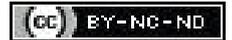


Prevalence, Risk Factors and Management of Vernal Keratoconjunctivitis: A Cross-sectional Study from a Tertiary Care Centre in Western Maharashtra, India

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ABSTRACT

Introduction: Vernal Keratoconjunctivitis (VKC) is a chronic, recurrent allergic eye condition affecting children and adolescents, particularly in warm and dusty climates. It can lead to significant ocular morbidity if not recognised and treated early.

Aim: To investigate the prevalence, risk factors, clinical presentation, and management practices of VKC among children attending a tertiary care centre in Western Maharashtra, India.

Materials and Methods: A cross-sectional observational study was conducted over 18 months (September 2023-March 2025) at a tertiary healthcare facility in Maharashtra, India. One hundred patients (200 eyes) clinically diagnosed with VKC were enrolled. Data were collected through detailed history taking, standardised ophthalmological examination, and a structured questionnaire. Descriptive and inferential statistics were applied using Statistical Package for the Social Sciences (SPSS) version 27.0, and the Chi-square test was used to assess associations. A p-value of <0.05 was considered statistically significant.

Results: VKC most commonly affected males, with 72 (72%) cases. The highest prevalence was observed in the 12-14-year age group, with 37 patients (37%). A significant association was noted between the VKC form and age group (p-value=0.007). The palpebral form was the most prevalent, seen in 69 patients

(69%), followed by the limbal form in 16 (16%) and the mixed form in 15 (15%). The most frequently reported symptoms were ropy discharge in 94 patients (94%), foreign body sensation in 81 (81%), and tearing in 76 (76%). Reported risk factors included eye rubbing in 86 patients (86%), dust exposure in 54 (54%), and Ultraviolet (UV) radiation exposure in 41 (41%). Corneal involvement was noted in 19 patients (19%), with scarring being the most frequent complication, occurring in six patients (6%). A statistically significant association was observed between the mixed VKC form and higher complication rates (p-value <0.001). Management strategies included cold compresses in all patients (100%), topical antihistamines in 83 (83%), and mast cell stabilisers in 75 (75%). Corticosteroids were required in 23 (23%), and immunosuppressants were administered to 11 (11%).

Conclusion: VKC was observed predominantly in young male patients, with the highest frequency in the 12-14-year age group. The palpebral form was the most common clinical type, and symptoms such as ropy discharge, itching, and tearing were frequently reported. Risk factors included dust exposure, UV radiation, and a history of allergy or eye rubbing. The mixed form of VKC was associated with a higher incidence of complications. A stepwise treatment approach was found to be effective, and early identification with appropriate management can help prevent long-term visual impairment.

Keywords: Adolescent health, Allergic conjunctivitis, Eye diseases, Immunotherapy, Paediatric ophthalmology

INTRODUCTION

The VKC is a chronic, bilateral, seasonally recurring allergic inflammation of the conjunctiva that primarily affects children and young adolescents, especially males. The condition is more common in warm, dry climates such as those found in India, Africa, and parts of the Middle East. VKC is characterised by a prolonged course with seasonal exacerbations and may significantly impair vision if not diagnosed and managed early [1,2]. Clinically, VKC presents in three distinct forms: palpebral, limbal, and mixed. Hallmark symptoms include intense ocular itching, ropy discharge, photophobia, and tearing. In the palpebral form, giant papillae are observed on the upper tarsal conjunctiva. The limbal variant often presents with Horner-Trantas dots and limbal hypertrophy. The mixed type shows overlapping features of both [3-5].

The disease is often associated with a history of systemic atopy such as asthma, allergic rhinitis, and eczema. Environmental factors like dust, heat, and UV exposure act as aggravating triggers. Corneal involvement, though less common, can result in serious complications including keratoconus, shield ulcers, and scarring. In many cases, VKC follows a self-limiting course that resolves after puberty; however, severe or untreated cases may result in long-

term ocular morbidity. Management involves a stepwise approach, beginning with allergen avoidance and cold compresses, followed by pharmacotherapy including antihistamines, mast cell stabilisers, corticosteroids, and immunomodulators, depending on severity [6].

The present study was undertaken to evaluate the prevalence, risk factors, clinical patterns, and treatment responses of VKC in a paediatric population attending a tertiary care centre in Western Maharashtra, India. By analysing demographic distribution, clinical presentation, and therapeutic outcomes, this study aimed to provide region-specific data to support clinical decision-making.

