Original Article

Ocular Morbidity in Children with Allergic Conjunctivitis: A Rural-urban Survey

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Abstract

Background: Allergic conjunctivitis occasionally may result in some ocular morbidities. This ranges from innocuous to severe forms of ocular disorders. **Aim:** This study reports and compares ocular morbidities among children with ocular allergies living in an urban and rural community. **Materials and Methods:** A comparative cross-sectional study conducted in urban and rural schools among children aged 5–15 years using a multistage sampling method. Sociodemographic data, past ocular history, history of ocular allergies, and treatment were collected with an interviewer-based questionnaire and were analysed using the Statistical Package for the Social Sciences (SPSS) software version 25. Descriptive analyses of sociodemographic variables and associated ocular morbidity were carried out. The Chi-square test was used to test associations between rural and urban groups. A $P = 0.05$ or less was considered significant. **Results:** Associated ocular morbidities were seen in 8% (19/238) of the children with allergic conjunctivitis. There was no statistically significant difference in the proportion of ocular morbidities observed between both locations (8.1 vs. 7.9 in the rural and urban location, respectively, with a $P = 1.000$). Children with mild forms of allergic conjunctivitis were 197 (82.8%), and only 1.7% had severe forms. The moderate and severe form of allergic conjunctivitis were more prevalent in the rural area ($P = 0.002$) while untreated allergic conjunctivitis was found in 168 (70.6%) of those affected. **Conclusion:** This study demonstrated a higher proportion of moderate-to-severe forms of allergic conjunctivitis among school children in the rural region with the majority being untreated.

Keywords: Allergic conjunctivitis, children, rural, untreated allergies, urban

Introduction

Allergic conjunctivitis may be associated with systemic and ocular morbidities. Systemic associations usually include rhinitis or rhinosinusitis, asthma, or eczema[1,2] while ocular associations are more of anterior segment pathologies. Ocular morbidities may be part of the clinical features of the disease or as part of the complications from the disease. These ocular morbidities range from minor to severe and include adnexa diseases, ocular surface diseases, and refractive errors.[1]

Common adnexal pathologies include ptosis, blepharitis, and recurrent chalazion which can be due to the constant rubbing associated with allergic conjunctivitis.[3,4] Anterior segment pathologies include but are not limited to cornea ectasias, corneal ulcers and scars, pannus, tarsal conjunctival papillae, perilimbal papillae, refractive errors, and dry eyes.[1] Cosmetic concerns may arise due to hyperpigmentation of the periorbital region and the brownish discoloration of the conjunctiva.[2]

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The severity of allergic conjunctivitis depends on the presence of symptoms, signs, and involvement of the cornea.[5,6]

These range from mild cases that present with symptoms of itching, tearing or mucoid discharge, redness, mild discomfort, and palpebral papillae to severe cases where complications are common.[6]

The 5-5-5 exacerbation scale system used in this study is widely accepted for severity grading.[6] This scale system enables proper and objective evaluation as well as serving as a standard operating protocol for the management of the disease.

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Management of allergic conjunctivitis includes avoidance of allergens or precipitants, use of topical antihistamines, mast cell stabilizers, low potency steroids, and nonsteroidal anti-inflammatory drugs. Ocular complications may result from failure of treatment or inappropriate treatment. For instance, the use of traditional eye medications or the injudicious use of topical drugs such as steroids may result in glaucoma, keratitis, and cataracts.[3,7-9]

Community-based studies on associated ocular morbidities are few as many studies concentrated on systemic comorbidities such as rhinitis, asthma, and eczema. Furthermore, our literature search did not yield any community-based study on ocular morbidities in allergic conjunctivitis. This is a gap in knowledge that this study hopes to fill. In addition, in Nigeria, where few visual rehabilitation resources are available,[10] morbidities from allergic conjunctivitis may increase the health burden in the country.

