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ORIGINAL ARTICLE

Environmental exogenous factors and facial dermatitis: A case control study

Wen-Hui Wang [1], Lin-Feng Li [1,2,*], Xue-Yan Lu [1], Jing Wang [1]

[1] Department of Dermatology, Peking University Third Hospital, Beijing, China
[2] Department of Dermatology, Beijing Friendship Hospital, Beijing, China

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ABSTRACT

Background/objective: Facial dermatitis is common and the roles different exogenous factors play between facial and nonfacial dermatitis is unknown. The study aim was to investigate the etiology and self-reported exogenous aggravation factors in facial dermatitis.
Methods: There were 89 facial dermatitis patients patch tested in a tertiary hospital during a 1-year period, and 112 patients with nonfacial dermatitis tested in the same period who served as a control. Association of exogenous factors was investigated by multivariate analyses.
Results: Of the cases of facial dermatitis, 30.3% were confirmed allergic contact dermatitis, which was higher than that (23.2%) in controls. Cosmetic allergy was much more common in facial than nonfacial allergic contact dermatitis (96.3% vs. 19.2%); 51.9% of facial allergic contact dermatitis cases were caused by facial creams; 6.7% of facial dermatitis were irritant contact dermatitis, compared with 2.7% for controls; 9.0% of cases were seasonal facial dermatitis. The positive patch test reactions to at least one standard allergen were 65.2% in facial dermatitis and 58.0% in controls. Self-reported exogenous aggravation factors in facial dermatitis were spicy food ingestion (24.7%), low moisture (22.5%), sunlight (19.1%), alcohol ingestion (15.7%), seafood ingestion (14.6%), beef or lamb ingestion (12.4%), and high humidity (5.6%). Multivariate logistic regression analysis adjusting for sex, age, disease duration, atopic diathesis, and contact allergy showed that more patients reported aggravation by sunlight exposure ($p = 0.008$), ingestion of spicy food ($p = 0.025$), or alcohol ($p = 0.044$).
Conclusions: Contact factors play an important role in facial dermatitis. Aggravation by sunlight exposure, ingestion of spicy food, or alcohol are more reported in facial dermatitis compared with nonfacial dermatitis.

Introduction

Facial dermatitis (FD) is very common in dermatology practice, accounting for 30% of patients patch tested.[1–4] Clinically, the etiology of FD is very difficult to determine and recurrence is common. Exogenous factors and endogenous conditions may all possibly contribute to the development or aggravation of FD. Exposure to sunlight[5,6] or low humidity[7] has been reported to aggravate facial atopic dermatitis. Geographic areas with increased temperature, sun exposure, and humidity were associated with poorly controlled eczema in children. It is interesting to investigate the different contributions of environmental exogenous factors to FD and non-FD. The purpose of this study is to investigate the etiology of FD in China and whether exogenous factors play more of a role in FD than nonfacial dermatitis.

Patients and methods

Patients and controls

All patients with FD patch tested using a modified European standard series of allergens in the contact dermatitis clinic of Peking University Third Hospital, Beijing, China during a 1-year period were included. Patients with non-FD patch tested in the same

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* Corresponding author. Department of Dermatology, Peking University Third Hospital, North Garden Road 49, Haidian District, Beijing, 100191, China.
E-mail address: LinfengLidoc@126.com (L.-F. Li).

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period served as a control. The ethnicity of all patients was Chinese Han. The hospital was a tertiary hospital in north Beijing, and patients could be referred, or they were allowed to visit this hospital of their own accord. If the doctor considered that contact factors might play a role in the dermatitis of the patient, a patch test would be recommended; however, the patient would make the final decision to do the test or not.

FD

FD was defined as dermatitis involving the face, other skin diseases involving the face, such as acne, rosacea, herpes simplex, lupus erythematosus, and typical photosensitivity, being excluded by history and clinical examination. Seborrheic dermatitis was not included in this study.