MATERIALS AND METHODS

This cross-sectional observational study was carried out in the Department of Ophthalmology, Dr. D.Y. Patil Medical College, Pimpri, Pune, a tertiary care centre in Western Maharashtra, India. The study was conducted over an 18-month period from September 2023 to March 2025. The setting provided access to a wide and diverse population, ensuring adequate representation from both rural and urban areas.

Approval for the study was obtained from the Institutional Ethics Sub-Committee (Approval No. IESC/PGS/2023/117), dated September

26, 2023. All patients and/or their guardians were informed about the nature and objectives of the study in their native language. Written informed consent was obtained before inclusion. Confidentiality was maintained throughout the study, and participants were assured of their right to withdraw at any stage without any consequences.

Study population: The study enrolled 100 patients clinically diagnosed with VKC, accounting for a total of 200 affected eyes. The diagnosis was based on characteristic clinical signs and symptoms such as intense itching, photophobia, ropy discharge, and conjunctival papillae. Paediatric cases were included after obtaining consent from a parent or legal guardian. The participant pool comprised individuals from both rural and urban backgrounds, providing insights into regional variations in clinical presentation.

Inclusion criteria: Patients of all ages presenting with clinical features suggestive of VKC—such as ropy discharge, intense itching, photophobia, foreign body sensation, tearing, conjunctival hyperaemia, and the presence of giant papillae or Trantas dots—were included in the study.

Exclusion criteria: Patients presenting with other forms of conjunctivitis (bacterial, viral, or fungal), a history of ocular trauma, unrelated conjunctival or corneal pathologies, and patients who were unwilling or unable to comply with examination protocols were excluded from the study.

Sample size determination: Based on prevalence data reported by Alemayehu AM et al., indicating a VKC occurrence of approximately 11%, and applying a 95% confidence interval with an allowable error of 6.5%, the sample size was calculated using WinPEPI version 11.65. The final sample size of 100 patients was deemed statistically adequate for observational inference [7]. The formula used for the calculation was:

$$n = \frac{(Z^2 * P * (1 - P))}{d^2}$$

(N=sample size, Z=Z score, P= Proportion, d= Margin of error)

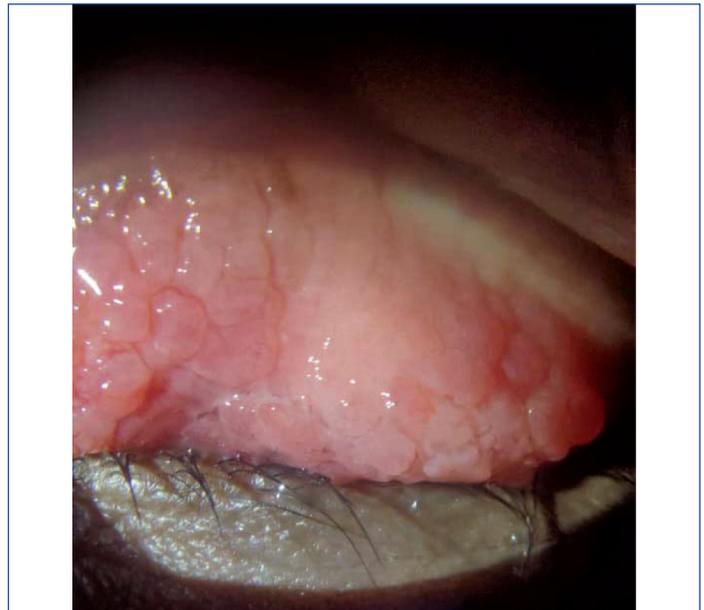
Sampling method: All consecutive patients meeting the eligibility criteria during the study period were recruited using convenience sampling. This method ensured rapid accumulation of relevant cases while maintaining adherence to the inclusion criteria.

Data collection procedure: Data were collected using a predesigned, semistructured questionnaire, refined after a pilot study involving five participants [Supplementary Document 1]. The tool collected detailed demographic data (age, sex, education, socio-economic status, area of residence), clinical symptoms (itching, redness, tearing, discharge), age of onset, personal and family history of allergy, environmental exposures (dust, UV radiation, animal contact), and treatment history. Additional data on clinical signs such as conjunctival papillae, Horner-Trantas dots, and corneal involvement were also captured. The questionnaire was formulated through collective input from all contributing authors.