Although a few hospital-based studies have reported the associated ocular morbidity in allergic conjunctivitis,[8,11] the values may not be representative as it is common knowledge that hospital-based studies are prone to referral bias and may not be generalisable to the community. In addition, populations in rural communities in Nigeria may have less access to health care and so may not readily present to the hospital when there is a need to do so. A community-based study on ocular morbidities and severity of allergic conjunctivitis is therefore imperative to provide a glimpse of the magnitude of ocular morbidities among children with allergic conjunctivitis. This study reports the prevalence of ocular morbidities in a population of school children and compared prevalence and severity as well as untreated cases among rural and urban dwellers.

Materials and Methods

A community-based comparative cross-sectional study was conducted from September to December 2021, in schools located in urban Ibadan North local government and rural Saki East Local Government Area all in Oyo state, Nigeria. Ethical approval was obtained from UI/UCH Institutional ethics review board (UI/EC/21/0046). In addition, permission was obtained from the State Ministry of Education and written informed consent was obtained from the parents of all participants.

Eligibility criteria

Schoolchildren in primary and secondary schools aged 5–15 years who gave assent and whose parents gave informed consent were included in the study, while excluded were children with a previous history of ocular trauma, visual impairment from previous ocular surgeries, and children with infectious causes of conjunctivitis.

Operational definition

- Allergic conjunctivitis: The presence of recurrent or persistent eye itching with one or more of the following symptoms: tearing, discharge, redness, and edema. The signs included one or more of the following: periorbital darkening, periorbital edema, tarsal or forniceal papillae, and perilimbal papillae[2,12]
- Cornea opacities: opacities on the cornea resulting from allergic conjunctivitis such as pseudogerontoxon and central cornea scarring from shield ulcers[1]
- Cornea erosions: epithelial defects staining with fluorescein[1]
- Ptosis: drooping of the upper lid,[1] not present from birth with symptoms of ocular allergy preceding the onset of ptosis
- Refractive errors: myopia; −0.50DS or more, hypermetropia; +2.00DS or more, astigmatism of more than −0.75 DC,[13] or significant improvement in visual acuity up to 2 lines with the use of pinhole.[14] This, however, does not imply that the refractive error is secondary to allergic conjunctivitis, but an association
- Glaucoma: optic neuropathy (cup-to-disc ratio > 0.5) and elevated intraocular pressure following the use of steroids for the treatment of allergic conjunctivitis[15,16]
- Cataract: any form of lens opacity[1] with allergic conjunctivitis
- Blepharitis: inflammation of the eyelid margin[1]
- Ectropion: outward turning of the eyelid margin[1]
- Entropion: inward turning of the eyelid margin[1]
- Trichiasis: inward misdirection of lashes[1]
- Symblepharon: adhesion between palpebral and bulbar conjunctival surfaces[1]
- Ankyloblepharon: adhesion between the upper and lower lids[1]
- Madarosis: loss of eyelashes or eyebrows.[1]

Severity of allergic conjunctivitis

The severity of the allergic conjunctivitis was classified based on the 5–5–5 exacerbation grading scale for allergic conjunctivitis.[6] The clinical findings of allergic conjunctivitis were classified into the 100-point-grade group, 10-point-grade group, or 1-point-grade group, according to the clinical severity of allergic conjunctivitis, and 5 critical findings were identified in each grade group [Table 1].

Grading of allergic conjunctivitis in this study is as follows:

- Mild allergic conjunctivitis: the presence of at least upper tarsal papillae in the one-point signs (lower palpebral follicles, palpebral conjunctiva hyperemia, bulbar conjunctiva hyperemia, and lacrimation). No sign in the 10 and 100-point categories
- Moderate allergic conjunctivitis: the presence of upper papillae with at least 1 additional sign in the 10-point category (blepharitis, velvety papillary proliferation, Horner–Trantas dot, chemosis, and superficial punctate keratopathy) and/or presence of not more than 1 clinical sign in the 100-point category (cobblestone papillae, gelatinous infiltrates of the limbus, erosive epithelial keratopathies, shield ulcers, and lower palpebral papillae).
- Severe allergic conjunctivitis: the presence of at least 2 signs in the 100-point category (cobblestone papillae,

