with allergic rhinitis, and healthy control subjects. The authors emphasized that the reliability of both methods was similar. Significant differences were evident in every subparameter of the RQLQ scale in the allergic rhinitis patients (RQLQ: 3.81) compared to healthy individuals (RQLQ: 3.55). Significant differences were noted in the occurrence rates of related symptoms such as waking during the night, tiredness, fatigue, poor concentration, thirst, and the inconvenience associated with constantly carrying tissues or handkerchiefs, amongst others.

In the present study, when we compared data obtained before and after dust storms, the RQLQ scores of group 1 were significantly poorer than those of group 2 and could be explained by increased particulate matter (increased nasal allergens). Analysis of absolute changes in RQLQ subparameters revealed that asthma was linked to significant deteriorations in the scores for eye symptoms, practical problems, global evaluation, and nasal symptoms.

Generally, the significant worsening of nose and eye subparameters of RQLQ scores in asthma patients after dust storms, compared to other scores, can be explained by the fact that such patients were more likely to exhibit systemic responses in addition to symptoms of a localized nasal allergy. In addition, the need to constantly wipe the nose or eyes worsened practical problems and reduced global scores; social life was compromised by communication issues. Changes in parameters other than those associated with non-hay fever symptoms and emotional subparameters were minimal after dust storms. The affected parameters are mainly those of patients with chronic pathophysiological diseases such as allergic rhinitis. It is possible, however, that symptoms were exacerbated by chronic exposure to dust storms. In agreement with the work of Meltzer et al.[15] we found that these subparameters deteriorated more severely in those with dominant ocular and nasal symptoms.

To evaluate differences in overall QoL between groups, we compared VAS and SF-36 scores. No intergroup difference in PrDS VAS scores was evident. However, during PoDS periods, significant deterioration in the VAS scores of both groups was apparent. The VAS scores of group 1 patients were significantly poorer. No significant intergroup difference in SF-36 scale results was evident before dust storms, although during PoDS periods, the scores deteriorated in both groups. In group 1 (only), the absolute changes in subgroup scores evaluating general health, physical function, vitality, and mental health were significant. The results of earlier studies differ in terms of the SF-36 subparameters affected by allergic rhinitis. Amizadeh et al.[16] compared the SF-36 scores of patients with and without allergic rhinitis and found significant changes in only the physical functioning and bodily pain subscores. Hellgren et al.[17] reported differences in the vitality, physical functioning, and social functioning subscores of those with non-infectious rhinitis compared to healthy individuals. However, allergic rhinitis alone seriously impairs QoL, and an association with asthma exacerbates this effect. As we also found in the present study, Leynaert et al.[18] showed that the QoL of allergic asthmatic patients was significantly impaired as measured by SF-36 subgroup scores on the physical functioning, physical role subscale, general health and vitality modules, compared to those who had allergic rhinitis alone. However, the "disability points" on these subjective scales differ from country to country, varying with population characteristics and sociocultural requirements. For example, the social needs of Iranians differ from those of Swedes, and the rates of change in SF-36 subparameters, and the impacts of such changes differ. Therefore, the effects of differences in subjective scores should be evaluated regionally rather than worldwide. Our VAS and SF-36 test results revealed significant impairment, especially in overall QoL of allergic patients

Figure 1. *Comparison of air quality of dusty and dust-free days.*

with asthma exposed to dust storms. Our results usefully show the negative effects of dust storms on both overall and specific aspects of QoL, in addition to lung capacity, as previously reported.[9] In addition we found the worsening in the specific and general QoL was worse 4.6 times in RQLQ and 3.8 times in SF-36 PoDS in patients with asthma and allergic rhinitis. The attributable risk of asthma was worse by 2.5 times in RQLQ and 1.9 times in SF-36. Prior to dust storms, asthma patients should be warned to minimize their exposure to dust. This is an appropriate preventive health measure. Figure 1 shows photographs taken on normal days and those of dust storms.

Intercontinental transport of dust particles is entirely natural and cannot be controlled. Therefore, models predicting such events, allowing national and regional authorities to implement measures that protect public health and encourage the taking of personal precautions, will improve QoL.

Gradually worsening drought, decreased rainfall rates, and global and regional warming, are predicted to aggravate the problems described above. Therefore, a sensitive approach toward correlating QoL parameters with changes in blood cytokine levels and/or the levels of specific IgE against dust storm allergens is required, and necessary precautions should be taken. Indeed, "dust clouds" are natural disasters with deleterious outcomes.

In conclusion, the QoL of patients with allergic rhinitis and asthma deteriorates after dust storms and associated personal and societal deficiencies emerge. Such deficiencies can be minimized if coordinated collaboration between health units and meteorological stations is instituted.

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