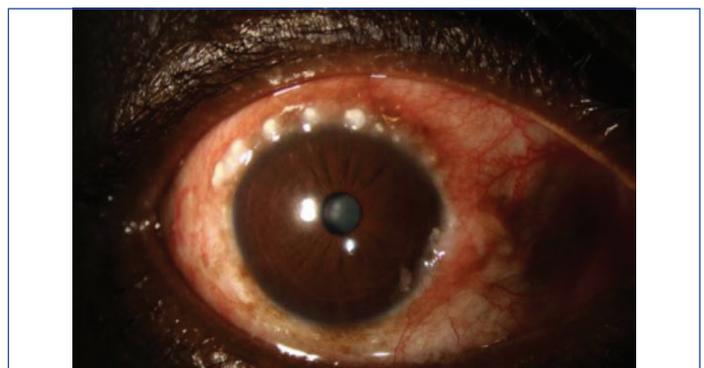
Ophthalmic examination: Each participant underwent a detailed ophthalmic examination. Visual acuity was assessed using a Snellen chart. Anterior segment evaluation was performed using slit-lamp biomicroscopy, focusing on the eyelid margin, conjunctiva (palpebral and bulbar), limbus, and cornea. Signs such as giant papillae (>1 mm), macropapillae, mucous strands, Horner-Trantas dots, corneal scarring, punctate epithelial erosions, and shield ulcers were recorded. Intraocular Pressure (IOP) was measured using a Goldmann applanation tonometer in cooperative patients. Posterior segment examination was performed using a 90D Volk lens and an indirect ophthalmoscope with a 20D lens under pharmacological dilation when necessary [Supplementary Document 2].

Anterior segment photographs were taken to document classic findings, including cobblestone papillae, Trantas dots, and corneal shield ulcers [Supplementary Document 2].

Photographic documentation: Anterior segment photographs were obtained for documentation and further reference. Images of typical cobblestone papillae [Table/Fig-1], Trantas dots [Table/Fig-2], and shield ulcers [Table/Fig-3] were captured.



[Table/Fig-1]: Palpebral form of VKC showing Cobblestone papillae in upper palpebral conjunctiva.



[Table/Fig-2]: Limbal form of VKC showing Horner-Trantas dots at the limbus.



[Table/Fig-3]: Shield ulcer complication in a patient of VKC.

STATISTICAL ANALYSIS

All collected data were entered into Microsoft Excel and analysed using IBM SPSS software, version 27.0. Descriptive statistics, including means and proportions, were used to summarise the data. Associations between categorical variables, such as VKC type and age group or symptoms, were evaluated using the Chi-square test. A p-value <0.05 was considered statistically significant. Tables and graphs were used to depict frequency distributions, associations, and outcomes of therapeutic strategies.

RESULTS

Demographic distribution: A total of 100 patients clinically diagnosed with VKC were enrolled, comprising 200 eyes. The majority of patients (37%) were aged between 12 and 14 years, representing the early adolescent period during which hormonal and environmental changes may exacerbate allergic conditions. The next most represented group was 9-11 years (29%), followed by 15-18 years (20%) and 6-8 years (14%). This age-wise trend highlights a peak incidence in mid-childhood to adolescence. A clear male predominance was observed, with 72% of patients being male and 28% female [Table/Fig-4], aligning with the known male predilection in VKC.

Parameters	Category	n (%)
Age group (years)	6-8	14 (14)
	9-11	29 (29)
	12-14	37 (37)
	15-18	20 (20)
Gender	Male	72 (72)
	Female	28 (28)
Age of onset (years)	6-8	13 (13%)
	9-11	33 (33)
	12-14	43 (43)
	15-18	10 (10)
Educational background	Primary (Class 1-5)	66 (66)
	Secondary (Class 6-12)	34 (34)
Residential area	Rural	66 (66)
	Urban	34 (34)
Socio-economic class	Class 1	12 (12)
	Class 2	21 (21)
	Class 3	34 (34)
	Class 4	27 (27)
	Class 5	6 (6)

[Table/Fig-4]: Demographic, educational, residential, and socioeconomic characteristics of VKC patients.

