

**Original**

## Meteorological influences on the incidence of lichen planus in a north Indian population

Ravi Prakash S. Mohan, Soumi Ghanta, Sankalp Verma, Neha Agarwal,  
Nupur Gupta, and Udit Singh

Department of Oral Medicine and Radiology, Kothiwal Dental College Research Centre and Hospital, India

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**Abstract:** Lichen planus is a chronic, autoimmune, mucocutaneous disease that shows differences in clinical presentation at different times of the year. The present retrospective study was conducted to clarify the meteorological factors that influence the incidence of lichen planus, as well as the general features and clinical presentation of this condition during three consecutive years, 2008, 2009, and 2010, in Moradabad district (Western Uttar Pradesh, India). The study group comprised 1,355 patients extracted from the records of the outpatient department of Kothiwal Dental College Research Centre and Hospital, who were clinically diagnosed as having lichen planus during this three-year period. The highest number of patients (735) were recorded in summer, and the lowest (56) in winter. Females were affected more often, and psychosocial influences were also evident. There were significant differences in the incidence of lichen planus in different seasons, and the summer peak was attributable to the intensity of sun exposure (actinic lichen planus and summertime lichen planus). (J Oral Sci 55, 311-318, 2013)

Keywords: lichen planus; meteorology; actinic lichen planus.

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### Introduction

It is generally agreed that the patterns of skin diseases differ among countries, and also within various regions of a country, depending on environmental, social, economic, or racial factors (1). Skin diseases tend to have low mortality but high morbidity (1), and their prevalence is affected by climate (2), which has an important influence on human health and general well-being (3). It has been generally observed that the patterns of skin diseases in patients presenting at dermatology clinics differ at various times throughout the year, especially in tropical and subtropical countries (2). India is a subtropical country where changes in climate have a definite impact on the incidence of skin diseases.

Lichen planus is a chronic, autoimmune, mucocutaneous, psychosocial disease that can affect the oral mucosa, skin, genital mucosa, scalp and nails (4,5). The disease has most often been reported in middle-aged patients, being more common in females than in males (4-6). It is also seen in children, although rarely. Clinically, it can present as white striations (Wickham's striae), white papules, white plaque, erythema, erosion or blisters (5). Oral lichen planus is typically present in the posterior buccal mucosa, on the tongue, or on the alveolar ridge/gingiva, but rarely on the palate or lip vermilion (4,6,7). There are six clinical variants: reticular, papular, plaque-like, erosive, atrophic, and bullous (4,5), and some can co-exist in the same patient. Lichen planus is a T-cell-mediated autoimmune disease in which autotoxic CD8<sup>+</sup> T-cells trigger apoptosis of epithelial cells. Microscopically, the disease is characterized by a dense subepithelial lympho-histocytic infiltrate, increased numbers of intra-epithelial lymphocytes, and degeneration of basal keratinocytes, which form colloid

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Correspondence to Dr. Ravi Prakash Sasankoti Mohan, Department of Oral Medicine and Radiology, Kothiwal Dental College Research Centre and Hospital, Mora Mustaqueem, Kanth Road, Moradabad, Uttar Pradesh 244401, India  
E-mail: sasan\_ravi@rediffmail.com

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or civatte bodies (5).

One variant of lichen planus is noticeably affected by climate in tropical and semitropical countries. This variant arises preferentially on exposed parts of the body, mainly the face, especially on the forehead, cheeks and lips, and also the upper area of the chest, the dorsum of the hands, and lower extensor surface of the forearms. This condition is more prevalent during the summer months, late spring and early autumn, i.e., when the light and sun are more intense. Itching or discomfort is minimal or absent during the winter (8).

The incidence of lichen planus has been increasing, and its treatment is challenging for dermatologists as well as dentists, as it tends to be chronic and recalcitrant to therapy. Relapses are common even after remission following treatment (9).