Table 1: Exacerbation grading scale

Grade of clinical signs	100-point grade	10-point grade	1-point grade
Clinical signs	1. Cobblestone papillae	1. Blepharitis	1. Upper palpebral papillae
	2. Gelatinous infiltrate of the limbus	2. Velvety papillary proliferation	2. Lower palpebral follicles
	3. Erosive epithelial keratopathies	3. Horner–Trantas dots	3. Palpebral conjunctiva hyperemia
	4. Shield ulcers	4. Chemosis	4. Bulbar conjunctiva hyperemia
	5. Lower palpebral papillae	5. Superficial punctate keratopathy	Lacrimation
Scores	100 points × number of positive findings	10 points × number of positive findings	1 points × number of positive findings
Range	0–500 points	0–50	0–5

Courtesy of Shoji *et al*.[6]

gelatinous infiltrates of the limbus, erosive epithelial keratopathies, shield ulcers, and lower palpebral papillae).

Sample size and sampling procedure

The sample size was calculated using the formula for comparing two proportions[17]

$$n = \frac{(Z_u + Z_{1\text{-}\beta})^2 \left[P_1 (1 - P_1) + P_2 (1 - P_2) \right]}{(P_2 - P_1)^2}$$

Where N is the sample size, Zα, the standard normal deviate corresponding to a level of significance of 5%; $Z_{1\text{-}\beta}$, the standard normal deviate corresponding to the power of 90%; P_1 proportion (31.5%)[4] of estimate from a previous study in an urban area and P_2, proportion (23.7%)[4] of estimate in a suburban area; and $(P_2 - P_1)$, difference between the proportion in the two groups the study hopes to detect. Accounting for 10% attrition rate, a sample size of 761 per group was calculated.

The sample frame was the population of registered students in Oyo state which according to the 2015/2016, data from shelf file from the State Ministry of Education were 1,654,357 in primary and 295,580 students in junior secondary schools. A multistage population proportionate to size sampling method was used to select the population to be studied in both Ibadan North and Saki East LGA. The study population comprised children in both public and private primary and secondary schools. A total of 1522 children were recruited and examined; 761 in each group. Table 2.

Visual acuity assessment was done using a six-meter Snellen's chart at locations with good ambient outdoor lighting. Visual acuity was assessed, one eye at a time, with the other eye properly occluded using a pediatric trial frame and an occluder. Each eye was also assessed with the use of a pinhole and spectacles if the pupil/student had one.

Screening and anterior segment examination

After the visual assessment, the participants were screened for allergic conjunctivitis using symptoms and signs. An initial anterior segment ocular examination with a magnifying loupe was carried out to assess the clinical features of allergy. Children without symptoms suggestive of allergic conjunctivitis and who on ocular examination did not have at least upper palpebral papillae had their sociodemographic data recorded and subsequently exited the study. In addition, children with ocular problems not related to allergies or who presented with visual acuity worse than 6/12 had autorefraction and detailed ocular examination to determine the cause of poor vision. Noncycloplegic autorefraction was carried out by the principal investigator for children with visual acuity of 6/12 and worse with a table-mounted autorefractor – (XIN YUAN FA 6800). Those who needed spectacles were given a prescription while those needing further care were referred to an eye clinic

Children with ocular allergies were interviewed with a questionnaire, and further anterior segment examination was done for all those with features of allergic conjunctivitis. This was conducted in a dimly lit room with the use of a pen torch and a magnifying loupe: the lid margins were examined for grossly obvious ptosis and other pathologies. Upper lids were everted to assess for papillae and/or follicles, and conjunctiva was assessed for edema, brownish discolorations, and limbal papillae.

Fluorescein was instilled after topical anesthetic drops to check for epithelial defects with the aid of blue light of the arclight and magnifying loupe. The lens of the direct ophthalmoscope was placed at +10.0D to detect the presence of any lens opacity by looking for dark shadow on the visual axis which would then be measured with the graticules in the ophthalmoscope.

Posterior segment examination was done using a direct ophthalmoscope to assess for the presence/absence of optic neuropathies or maculopathies. All ocular examination was conducted by the principal investigator to eliminate interobserver bias. Furthermore, the same instruments were used for all the children minimising instrument-dependent bias. Those with allergies were given Ocullerg® eye drops and then referred to the eye clinic for long-term care.