The data indicated that VKC most commonly began between 12 and 14 years of age, with 43 patients (43%), followed by 33 patients (33%) between 9 and 11 years, and 13 patients (13%) between 6 and 8 years. Only 10 patients (10%) reported onset in late adolescence (15-18 years). This trend supports the hypothesis of increased allergic susceptibility during the prepubertal and early adolescent periods [Table/Fig-4]. Regarding educational background, 66 patients (66%) were enrolled in primary education (classes 1-5), while the remaining 34 patients (34%) were in secondary education (classes 6-12) at the time of presentation. This reflects the significant burden of VKC among school-going children and early adolescents [Table/Fig-4].

Residential and socioeconomic characteristics: Among the study participants, 66% were from rural areas and 34% from urban locations [Table/Fig-4]. This distribution may reflect differences in environmental exposure, allergen density, and access to medical care. Socio-economic classification based on the Modified Kuppuswamy Scale [8] revealed that the largest segment (34%) fell into Class 3, followed by Class 4 (27%), Class 2 (21%), Class 1 (12%), and Class 5 (6%). This suggests that VKC affects a wide range of economic strata but is especially prevalent in the middle and lower classes [Table/Fig-4].

Seasonality of presentation: The disease showed clear seasonal trends, with the majority of patients presenting in the late winter to early summer months. February recorded the highest number of cases (19%), followed by March (16%), April (15%), and May (15%) [Table/Fig-5]. This pattern correlates with increased pollen and allergen levels during these months, supporting VKC's classification

Month	n (%)
February	19 (19)
March	16 (16)
April	15 (15)
May	15 (15)
June	9 (9)
July	4 (4)
August	3 (3)
September	4 (4)
October	4 (4)
November	4 (4)
December	4 (4)
January	3 (3)

[Table/Fig-5]: The distribution of patients according to the month of VKC presentation.

as a seasonally exacerbated condition. Fewer cases occurred during the monsoon and winter months, indicating an environmental influence on disease activity.

Allergy history and environmental exposure: A personal history of atopic disease was reported in 60% of patients [Table/Fig-6]. Rhinitis (22%) and asthma (21%) were the most common associated conditions, followed by eczema (11%) and urticaria (6%). A family history of allergy was present in 48% of patients, reflecting a potential genetic predisposition. Environmental factors such as dust (54%), UV exposure (41%), and animal contact (36%) were frequently reported. Notably, 86% of patients had a history of eye rubbing, a known risk factor for mechanical aggravation and complications like keratoconus.

Parameters	Category	n (%)
Personal history of allergy	Rhinitis	22 (22)
	Asthma	21 (21)
	Eczema	11 (11)
	Urticaria	6 (6)
	No allergy	40 (40)
Family history of allergy	Present	48 (48)
	Absent	52 (52)
Environmental exposure	Dust	54 (54)
	UV radiation	41 (41)
	Animal contact	36 (36)
	Eye rubbing	86 (86)

[Table/Fig-6]: The distribution of patients according to the type of allergic condition reported in VKC patients.

Clinical features and symptom profile: Patients presented with multiple concurrent symptoms. Ropy discharge was the most prevalent, affecting 94% of patients—a hallmark feature of VKC due to excessive mucus production. Foreign body sensation was present in 81% of patients, and excessive tearing in 76%. Itching, a dominant symptom, was reported in 66%, while pain was present in 54% of patients. Redness (47%) and photophobia (37%) were also notable complaints [Table/Fig-7]. These symptoms align with the chronic inflammatory and allergic nature of VKC.

Clinical forms and corneal involvement: VKC was clinically classified into three forms. The palpebral form was the most frequent (69%), associated with giant papillae on the upper tarsal conjunctiva. Limbal VKC accounted for 16% of cases and presented with gelatinous limbal thickening and Trantas dots. The mixed form, comprising features of both, was seen in 15% of patients [Table/Fig-8].

Corneal involvement was absent in 81% of patients. Among those affected, corneal scarring was observed in 6%, conjunctivalisation and punctate keratitis each in 4%, keratoconus in 3%, and shield ulcers in

Symptom	n (%)
Ropy discharge	94 (94)
Foreign body sensation	81 (81)
Tearing	76 (76)
Itching	66 (66)
Pain	54 (54)
Redness	47 (47)
Photophobia	37 (37)

[Table/Fig-7]: The distribution of symptoms experienced by patients.