The aim of this retrospective study was to clarify the meteorological factors influencing the incidence of lichen planus, as well as the general features and clinical presentation of this lesion, and the effects of socioeconomic factors, stress and some systemic illnesses on its incidence during a three-year period in 2008, 2009, and 2010 in Moradabad district (Western Uttar Pradesh, India).

## Materials and Methods

The study group comprised 1,355 patients whose data were extracted from the records of the outpatient department of Kothiwal Dental College Research Centre and Hospital, who had been clinically diagnosed as having lichen planus in 2008, 2009, and 2010. Data related to patient age, sex, socio-economic condition, signs and symptoms, and treatment outcome were extracted from the case history records. Patients from both urban and rural areas were taken into consideration.

Meteorological data for the study period were obtained from the Government Department of Meteorology for the Moradabad region.

### Clinical diagnostic criteria for lichen planus

The diagnostic criteria for lichen planus may have changed over time in the light of increased knowledge. The clinical diagnostic criteria for oral lesions used in this study were as follows (4):

1. The presence of keratotic, pinhead-sized, white, slightly elevated papules (papular lichen planus), which may be discrete or arranged in reticular (reticular lichen planus) or plaque-like (plaque-like lichen planus) configurations
2. Atrophic lichen planus, characterized by thinning of the epithelium leading to the appearance of atrophic

red areas within the white lesions

3. Erosive (ulcerative) lichen planus, characterized by areas of well-defined ulceration within the above-mentioned lesions
4. Bullous lichen planus, characterized by the presence or development of bullous areas within the above-mentioned lesions

The clinical diagnostic criteria for skin lesions used in this study were as follows (8,10):

1. Hypertrophic lichen planus, characterized by thickened, hyperkeratotic, intensely pruritic lesions ranging in color from purple to gray or black
2. Annular-type lichen planus, characterized by erythematous brownish plaques with an annular configuration
3. Actinic-type lichen planus, characterized by hyperpigmented or violaceous to blue-brown papules with a thready, rolled edge and well defined borders with minimal scaling on exposed parts of the body (such as, forehead, face, nape of neck, hand etc.) and also a history of onset especially in the spring and summer
4. Miscellaneous types of lichen planus, including classic lichen planus present elsewhere on the body or mucous membrane, follicular spinous lesions, cicatricial alopecia of the scalp and non-scarring alopecia of the axilla and groin, or nail changes showing longitudinal ridging and grooving, splitting (onychoschizia), longitudinal striation (onychorrhexis), onychia and subungual hyperkeratosis

Histopathological diagnosis was performed whenever there was any doubt about the clinical diagnosis.

### Inclusion criteria

All diagnosed patients with lichen planus, both adults and children, were included in this study.

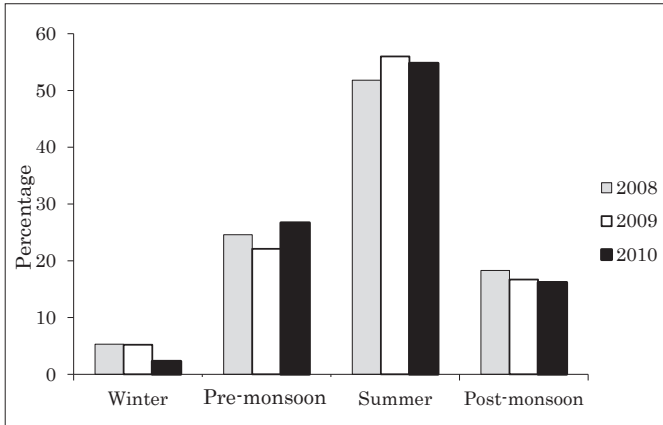
### Exclusion criteria

Patients with clinicopathological signs of epithelial dysplasia, or use of any drugs or dental restorations implicated in lichenoid reactions, were excluded from the study.