Allergic contact dermatitis

Suspected allergic contact dermatitis (ACD) was diagnosed clinically by the disease history and clinical examination based on standard textbooks.[8,9] Only patients with strong evidence supporting the diagnosis were included. A lesion is a pruritic eczematous eruption and is localized to the area of skin that contacts with a suspected substance. If the patients could reapply the suspected substance without any reactions, a diagnosis of ACD was excluded. Confirmed ACD also fulfilled the following criteria: (1) a positive usage test result; (2) a relevant positive patch testing (PT) reaction to allergens in the European standard series or a positive PT result with the suspected material as is; and (3) a positive repeated open application test result. The usage test was performed using the method similar to that reported by Bashir and Maibach,[10] in which a patient thought to have ACD used the suspected substance in the same way as when the dermatitis developed, for example, by applying suspected facial cream twice daily to a small area (1 cm $\times$ 1 cm) on the face for a week. If an eczematous skin reaction occurred during the test period, the test was considered positive and stopped. PT with the suspected material as is was performed according different product types. For nonrinse-off products, such as facial cream, eyeshadow and lipstick, use the product as is; for rinse-off products, such as facial cleansing lotion and shampoo, use distilled water dilution to 2%; for perfume, use 70% alcohol dilution to 5%. In a repeated open application test, test substances—either commercial products, as is, or special test substances (e.g. PT allergen)—were applied twice daily to the upper arm on a 5-cm $\times$ 5-cm area for a week. If an eczematous skin reaction occurred in the test period, the test result was considered to be positive, and the test was stopped.[9] If the patients had positive standard PT results, but the relevance of positive allergens to the lesions could not be determined, they were classified as suspected ACD.

Irritant contact dermatitis

Irritant contact dermatitis (ICD) was diagnosed clinically by the disease history and clinical examination based on standard textbooks.[8,9] The lesions usually presented as dry erythema with fine scale confined to the contact site with more frequent complaint of burning and stinging, and ACD was excluded by negative PT results.

Seasonal FD

Seasonal FD was defined as FD appearing in spring and autumn and disappearing in summer and winter for >2 years.[11,12]

In patients with multiple factors involved, the final diagnosis was based only on the major cause of the dermatitis. For example, if a patient's dermatitis fulfilled the diagnostic criteria of seasonal FD and was also found to react to some allergens, but the ACD was temporal and could not explain the whole skin condition, the final diagnosis was seasonal FD.

Atopic dermatitis and atopic diathesis

Atopic dermatitis was diagnosed using the UK diagnostic criteria.[13] Atopic diathesis was considered when allergic rhinitis, allergic asthma, or atopic dermatitis could be found in the patient's personal or family history.

The final diagnosis was made by consensus of the authors.

PT

PT was performed using a modified European standard series of allergens including benzocaine, black rubber mix, 2-bromo-2-nitropropane-1,3-diol, carba mix, colophony, epoxy resin, ethylenediamine dihydrochloride, formaldehyde, fragrance mix (FM), imidazolidinylurea, mercapto mix, N-(cyclohexylthio)phthalimide, nickel sulfate, parabens, para-phenylenediamine (PPD), potassium dichromate, sesquiterpene lactone mix, thimerosal, thiuram mix, and tixocortol-21-pivatate (Chemotechnique Diagnostics, Malmö, Sweden). Allergens were applied to the upper back for 2 days and the results were recorded at 2 days and 3 days according to International Contact Dermatitis Research Group (ICDRG) recommendations.[9] If possible, PT with the patients' own products was also performed, using published methods.[9] PT was performed by the same technician, and the results were recorded by the other authors together. The relevance of a positive PT was considered if the patient had been exposed to the substance containing the positive allergen and dermatitis definitely improved with the avoidance of that allergen.