Parameter	Category	n (%)
Clinical form of VKC	Palpebral (Cobblestone papillae)	69 (69)
	Limbal (Horner trantas dot)	16 (16)
	Mixed	15 (15)
Corneal involvement	None	81 (81)
	Corneal scarring	6 (6)
	Conjunctivalisation	4 (4)
	Punctate keratitis	4 (4)
	Keratoconus	3 (3)
	Shield ulcers	2 (2)

[Table/Fig-8]: Clinical forms and corneal involvement in VKC patients.

2% of patients [Table/Fig-8]. These findings emphasise that although VKC is often benign, it carries a risk of serious complications.

Complications: A total of 21% of patients presented with complications. Corneal scarring (6%) was the most common, likely resulting from chronic inflammation and delayed healing. Conjunctivalisation of the cornea (4%) indicated severe limbal stem cell deficiency. Punctate keratitis (4%) and keratoconus (3%) reflected surface damage and mechanical stress due to eye rubbing. Shield ulcers, found in 2% of patients, represented advanced corneal involvement. Rare complications included cataract (1%), glaucoma (1%), and ptosis (1%) [Table/Fig-9]. These data underscore the vision-threatening potential of VKC if inadequately treated.

Complication	n (%)
Corneal scarring	6 (6)
Conjunctivalisation of cornea	4 (4)
Punctate keratitis	4 (4)
Keratoconus	3 (3)
Shield ulcer	2 (2)
Cataract	1 (1)
Glaucoma	1 (1)
Ptosis	1 (1)

[Table/Fig-9]: Ocular complications observed in VKC patients.

Patients exhibiting sequelae such as keratoconus, shield ulcers, and cataract demonstrated reduced visual acuity ranging from 6/60 to 6/24. No evidence of zonular instability was appreciated on slit-lamp biomicroscopic evaluation.

Treatment modalities: Treatment strategies included both pharmacologic and non pharmacologic measures. Cold compresses were used in all patients (100%) as a basic intervention for symptomatic relief [Table/Fig-10]. Topical antihistamines were prescribed to 83% and mast cell stabilisers to 75%, indicating their role in long-term allergic suppression. Topical corticosteroids were required in 23% of patients for more severe inflammation. Immunomodulators (cyclosporine/tacrolimus) were used in 11% to reduce steroid dependence. Lubricants (12%) helped improve surface comfort. A minority of patients received antibiotics (2%), supratarsal steroid injections (2%), or anti-glaucoma medications (1%), based on specific clinical needs.

Treatment modality	n (%)
Cold compress	100 (100)
Topical antihistamines	83 (83)
Topical mast cell stabilisers	75 (75)
Topical corticosteroids	23 (23)
Topical immunomodulators (cyclosporine/tacrolimus)	11 (11)
Lubricants	12 (12)
Topical antibiotics	2 (2)
Supratarsal steroid injections	2 (2)
Topical anti-glaucoma drugs	1 (1)

[Table/Fig-10]: Treatment modalities used in VKC management.

Statistical associations: Age group and VKC type showed a significant association (p-value=0.007), with palpebral VKC being more common in younger children and mixed forms occurring more frequently in older adolescents. Area of residence (p-value=0.259) and socio-economic status (p-value=0.717) showed no significant correlation with VKC type [Table/Fig-11]. Symptoms such as itching (p-value=0.009), redness (p-value=0.002), and photophobia (p-value=0.01) were significantly more frequent in limbal and mixed VKC. No significant association was found between type of allergy or drug use history and VKC type [Table/Fig-11]. However, corneal involvement (p-value <0.001) [Table/Fig-12] and overall complication rates (p-value <0.001) were significantly higher in mixed VKC, supporting its classification as a more severe phenotype [Table/Fig-13].