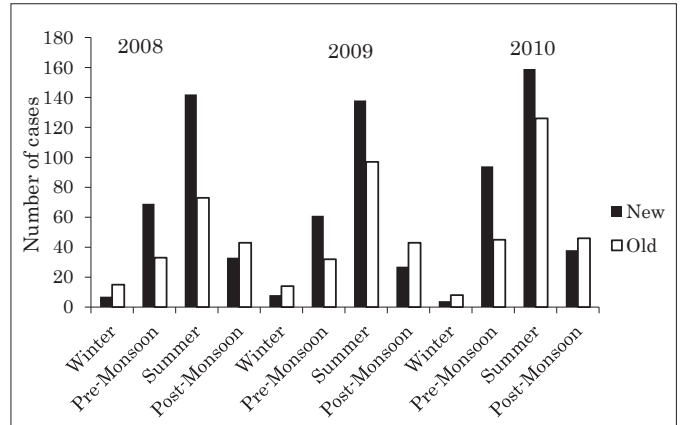
The study protocol was reviewed and approved by the Research Ethics Committee of M.J.P. Rohilkhand University, Uttar Pradesh (KDCRC/ETH/OMDR/2011/03).

## Results

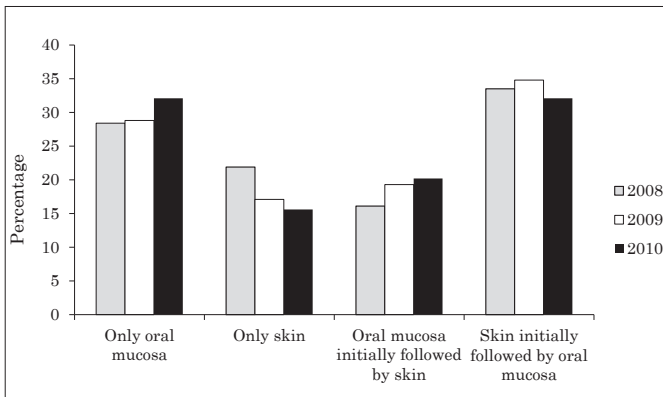
Hospital records of Kothiwal Dental College for the years 2008, 2009 and 2010 were explored. A total of 1,355 patients with a confirmed diagnosis of lichen planus were extracted and included. A total of 415 cases were recorded in 2008, 420 in 2009, and 520 in 2010.



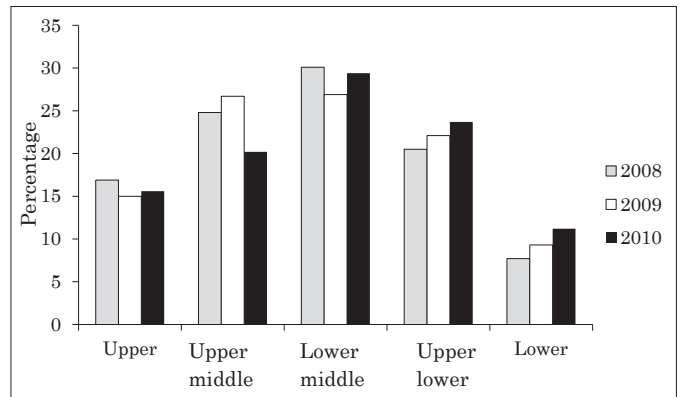
**Fig. 1** Year-wise distribution of cases across different seasons. In all of the three studied years, most cases were reported during summer, while the least were reported during winter ( $P = 0.118$ ).



**Fig. 2** Nature of cases (new/old) in different seasons during the entire three-year period. A significant increase in the proportion of new cases was seen during the pre-monsoon and summer seasons, as compared with the post-monsoon and winter seasons, in all three of the studied years. Both old and new cases showed the lowest occurrence in winter.



**Fig. 3** Distribution of cases according to area of involvement. The majority of cases in each year involved the skin initially, followed by the oral mucosa; the next most common type was involvement of the oral mucosa alone. Involvement of the skin alone accounted for the lowest number of patients, except in 2008 ( $P = 0.154$ ).