Investigation of suspected environmental exogenous factors by questionnaire

The suspected causal exogenous agent was investigated by using a modified questionnaire[14] after PT. In the questionnaire, the patient's personal data, history of the present illness (patient's description, date of onset, effects of weekends and vacation on dermatitis, previous therapy, etc.), contactants that existed at work and in clothes, toiletries, household contact and treatment medications, atopic diathesis, and medications used were included. Effects of sunlight exposure, low moisture, high humidity, and food ingestion on the patient's dermatitis were also recorded.

Follow-up

After PT, the patients were followed-up for 3 months to 2 years to further confirm the diagnosis.

Statistical analysis

To assess differences between FD and control, 2 $\times$ Chi-square test or, if appropriate, Fisher exact test was used. Stepwise logistic multiple regressions were performed to identify the statistically significant associate factors of FD. The stepwise models contained sex, age, disease duration, atopic diathesis, contact sensitization, and self-reported aggravation factors. The data were processed using statistical software SPSS (Systat version 16.0, SPSS, Chicago, IL, USA). A p value < 0.05 was regarded as significant.[14]

Results

In total, 89 patients with FD and 112 patients with non-FD were studied. The final diagnoses of each group are shown in Table 1. The

Table 1 Final diagnoses of facial dermatitis and nonfacial dermatitis.

	Facial dermatitis ($n = 89$)	Nonfacial dermatitis ($n = 112$)
Confirmed allergic contact dermatitis	27 (30.3)	26 (23.2)
Suspected allergic contact dermatitis	27 (30.3)	39 (34.8)
Irritant contact dermatitis	6 (6.7)	3 (2.7)
Seasonal facial dermatitis	8 (9.0)	
Atopic dermatitis	2 (2.2)	3 (2.7)
Unclassified eczema [a,*]	19 (21.3)	39 (34.8)
Asteatotic eczema		2 (1.8)

Data are presented as *n* (%).
* $p < 0.05$, Chi-square test.
[a] Unclassified eczema refers to eczema that could not fit into a specific type of eczema, such as contact dermatitis, atopic dermatitis, asteatotic eczema, seborrheic dermatitis, infective dermatitis, dermatophytide, post-traumatic eczema, discoid eczema, stasis eczema, metabolic eczema, eczematous drug reactions, and pityriasis alba.

proportion of confirmed ACD in FD (30.3%) was higher than that in non-FD (23.2%), but was not statistically significant ($p = 0.305$, Chi-square test). The proportion of ICD in FD (6.7%) was also higher than that in non-FD (2.7%), with no statistical significance ($p = 0.305$, Fisher exact test).

Of facial confirmed ACD cases, 96.3% (26/27) were cosmetic ACD, which was much higher than that (5/26, 19.2%) of nonfacial confirmed ACD ($p < 0.01$, Chi-square test). Facial moisturizing cream (51.9%) was the most common cause and hair dye (18.5%) the next for facial confirmed ACD. The PT results of cosmetic ACD patients are listed in Table 2. Eight (29.6%) facial ACD patients showed negative standard PT results and one of them (12.5%) showed positive result to the cosmetics as is.

The one case of noncosmetic facial ACD was caused by topical *Jing Wan Hong*, a kind of traditional Chinese medicine in treating burning wounds. The ingredients listed in *Jing Wan Hong* include myrrh, rhubarb, cape jasmine fruit, and safflower. The patient reacted to colophony and FM. The noncosmetic relevant allergic materials in the non-FD group were metals (14/26, 53.8%), topical traditional Chinese medicine (5/26, 19.2%), and rubber (4/26, 15.4%).

Of facial suspected ACD cases, 74.1% (20/27) were cosmetic ACD, which was also much higher than that (3/39, 7.7%) of nonfacial confirmed ACD (P < 0.01, Chi-square test). Facial moisturizing cream (35.0%) was the most common cause and whitening cream with herbs (11.1%) the next for facial suspected ACD.

The most common allergens detected in the FD group were nickel (33.7%), potassium dichromate (16.9%), FM (9.0%), and PPD (9.0%), which was similar to that of the non-FD group. No significant differences were found in the positive PT reactions to at least one allergen (65.2% vs. 58.0%) and to each allergen between FD and non-FD.