A. Age group vs VKC type (p-value=0.007*)				
Age group (years)	Limbal	Mixed	Palpebral	Total
6-8	2 (12.5%)	0	12 (17.4%)	14 (14.0%)
9-11	2 (12.5%)	4 (26.7%)	23 (33.3%)	29 (29.0%)
12-14	8 (50.0%)	3 (20.0%)	26 (37.7%)	37 (37.0%)
15-18	4 (25.0%)	8 (53.3%)	8 (11.6%)	20 (20.0%)
Total	16 (100.0%)	15 (100.0%)	69 (100.0%)	100 (100.0%)
B. Area vs VKC type (p-value=0.259)				
Area	Limbal	Mixed	Palpebral	Total
Rural	12 (75.0%)	12 (80.0%)	42 (60.9%)	66 (66.0%)
Urban	4 (25.0%)	3 (20.0%)	27 (39.1%)	34 (34.0%)
Total	16 (100.0%)	15 (100.0%)	69 (100.0%)	100 (100.0%)
C. Socio-economic class vs VKC type (p-value=0.717)				
Class	Limbal	Mixed	Palpebral	Total
Class 1	2 (12.5%)	1 (6.7%)	9 (13.0%)	12 (12.0%)
Class 2	5 (31.3%)	4 (26.7%)	12 (17.4%)	21 (21.0%)
Class 3	4 (25.0%)	7 (46.7%)	23 (33.3%)	34 (34.0%)
Class 4	5 (31.3%)	2 (13.3%)	20 (29.0%)	27 (27.0%)
Class 5	0	1 (6.7%)	5 (7.2%)	6 (6.0%)
Total	16 (100%)	15 (100%)	69 (100%)	100 (100%)
D. Personal history of allergy vs VKC type (p-value=0.154)				
History of allergy	Limbal	Mixed	Palpebral	Total
Yes	6 (37.5%)	10 (66.7%)	44 (63.2%)	60 (60.0%)
No	10 (62.5%)	5 (33.3%)	25 (36.8%)	40 (40.0%)
Total	16 (100%)	15 (100%)	69 (100%)	100 (100%)
E. Type of allergy vs VKC type (p-value=0.685)				
Allergy type	Limbal	Mixed	Palpebral	Total
Asthma	3 (18.8%)	4 (26.7%)	14 (20.3%)	21 (21.0%)
Eczema	1 (6.3%)	1 (6.7%)	9 (13.0%)	11 (11.0%)
Rhinitis	4 (25.0%)	5 (33.3%)	13 (18.8%)	22 (22.0%)
Urticaria	0	0	6 (8.7%)	6 (6.0%)
No allergy	8 (50.0%)	5 (33.3%)	27 (39.1%)	40 (40.0%)

F. History of drug use vs VKC type (p-value=0.462)				
Drug use	Limbal	Mixed	Palpebral	Total
Yes	7 (43.8%)	10 (66.7%)	35 (50.7%)	52 (52.0%)
No	9 (56.3%)	5 (33.3%)	34 (49.3%)	48 (48.0%)

[Table/Fig-11]: Associations with VKC Type (Summarised).

Corneal involvement	Form of VKC				p-value
	Limbal n (%)	Mixed n (%)	Palpebral n (%)	Total n (%)	
Conjunctivalisation of cornea	2 (50.0)	2 (50.0)	0	4 (100.0)	<0.001*
Corneal scarring	0	2 (33.3)	4 (66.7)	6 (100.0)	
Keratoconus	1 (33.3)	2 (66.7)	0	3 (100.0)	
Punctate keratitis	0	0	5 (100.0)	5 (100.0)	
Shield ulcer	0	2 (100.0)	0	2 (100.0)	
No involvement	13 (16.3)	7 (8.8)	60 (75.0)	80 (100.0)	
Total	16 (16.0)	15 (15.0)	69 (69.0)	100 (100.0)	

[Table/Fig-12]: Association between type of corneal involvement and form of VKC.

Complications of VKC	Form of VKC				p-value
	Limbal n (%)	Mixed n (%)	Palpebral n (%)	Total n (%)	
Cataract	0	1 (100.0)	0	1 (100.0)	<0.001*
Conjunctivalisation of cornea	2 (50.0)	2 (50.0)	0 (0.0%)	4 (100.0)	
Corneal scarring	0	2 (33.3)	4 (66.7)	6 (100.0)	
Glaucoma	0	1 (100.0)	0	1 (100.0)	
Keratoconus	1 (33.3)	2 (66.7)	0	3 (100.0)	
Ptosis	0	0	1 (100.0)	1 (100.0)	
Punctate keratitis	0	0	4 (100.0)	4 (100.0)	
Shield ulcer	0	2 (100.0)	0	2 (100.0)	
No complication	13 (16.7)	5 (6.4)	60 (76.9)	78 (100.0)	
Total	16 (16.0)	15 (15.0)	69 (69.0)	100 (100.0)	

[Table/Fig-13]: Association between complications of VKC and form of VKC.