**Fig. 4** Distribution of cases according to socio-economic status. The majority of patients, irrespective of the year, were from the upper middle and lower middle socioeconomic strata ( $P = 0.281$ ) [Kuppuswamy's socio-economic status scale was used].

**Year-wise distribution of cases across different seasons**

In all of the three years, the maximum number of cases was reported during summer, whereas the minimum number was reported during winter. The pre-monsoon and post-monsoon seasons showed relatively higher proportions of patients than in winter, but the numbers were much lower than those during summer. Statistically, there were no significant differences in the seasonal distribution of patients among the three groups (groups for 2008, 2009, and 2010) ( $P = 0.118$ ) (Fig. 1).

**Nature of cases (new/old) in different seasons**

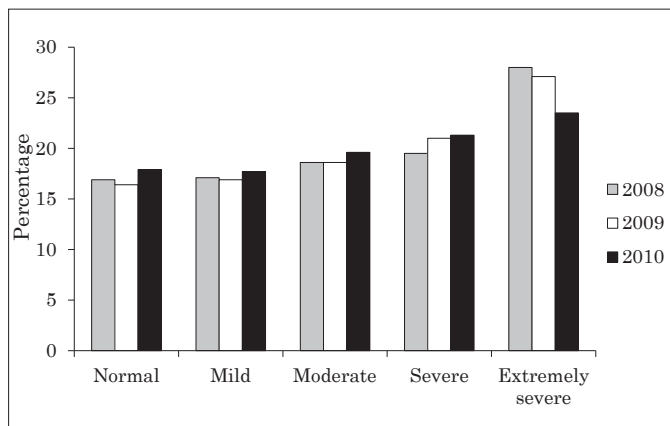
In all of the three years investigated, the proportional distribution of new and old cases varied significantly across different seasons. There was a significant rise in the proportion of new cases during the pre-monsoon and

summer seasons relative to the post-monsoon and winter seasons (Fig 2). July saw the highest number of cases and January the lowest.

A total of 508 (37.5%) patients were males and 847 (62.5%) were females, the latter outnumbering the former by about 2:1.

**Distribution of cases according to area of involvement**

We divided the cases into four categories according to the area of involvement: oral mucosa only, skin only, oral mucosa initially followed by the skin, and skin initially followed by the oral mucosa. The latter accounted for the highest number of cases in each year, followed by involvement of the oral mucosa only; involvement of the skin only accounted for the lowest number of cases, except in 2008, where involvement of the oral mucosa



**Fig. 5** Distribution of cases during the three-year study period in relation to stress. Most patients with lichen planus were under extreme stress [Depression-Anxiety-Stress Scale (DASS) was used].

initially followed by the skin accounted for the lowest number. Statistically, these differences were not significant ( $P = 0.154$ ) (Fig. 3).

**Distribution of cases according to socio-economic status**

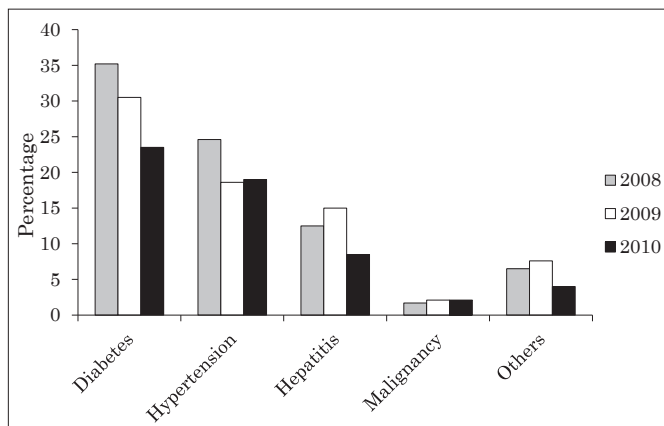
According to Kuppaswamy’s socio-economic status scale, we divided the cases into five socio-economic groups: upper class, upper middle class, lower middle class, upper lower class, and lower class. We found that the majority of cases, irrespective of the year, were from the upper middle and lower middle socio-economic classes. Again, among these two classes, the lower middle was affected more than the upper middle class. Statistically, there was no significant difference among the three years with respect to the socio-economic strata of the patients ( $P = 0.281$ ) (Fig. 4).