A comparison between FD and non-FD patients is shown in Table 3. Female sex was overrepresented ($p = 0.024$) and disease duration over 3 months before PT was underrepresented ($p = 0.048$) in FD group. Sunlight exposure ($p = 0.008$) and ingestion of spicy food ($p = 0.025$) or alcohol ($p = 0.044$) were associated with self-reported dermatitis aggravation in the FD group.

Discussion

In our study, ACD and ICD accounted for 30.3% and 6.7% of FD, and another 30.3% of FD had suspected ACD, indicating that contact dermatitis is very common in patch-tested FD patients. The results were similar to Katz and Sherertz's study,[1] in which ACD accounted for one third and ACD with other contributing factors accounted for one third of FD. It is reasonable to find that most facial ACD was cosmetic ACD (96.3%) because the face is frequently exposed to cosmetics. Facial ACD caused by topical medications or rims of glasses was underrepresented in our study, because they were

Table 2 Number (%) of patients with cosmetic allergic contact dermatitis (ACD) and results of patch testing.

	Facial ACD ($n = 27$)	Nonfacial ACD ($n = 26$)
Facial cream	14 (51.9) 2 reacted to FM; 1 reacted to colophony, FM, and parabens; 3 reacted to nickel sulfate; 1 reacted to nickel sulfate and potassium dichromate; 1 reacted to nickel sulfate and carba mix; 1 reacted to potassium dichromate; 5 were negative.	0
Hair dye	5 (18.5) 3 reacted to PPD; 1 reacted to PPD and carba mix; 1 reacted to FM.	3 (11.5) 1 reacted to PPD; 1 reacted to PPD and potassium dichromate; 1 reacted to formaldehyde
Facial cleansing lotion	2 (7.4) 1 reacted to nickel sulfate and potassium dichromate; 1 was negative.	0
Mask	1 (3.7) Negative	0
Toner lotion	1 (3.7) Formaldehyde	0
Powder	1 (3.7) Negative	0
Eye shadow	1 (3.7) PPD and 2-bromo-2-nitropropane-1,3-diol	0
Lipstick	1 (3.7) Thimerosal and thiuram mix	0
Perfume	0	2 (7.7) 1 reacted to FM and nickel sulfate; 1 was negative.

ACD = allergic contact dermatitis; FM = fragrance mix; PPD = paraphenylenediamine.

Table 3 Comparison of facial dermatitis and nonfacial dermatitis.

	Facial dermatitis ($n = 89$)	Nonfacial dermatitis ($n = 112$)
Demographic data		
Female *	72 (80.9)	70 (62.5)
Age ≥ 40 y	31 (34.8)	54 (48.2)
Disease duration over 3 mo before PT *	61 (68.5)	87 (77.7)
Atopic diathesis	9 (10.1)	18 (16.1)
Reacted to at least 1 standard PT allergen	58 (65.2)	65 (58.0)
Aggravation by environment		
Sunlight *	17 (19.1)	6 (5.4)
Lower humidity	20 (22.5)	32 (28.6)
Higher humidity	5 (5.6)	9 (8.0)
Aggravation by ingestion		
Beef or lamb	11 (12.4)	6 (5.4)
Seafood	13 (14.6)	13 (11.6)
Spicy food *	22 (24.7)	11 (9.8)
Alcohol *	14 (15.7)	7 (6.3)

Data are presented as *n* (%).
* $p < 0.05$, multivariate logistic regression analysis using a stepwise backward method.
PT = patch testing.

easier to diagnose and rarely patch tested in our clinic. It is worthwhile to notice that the high percentage of negative standard PT results in facial ACD (Table 2), indicating that a significant number of ACD, would be missed if only standard series were used, extra cosmetic series should be tested in FD patients. The reported cosmetic allergens outside the standard series were shellac, cocamidopropyl betaine, hexamethylenetetramine, dodecyl gallate, Amerchol L 101, and abitol in China[15,16] and those in India were gallate mix and cetrimide.[17]