DISCUSSION

This cross-sectional observational study provides valuable insights into the prevalence, clinical profile, risk factors, and management of VKC among paediatric and adolescent patients attending a tertiary care centre in Western Maharashtra. Present study findings align with previous Indian and international studies, while also adding regional relevance through a robust sample size and seasonally adjusted data.

Among the study participants, 66% were from rural areas and 34% from urban, these findings were consistent with previous studies, such as that by Ukponmwan CU et al., who reported similar demographic and socio-economic patterns in VKC prevalence [8]. The palpebral form was the most frequent (69%), followed by limbal and mixed, findings compared with Leonardi A and Tabbara KF [9,10].

The demographic data revealed a significant male predominance (72%), consistent with findings from Senthil S et al., and Bielory L et al., from the Indian subcontinent, who reported male preponderance ranging between 65% and 75% [11,12]. In present study majority of cases (37%) were between 12-14 years of age aligns with findings by Koo EB et al., where peak incidence was noted between 10 and 15 years [13]. This age distribution emphasises that VKC is predominantly a disease of school-going boys, likely influenced by hormonal, immunological, and environmental factors.

Seasonal patterns of VKC observed in this study mirrored those seen in tropical and semi-arid regions. The highest incidence occurred from February to May, corresponding to spring and early summer, similar to studies by Senthil S et al., and Hayilu D et al., [11,14]. These findings reiterate the critical role of climate and

environmental allergens in disease exacerbation and highlight the need for anticipatory management during peak months.

In terms of clinical subtype distribution, present study findings showed that the palpebral form was predominant (69%), followed by the limbal (16%) and mixed (15%) forms. These results closely resemble those reported by Bielory L, where the palpebral form accounted for 67%, and by Bielory L et al., who also emphasised the dominance of palpebral VKC in Indian patients [12,15]. The clinical symptoms observed—especially ropy discharge (94%), foreign body sensation (81%), and tearing (76%)—are hallmark features of VKC and consistent with the classical symptom complex described in earlier literature [12].

A personal history of allergic disorders was present in 60% of patients, which was in line with previous studies by Ukponmwan CU and Tabbara KF, who reported associations of VKC with atopic disorders in 55-70% of patients [8,10]. Present study further revealed that eye rubbing was reported in 86% of patients, which was significant, considering its strong association with keratoconus, as described by Bielory L and Koo S [12,16].

Corneal involvement was noted in 19% of patients in the present study. This included corneal scarring (6%), conjunctivalisation (4%), punctate keratitis (4%), keratoconus (3%), and shield ulcers (2%). These findings are similar to those of Bielory L, and Koo S et al., who reported corneal complications in 15-25% of cases and emphasised that mixed VKC has the highest complication rates [12,16]. The statistical association found in our study between mixed VKC and complication rates (p-value <0.001) reaffirms the findings who have emphasised the need for aggressive treatment in mixed forms of the disease [12,13].

Management practices in present study included universal use of cold compresses (100%) and frequent use of antihistamines (83%) and mast cell stabilisers (75%), which reflects the stepladder approach described in international VKC management guidelines. Topical corticosteroids were administered in 23% of patients and immunomodulators in 11%, indicating careful escalation of therapy. These figures are similar to usage patterns reported by Koo EB, et al., and Bielory L et al., [13,15]. The occurrence of steroid-induced complications such as cataract and glaucoma (1% each) in present study further supports the call for cautious and judicious steroid use, echoing concerns raised by Tabbara KA, [10].

Significant associations were observed between VKC type and age group (p-value=0.007), as well as between symptoms like itching (p-value=0.009), redness (p-value=0.002), and photophobia (p-value=0.01) and VKC subtype. Similar associations were reported in studies by Bielory L and Koo EB et al., who noted that mixed and limbal VKC tend to present with more severe clinical profiles and complications [12,13].

Limitation(s)

This study is robust due to its comprehensive inclusion criteria, prospective design, and real-world data reflective of clinical settings. However, the lack of follow-up restricts assessment of long-term treatment outcomes. Additionally, the absence of allergen testing restricts specific aetiological conclusions. Future multicentric studies incorporating immunological profiling, tear film biomarkers, and long-term monitoring are needed to develop individualised VKC management protocols.