**Distribution of cases during the three years according to stress condition**

We divided the total patients into five stress conditions using the Depression-Anxiety-Stress Scale (DASS): normal, mild, moderate, severe, and extremely severe. Less than one-fifth (16.4% to 17.9%) of the patients had stress levels within the normal range. Most of the lichen planus patients were under extremely severe stress. Statistically, there were no significant differences in stress condition throughout the three studied years ( $P = 0.928$ ) (Fig. 5).

**Distribution of cases in relation to history of systemic illness**

We took into consideration some systemic diseases, including diabetes, hypertension, hepatitis, malignancy,



**Fig. 6** Distribution of patients with a history of systemic illness. Diabetes was the most common presenting systemic illness, followed by hypertension and hepatitis.

**Table 1** Distribution of different types of lichen planus

SN	Clinical types of lichen planus	No. of cases	Percentage (%)
1	Reticular	406	30
2	Annular	68	5
3	Papular	81	6
4	Erosive	203	15
5	Plaque-like	108	8
6	Atrophic	54	4
7	Bullous	41	3
8	Actinic	285	21
9	Hypertrophic	68	5
10	Miscellaneous	41	3
		1,355	100

During the study period, the majority of cases were the reticular type, followed by the actinic type and erosive type.

and others (gastrointestinal diseases, alopecia areata, dermatitis herpetiformis, Hashimoto’s thyroiditis, pemphigus foliaceus, pemphigus vulgaris, systemic sclerosis, myasthenia gravis etc.).

In all of the three studied years, diabetes was the most common presenting systemic illness, followed by hypertension and hepatitis. During the study period, 1.7-2.1% of the patients had malignancy and 4-6.5% had other systemic illnesses (Fig. 6).

**Distribution of different types of lichen planus**

Among the 1,355 patients, most (30%) were diagnosed as having reticular-type lichen planus, followed by the actinic type (21%) and erosive type (15%) (Table 1).

**Distribution of different types of lichen planus across different seasons**

A total of nine major types and 8-9 less frequent types

**Table 2** Distribution of different types of lichen planus across different seasons

SN	Clinical types of Lichen Planus	Seasons								Statistical significance	
		Winter (n = 56)		Pre-monsoon (n = 334)		Summer (n = 735)		Post-monsoon (n = 230)		$\chi^2$	P
		No.	%	No.	%	No.	%	No.	%		
1	Reticular	20	35.7	102	30.5	186	25.3	98	42.6	26.058	<0.001
2	Annular	5	8.9	12	3.6	42	5.7	9	3.9	4.557	0.207
3	Papular	6	10.7	19	5.7	32	4.4	24	10.4	13.863	0.003
4	Erosive	9	16.1	54	16.2	101	13.7	39	17.0	2.013	0.570
5	Plaque-like	4	7.1	20	6.0	72	9.8	12	5.2	7.557	0.057
6	Atrophic	3	5.4	15	4.5	27	3.7	9	3.9	0.689	0.876
7	Bullous	2	3.6	10	3.0	21	2.9	8	3.5	0.290	0.962
8	Actinic	3	5.4	81	24.3	183	24.9	18	7.8	41.132	<0.001
9	Hypertrophic	2	3.6	16	4.8	44	6.0	6	2.6	4.529	0.210
10	Miscellaneous	2	3.6	5	1.5	27	3.7	7	3.0	3.768	0.288

The reticular type was most common in the post-monsoon season and least common during the summer. The actinic type was more common in the pre-monsoon and summer seasons than in the winter and post-monsoon seasons ( $P < 0.001$ ).