PT has been and still is the gold standard in diagnosing ACD. However, a negative PT result could not always exclude ACD. First, the European standard series only contains limited allergens, and the ingredients listed on the products are not frequently covered by the European standard series, thus confirmation of cosmetic ACD by a positive PT result to ingredients present in cosmetics could not always be achieved. Second, patch testing with patients' own products is also very important, however, it is unrealistic for all the patients to take their suspected materials to the clinic in real clinical practice, and a negative result with a patient's own product does not exclude contact allergy to some of its components. Third, PT might yield false-negative result that is influenced by some factors, such as allergen concentration, vehicle, the responsiveness of the patient, etc. Considering the above, if a positive PT is mandatory in diagnosing ACD, some ACD cases would be missed. Other tests, such as usage test and repeated open application test are also valuable in diagnosing ACD.[18]

The percentage of seasonal FD was 9.0%, in which aeroallergens might play a role. Liu's study of 55 cases of seasonal FD in south China suggested that seasonal pollen might be one of the causative agents.[12] In our study, atopic dermatitis only accounted for 2.2% of FD, this may be partly because most of our patients were adults and partly because patients with atopic dermatitis did not always undergo PT in our clinics. The low prevalence of atopic dermatitis (0.70% in students aged 6–20 years) in China[19] may also have contributed to this finding.

Compared with non-FD, female sex was overrepresented and disease duration over 3 months before PT was underrepresented in FD. These were reasonable because women may pay more attention to their face and be exposed to more cosmetics on the face, and for most people a mild erythema on the face may be a greater burden than a more severe one on another part of the body, thus, they will go to see the doctor on their own initiative.

More FD patients experienced sunlight aggravation than non-FD patients, which was probably due to the face being exposed to more sunlight than other body sites. A study in the UK showed that 15.6% of schoolchildren with atopic dermatitis perceived rash exacerbation to sunlight exposure (sites not mentioned).[20] In a university hospital in Korea, 50% of head and neck atopic dermatitis patients reported aggravation by sun exposure.[5] A study in Japan showed that 55.4% of adult atopic dermatitis experienced an exacerbation of the facial lesions after sun exposure.[6] However, that sunlight-induced exacerbation of dermatitis contrasted with therapeutic use of ultraviolet was a paradox. The paradox was also seen in psoriasis, in which phototherapy was a standard therapy, but some psoriasis patients aggravated in summer and these patients usually responded poorly to phototherapy. Some unknown endogenous factors may contribute to the difference and need to be studied further.

In China, beef or lamb, seafood, spicy food and alcohol have been believed to be *rash-inducing or aggravating foods* for thousands of years.[21] Some patients did experience dermatitis exacerbation by taking these foods in our study (Table 3), which did not seem to be caused by food allergy, since no other allergic symptoms were found. More FD patients experienced dermatitis exacerbation by ingestion of spicy food or alcohol, vasodilatation effects might contribute a part. A study on ethnic variations in self-perceived sensitive skin showed that Asians appeared to have greater facial skin reactivity to spicy food,[22] it has also been reported that about 83% of Orientals were alcohol facial flushers,[23] thus genetic factors might also be involved.

In our study, environmental humidity did not show significant roles between the facial and nonfacial group, >20% of patients claimed aggravation by lower humidity and <10% patients claimed aggravation by higher humidity in both groups (Table 3). It was reported that higher humidity might be associated with poorly controlled children eczema in the USA, the author explained that warm and humid weather promotes the evaporation of water on the skin surface, which may further exacerbate skin dryness.[24]

Finally, because this study was only a clinical observation, no Type I allergy test or photosensitivity test was performed; the mechanism of aggravation of FD by sunlight exposure and ingestion of spicy food is still unknown and should be studied further.

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