A pilot study was conducted in a private school in Ibadan North local government with a total of 73 students examined to test the research tool and feasibility.

Data analysis

Data were managed and analysed using the IBM SPSS Statistics for Windows,Version 25. Armon, NY:IBM Corp. Data were descriptively summarised using means and standard deviations for numerical variables and proportions for categorical variables. Comparisons between urban and

rural populations were done with Chi-square test and adjusted comparisons were done using multiple logistic regression analysis. A $P = 0.05$ or less was considered as statistically significant.

Results

A total of 1522 participants were examined, 761 in each arm, with mean ages of 11.26 (±3) years, 771 (50.6%) were males and 751 (49.4%) were females. The children with allergic conjunctivitis in both locations were 238; 74 children living in the rural region and 164 children in the urban region.

The symptom of eye itching was most common (100%), and the least common symptom was lid edema. Lid edema was significantly more common in the rural compared to the urban region with a $P = 0.006$. Table 3 reports the symptoms of allergic conjunctivitis by location.

All the children with allergies 238 (100%) had upper tarsal papillae and majority (205; 86.1%) had bulbar conjunctival hyperemia, 68 (91.9%) in the rural region and 137 (83.5%) in the urban area with no statistically significant difference. Table 4 shows the clinical signs of allergic conjunctivitis.

Significant refractive errors were found in 17 (7.1%) children. There were only 4 children with lid abnormalities: 1 (0.4%) had madarosis of both upper and lower lids and 3 children had chronic blepharitis. Four (1.7%) had superior corneal opacity (pseudogerontoxon). There was no statistically significant difference when comparing the proportion of ocular morbidities between the two school locations. Table 5 shows the proportion of ocular morbidities by location.

The most common significant refractive error seen was myopia, with 9 children having myopia, 8 children being hyperopic, and 4 children having astigmatism. There was no statistically significant difference between the rural and urban regions ($P = 1.000$). Similarly, no statistically significant difference was found when comparing the proportion of lid abnormalities between schools located in the rural and urban regions ($P = 0.09$).

Corneal abnormalities were seen only in the rural region and this was statistically significant ($P = 0.009$).

Of the children with allergic conjunctivitis, 197 (82.8%) were mild cases while the moderate cases were 37 (15.5%) and 4 (1.7%), respectively. Moderate and severe forms of allergic conjunctivitis were more common in the rural region and were statistically significant ($P = 0.002$). Table 6 shows the severity of allergic conjunctivitis by location.

The most common systemic morbidity associated with allergic conjunctivitis was rhinitis. There was no statistically significant difference between the two groups. The proportion of children with asthma was significantly higher in the urban than in rural area with a $P < 0.001$. Table 7 reports the systemic comorbidities of allergic conjunctivitis by location.

Of the 238 children with allergic conjunctivitis, 168 (70.6%) were untreated and the proportion was statistically higher in the rural area compared to the urban area. Table 8 shows the proportion of untreated allergic conjunctivitis by location.

Table 2: Numbers of schoolchildren recruited per school

Location	Rural	Urban	Total
Public primary schools	248	156	404
Private primary schools	87	94	181
Public secondary schools	299	381	680
Private secondary schools	127	130	257
Total	761	761	1522

Table 3: Symptoms of allergic conjunctivitis by location

Symptoms	Rural ($n=74$), n (%)	Urban ($n=164$), n (%)	Total ($n=238$), n (%)	χ^2	P
Itching	74 (100)	164 (100)	238 (100)	Nil	Nil
Tearing	47 (63.5)	118 (72)	165 (69.3)	1.53	0.229
Redness	55 (74.3)	105 (64)	160 (67.2)	2.64	0.137
Edema	27 (36.5)	32 (19.5)	59 (24.8)	7.880	0.006
Mucoid discharge	20 (27)	78 (47.6)	98 (41.2)	8.88	0.003
Photophobia	29 (39.2)	57 (34.8)	86 (36.1)	0.434	0.561

Discussion

The itching was the most common symptom of ocular allergy in this study and this is similar to findings in several studies globally.[4,11,18-21]

Upper palpebral papillae were present in all the children while conjunctival erythema was the second most common sign seen on ocular examination. These findings are comparable with a study by Leonardi *et al*.,[2] who reported ocular redness as the second most common symptom and sign.