**Table 3** Most common recalcitrant types of lichen planus

SN	Clinical types of lichen planus	New cases (n = 780)		Old cases (n = 575)	
		No.	%	No.	%
1	Reticular	333	42.7	73	12.7
2	Annular	50	6.4	18	3.1
3	Papular	46	5.9	35	6.1
4	Erosive	70	9	133	23.1
5	Plaque-like	44	5.6	64	11.1
6	Atrophic	8	1	46	8
7	Bullous	26	3.3	15	2.6
8	Actinic	160	20.5	125	21.7
9	Hypertrophic	14	1.8	54	9.4
10	Miscellaneous	29	3.7	12	2.1

Whereas most new cases were diagnosed as the reticular type, the majority of old cases reported as exacerbations were diagnosed as the erosive type, followed by the actinic type.

of lichen planus categorized as miscellaneous were encountered in our study. Seasonal variability in the distribution of the reticular, papular and actinic types was observed. The reticular type was most frequent in the post-monsoon season (42.6%) and least frequent during summer (25.3%), showing a significant seasonal variability ( $P < 0.001$ ). The papular type was more frequent in the post-monsoon (10.4%) and winter (10.7%) seasons than in the pre-monsoon (5.7%) and summer (4.4%) seasons, the seasonal variability being significant ( $P = 0.003$ ). Actinic-type lichen planus was more frequent in the pre-monsoon (24.3%) and summer (24.9%) seasons than in the winter (5.4%) and post-monsoon (7.8%) seasons ( $P < 0.001$ ) (Table 2).

#### Most common recalcitrant type of lichen planus

Most (23.1%) cases of recalcitrant lichen planus were the erosive type, followed by the actinic type (21.7%),

whereas most new cases were the reticular type (Table 3).

## Discussion

The prevalence of skin diseases in a community is affected by many factors, but climate plays a major role (2). The Meteorological Department in India was established as a national agency in 1875, amalgamating various provincial meteorological services. Basically, the climate of India is dominated by the summer monsoon. According to the India Meteorology Department, the year can be divided into four seasons (11, <http://www.imdpune.gov.in/research/ncc/climatebulletin/>):

- i) Winter (January and February)
- ii) Pre-monsoon or hot weather season (March-April-May)
- iii) Southwest or summer monsoon season (June-July-August-September)
- iv) Post-monsoon season (October-November-)

December)

Lichen planus is a common papulosquamous disease (10), and can affect either the skin, mucosa, or both (12). In our present study, in all of the three years investigated, most cases were reported during summer, and the least during winter. These findings are in accordance with those of previous studies by el-Zawahry (8), Boyd and Neldner (10), Ramirez et al. (13), and Issacson et al. (14), who all suggested that the condition is more prevalent during the summer months, the end of the pre-monsoon, and the early post-monsoon, when sunlight is more intense. el-Zawahry (8) demonstrated that exposure to sunlight increases the itching and the severity of the disease, and that protection from sunlight lessens the discomfort. They designated this type of lichen planus to be "lichen planus tropicus" rather than "lichen planus actinicus", because its development is linked to not only sunlight but also a tropical or semitropical climate. Kim and Mikkilineni (15) suggested that ultraviolet radiation was an important factor, possibly leading to the expression of altered self-antigens on basal keratinocytes, allowing the recruitment of cytotoxic T-cells, which play a role in development of the lesions.