CONCLUSION(S)

This study highlights the clinical burden and management trends of VKC in a paediatric and adolescent population. VKC primarily affected early adolescents, with a male predominance and peak incidence in the 12-14-year age group. The palpebral form was most common, and ropy discharge, itching, and tearing were frequently reported symptoms. Environmental and allergic risk factors were prevalent. Most cases responded to conservative therapy, with

steroids and immunomodulators used selectively. Early diagnosis and tailored treatment are essential to prevent vision-threatening complications.

REFERENCES

- [1] Leonardi A, Busca F, Motterle L, Fregona IA, Plebani M, Secchi AG. Case series of 406 vernal keratoconjunctivitis patients: A demographic and epidemiologic study. *Acta Ophthalmol Scand.* 2006;84(3):406-10.
- [2] Brindisi G, Cinicola B, Anania C, De Castro G, Nebbioso M, Del Giudice MM, et al. Vernal keratoconjunctivitis: State of art and update on treatment. *Acta Bio Medica: Atenei Parmensis.* 2021;92(Suppl 7):e2021517.
- [3] Ali A, Bielory L, Dotchin S, Hamel P, Strube YN, Koo EB. Management of vernal keratoconjunctivitis: Navigating a changing treatment landscape. *Surv Ophthalmol.* 2024;69(2):265-78.
- [4] Zicari AM, Capata G, Nebbioso M, De Castro G, Midulla F, Leonardi L, et al. Vernal keratoconjunctivitis: An update focused on clinical grading system. *Italian Journal of Pediatrics.* 2019;45:01-06.
- [5] Capponi M, Cinicola BL, Brindisi G, Guido CA, Torcé MC, Zicari AM, et al. COVID-19 and abducens nerve palsy in a 9-year-old girl—Case report. *Italian Journal of Pediatrics.* 2022;48(1):102.
- [6] Bielory L. Allergic conjunctivitis and the impact of allergic rhinitis. *Curr Allergy Asthma Rep.* 2010;10:122-34.
- [7] Alemayehu AM, Yibekal BT, Fekadu SA. Prevalence of vernal keratoconjunctivitis and its associated factors among children in Gambella town, southwest Ethiopia, June 2018. *PLoS One.* 2019;14(4):e0215528.
- [8] Ukponmwan CU. Vernal keratoconjunctivitis in Nigerians: 109 consecutive cases. *Trop Doct.* 2003;33(4):242-45.
- [9] Leonardi A. Vernal keratoconjunctivitis: Pathogenesis and treatment. *Prog Retin Eye Res.* 2002;21(3):319-39.
- [10] Tabbara KF. Ocular complications of vernal keratoconjunctivitis. *Can J Ophthalmol.* 1999;34(2):88-92.
- [11] Senthil S, Thakur M, Rao HL, Mohamed A, Jonnadula GB, Sangwan V, et al. Steroid-induced glaucoma and blindness in vernal keratoconjunctivitis. *Br J Ophthalmol.* 2020;104(2):265-69.
- [12] Bielory L. The link between allergic rhinitis and keratoconus: A call for greater awareness, early intervention and future ocular surface diagnostic tools. *J Allergy Clin Immunol Pract.* 2024;12(11):3105-06.
- [13] Koo EB, Wiener LA, Syntosi A. Real-world evaluation of amblyopic patient characteristics, clinical outcomes, and treatment patterns using the IRIS Registry. *J AAPOS.* 2023;27(2):82.e1-82.e6. Doi: 10.1016/j.jaapos.2023.01.016.
- [14] Hayilu D, Legesse K, Lakachew N, Asferaw MA. Prevalence and associated factors of vernal keratoconjunctivitis among children in Gondar city, Northwest Ethiopia. *BMC Ophthalmol.* 2016;16:34-39.
- [15] Bielory L, Lien KW, Bigelsen S. Efficacy and tolerability of newer antihistamines in the treatment of allergic conjunctivitis. *Drugs.* 2005;65:215-28.
- [16] Koo S, Kim WK, Park YK, Jun K, Kim D, Ryu IH, et al. Development of a machine-learning-based tool for overnight orthokeratology lens fitting. *Transl Vis Sci Technol.* 2024;13(2):17.

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