Refractive error was the most common associated ocular morbidity in this study. This is not surprising as refractive errors are common ocular problems in childhood.[22,23]

Malu[8] reported similar observations in a hospital-based study on allergic conjunctivitis conducted in Jos, Nigeria. On the contrary, another hospital-based study by Fasasi *et al*.[11] documented conjunctival degenerations as the most common morbidity. They postulated that the findings may be due to the dusty environment in their locality and the middle-aged population studied. Furthermore, the use of a slit lamp by Fasasi *et al*.[11] in their study would provide better details of anterior segment findings compared to an arc light used in this study.

Myopia was the most common refractive error in our study, similarly reported in several other studies,[24-26] as myopia is more prevalent among populations of this age group. In addition, a population-based study by Wei[27] reported allergic conjunctivitis as a risk factor for the development of myopia.

Table 4: Clinical signs of allergic conjunctivitis

Clinical signs	Rural (*n*=74), *n* (%)	Urban (*n*=164), *n* (%)	Total (*n*=238), *n* (%)	χ^2	*P*
Hyperpigmented lids	19 (25.7)	24 (14.6)	43 (18.1)	4.20	0.046
Thickened lids	2 (2.7)	1 (0.6)	3 (1.3)	1.79	0.229
Blepharitis	2 (2.7)	1 (0.6)	3 (1.3)	1.79	0.229
Madarosis	1 (1.4)	0	1 (0.4)	2.226	0.311
Bulbar conjunctiva erythema	68 (91.9)	137 (83.5)	205 (86.1)	2.981	0.105
Brownish discoloration	19 (25.7)	36 (22.0)	55 (23.1)	0.398	0.618
Chemosis	10 (13.5)	12 (7.3)	22 (9.2)	2.334	0.148
Upper palpebral papillae	74 (100)	164 (100)	238 (100)		
Lower palpebral papillae	9 (12.2)	0	9 (3.8)	20.73	<0.001
Limbal papillae/Horner–Trantas dot	16 (21.6)	12 (7.3)	28 (11.8)	10.051	0.004
Cobblestone papillae	4 (5.4)	0	4 (1.7)	9.016	0.009
Superficial punctate keratopathy	2 (2.7)	0	2 (0.8)	4.47	0.096

Table 5: Proportion of ocular morbidities by location

Ocular morbidities	Rural (*n*=74), *n* (%)	Urban (*n*=164), *n* (%)	Total (*n*=238), *n* (%)	χ^2	*P*
Yes	6 (8.1)	13 (7.9)	19 (8)	0.002	1.000
No	68 (91.9)	151 (92.1)	219 (92)		
Total	74 (100)	164 (100)	238 (100)		

Table 6: Severity of allergic conjunctivitis by location

	Rural (*n*=74), *n* (%)	Urban (*n*=164), *n* (%)	Total (*n*=238), *n* (%)	χ^2	*P*
Mild	54 (73)	143 (87.2)	197 (82.8)	12.66	0.002
Moderate	16 (21.6)	21 (12.8)	37 (15.5)		
Severe	4 (5.4)	0	4 (1.7)		
Total	74 (100)	164 (100)	238 (100)		

Table 7: Systemic comorbidities of allergic conjunctivitis by location

Systemic associations	Rural (*n*=74), *n* (%)	Urban (*n*=164), *n* (%)	Total (*n*=238), *n* (%)	χ^2	*P*
Rhinitis	44 (59.5)	87 (53)	131 (55)	0.847	0.400
Asthma	2 (2.7)	36 (22)	38 (16)	14.08	<0.001
Eczema	27 (36.5)	23 (14)	50 (21)	15.50	<0.001

He postulated that a modification of the cornea occurs from alteration of the cornea tight junctions following mast cell degranulation in ocular allergy. Astigmatism may also be sequelae of allergic conjunctivitis due to persistent eye rubbing, cornea scarring, and papillae which leads to irregularity of the cornea.[4] However, the degree of astigmatism was significant in a small proportion of our study population as most children with astigmatism had values <−0.75 diopter sphere.