Oral lichen planus is the most commonly reported form after the cutaneous type. Up to 65% of patients with classical cutaneous lichen planus have oral involvement (10). The cutaneous lesions are pruritic, mainly annular in form, and intensely pigmented, being erythematous to violaceous (8,10). Brownish and dark long-standing post-lichen pigmentation remains after resolution of the lesions, and this may be annoying to patients if it affects exposed parts of the body (8). In all of the three years we studied, the proportional distribution of new and old cases varied significantly across different seasons. There was a significant rise in the proportion of new cases during the pre-monsoon and summer seasons relative to the post-monsoon and winter seasons. Also, a higher number of recalcitrant cases than new cases were observed in the winter and post-monsoon seasons. The intensity of sun exposure is the probable reason for the greater number of new cases during summer and the pre-monsoon and the lower number in winter. el-Zawahry (8) demonstrated that the summer months have a detrimental effect on lesions, and that most patients seen during winter complain primarily about residual pigmentation.

In all of the three years we studied, there was a gradual increase in the number of cases from January to July, and the peak incidence occurred in July, in accordance with the findings of Boyd and Neldner (10). Those authors referred to a variety of lichen planus named actinic lichen planus which has been given many names in the ensuing

years, including lichen planus subtropicus, lichen planus tropicus, summertime actinic lichenoid eruption, lichen planus actinicus, lichen planus atrophicus annularis and lichenoid melanodermatosis in which sunlight plays an important role, the majority of cases occurring in summer and spring.

In our present series, the majority of patients were female, being concordant with the studies of Ingafou et al. (4), Mollaoglu (12), Scully and Carrozzo (16), Rodríguez-Núñez et al. (17), and Wolff K et al. (18). Rodríguez-Núñez et al. (17) and Lacy et al. (19) suggested that males tend to be mostly affected in their early thirties, whereas most women develop lichen planus in their fifties. However, el-Zawahry (8) considered actinic lichen planus to be more common in males than in females.

In each of the studied years, lichen planus involving the skin initially, followed by the oral mucosa, accounted for the majority of cases, followed by cases involving the oral mucosa alone, whereas cases involving only the skin were the least common, except in 2008. Boyd and Neldner (10) suggested that cases involving only the oral mucosa accounted for 15-35%. They also referred to a Scandinavian study suggesting that oral involvement was eight times more common than cutaneous involvement. They also suggested that 20-34% of patients with oral lichen planus also have concomitant cutaneous involvement, or that conversely, up to 65% of patients with classical cutaneous lichen planus have oral involvement. el-Zawahry (8) considered that males are more prone to lichen planus tropicus, where the exposed parts of the body, mainly the face, and especially the forehead, cheeks and lips, together with the upper area of the chest, the dorsum of the hands, and the lower parts of the extensor surface of the forearms, are mainly affected.

We found that the majority of patients, irrespective of the year, were from the upper middle and lower middle socio-economic classes. This accords with the study of Ingafou et al. (4), who concluded that there was an unequal distribution of patients across the socio-economic groups, ranging from 2.3% of employers or managers to 20% of semi-skilled manual workers.

We found that most patients with lichen planus, including both cutaneous and oral lesions, were under extreme stress, in agreement with the study of Girardi et al. (20), suggested an association between oral lichen planus and anxiety, salivary levels of dehydroepiandrosterone (DHEA) and cortisol playing an important role. On the other hand, Allen et al. (21) suggested that patients with oral lichen planus had no greater tendency for anxiety or stressful life events than other individuals.

Lichen planus has been reported to be associated with

a variety of totally unrelated disorders. Although it is very difficult to confirm such an association, it seems that immunodeficiency would likely be the underlying cause of both conditions in some cases (10). In the present series, we found that diabetes was the most common associated systemic illness, followed by hypertension and hepatitis. Defective carbohydrate metabolism is probably responsible for the association between lichen planus and diabetes. Boyd and Neldner (10) and Christensen et al. (22) cited the same study by Lynch that had demonstrated a positive correlation between lichen planus and high blood pressure. The triad of hypertension, diabetes mellitus and lichen planus has been reported as Grinspan's syndrome (10). Boyd and Neldner (10) reported that the incidence of hepatitis in patients with lichen planus varied from 9.5% to 13.5%. Strauss et al. (23) suggested that the most common liver ailments associated with lichen planus are chronic active hepatitis and primary biliary cirrhosis, and also proposed that administration of D-penicillamine may predispose a patient with primary biliary cirrhosis to the development of lichen planus as well as aggravating any existing disease. Al-Khenaizan (24) reported a case of lichen planus occurring after hepatitis B vaccination. They suggested that a chronic graft-versus-host-like autoimmune reaction might have been responsible for the pathogenesis, involving possible cross-reactivity between HBsAg use in HBV vaccines and shared epitopes on keratinocytes. Bagán et al. (25) have concluded that there is an association between hepatitis C virus infection and oral lichen planus. In our present series, a small proportion of the patients had associated malignancy. Boyd and Neldner (10) demonstrated that lichen planus pemphigoides was associated with stomach cancer, lymphosarcoma, reticulum cell sarcoma, neuroblastoma, craniopharyngioma and pararenal malignancy. They also reported one case of pituitary adenoma in a patient with bullous lichen planus, and cited a study by Gohman-Yahr et al. in which a case of lichen planus coincided temporally with malignant fibrohistiocytoma.

In the present study, we divided the cases into ten clinical variants of lichen planus: reticular, plaque-like, papular, atrophic, erosive, bullous, actinic, hypertrophic, annular, and miscellaneous. Patients who had lichen planus planopilaris had classic lichen planus lesions elsewhere on the body or mucous membrane, follicular spinous lesions, cicatricial alopecia of the scalp and non-scarring alopecia of the axilla and groin, and those who had nail lichen planus showed longitudinal ridging and grooving, splitting (onychoschizia), longitudinal striation (onychorrhexis), onychia, and subungual hyperkeratosis; these two types were included in the miscellaneous

group. We found that the reticular lichen planus was the most common type, followed by the actinic and erosive types, in agreement with the studies of Boyd and Neldner (10) and Ingafou et al. (4). We found that all patients in the miscellaneous group had Graham-Little-Piccardi-Lassueur syndrome, characterized by cicatricial alopecia of the scalp and non-scarring alopecia of the axilla and groin, follicular spinous papules on the body, scalp or both, and pterygium formation on the nails, associated with oral lichen planus.

We found that reticular-type lichen planus showed the highest prevalence in the post-monsoon season, and was least common during summer, whereas the actinic type was more common in the pre-monsoon and summer seasons than in the winter and post-monsoon seasons.

Among recalcitrant types of lichen planus, the erosive type was the most common, followed by the actinic type. The erosive type is most resistant to treatment. el-Zawahry (8) reported a female patient who had a history of recurrence each summer over an 8-year period, exhibiting involution of the lesions during winter, in accord with our findings. Most of the new cases were the reticular type, whereas old and recurrent cases were generally the erosive type, which may account for the fact that reticular lichen planus often changes into atrophic or erosive variants in the chronic phase. The literature refers little to this aspect.

As India is a subtropical (6°45'-37°6'N, 68°7'-97°5'E) country, the high temperature and humidity throughout the year appear to account for the large number of patients presenting with lichen planus, especially in the summer.

Most patients with actinic lichen planus presented with skin lesions alone. Sunlight plays an important role in the pathogenesis of actinic lichen planus by altering the expression of self-antigen on basal keratinocytes and recruitment of cytotoxic T-cells.

Moreover, stress, especially in women as a result of cultural factors (a lifestyle confined to the family and home, and lack of social activities), and also unemployment in men, is an important reason for the large number of patients with lichen planus in India.

There is definite correlation between meteorological influence and the occurrence and remission of lichen planus, especially in tropical and semitropical countries, but a clear linear correlation between meteorological parameters and the disease presentation pattern could not be established in the present study. Further investigations will be required to clarify whether such a correlation exists.

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