Eyelid morbidities were found in very few of the children. In addition, cornea abnormalities were only found in the rural dwellers which could be due to the greater number of severe and untreated eyes seen in this group. There was no case of cataract, pupillary abnormalities, cornea pannus, or glaucoma seen in this study. Contrary to our findings, Malu.[8] and Fasasi *et al*.[11] reported cataracts and glaucoma as associated ocular morbidities in their studies. This could be attributed to the hospital-based design of their studies. Expectedly, children with these associations are more likely to have presented in the hospital due to the accompanying visual impairment and severe discomfort.

There was no statistically significant difference in the proportion of ocular morbidities found in the rural and urban dwellers. However, ocular morbidities such as lid and corneal abnormalities were more in the rural dwellers than the urban dwellers. In a study in the United Kingdom, Singh *et al*.[28] in a hospital-based study on allergic conjunctivitis in children reported cornea complications such as punctate epithelial erosions, plaques, pannus, and scars resulting in visual impairment. The effect of referral bias would see children with these severe forms of allergic conjunctivitis seen more in hospital-based studies unlike community-based studies like ours.

A retrospective study conducted in a Yemen hospital by Al-Akily and Bamashmus[29] on ocular morbidities in vernal keratoconjunctivitis reported that 29% of the patients with allergic conjunctivitis were either blind or had severe visual impairment. The causes of blindness were keratoconus, steroid-induced cataract, central cornea scars, and steroid-induced glaucoma. However, our study did not observe any case of blindness and it is therefore imperative to ensure those who were untreated get care before the disease progresses to visual loss.

Furthermore, ocular morbidities from allergic conjunctivitis have been shown to affect patients' quality of life, as well as increase economic burden as patients spend more to relieve their symptoms.[30,31] Cornea scarring, madarosis, thickened lids, ankyloblepharon, symblepharon, and keratoconus may be both cosmetically and visually unacceptable. Children with these ocular morbidities may be prone to verbal bullying,[32] while those with visual impairment may perform poorly in

Table 8: Proportion of untreated allergic conjunctivitis by location

Treatment	Rural (*n*=74), *n* (%)	Urban (*n*=164), *n* (%)	Total (*n*=238), *n* (%)	χ^2	*P*
Yes	15 (20.3)	55 (33.5)	70 (29.4)	4.32	0.045
No	59 (79.7)	109 (64.5)	168 (70.6)		
Total	74 (100)	164 (100)	238 (100)		

school.[31-33] Thus, the importance of incorporating recognition and treatment of ocular allergies as part of school health and education to prevent severe forms as we observed high number of untreated cases in our study.

The most common systemic association in this study was allergic rhinitis. This is similar to community-based studies conducted on school-aged children in Northern India by Kahol *et al*.[34] and in China by Feng *et al*.[35] Children who had both allergic conjunctivitis and asthma were significantly more in the urban area. This is also in keeping with a population-based study conducted by Desalu *et al*.[36] in Ilorin Nigeria and may be attributed to urbanisation and air pollution. There was a family history of allergic conjunctivitis and other allergic/atopic diseases in our study participants, which points to a hereditary pattern as documented in several publications on allergy.[2,7,13,37,38]

Concerning the severity of allergic conjunctivitis, this study found that although the urban area had a higher prevalence of allergic conjunctivitis, mild disease was more common in urban dwellers while moderate and severe disease was more common in the rural dwellers. This may be explained by the frequent contact of children with pollen, grass, animal dander from farm animals, and dust in the rural region. It may also suggest that the allergens are more common in the rural area for our population or maybe the children in the urban region probably have better access to treatment, whether self-medication or otherwise.

There are few studies on the severity of allergic conjunctivitis and even fewer studies comparing the severity of allergic conjunctivitis between rural and urban schoolchildren in our locality. A case-control study conducted at the University College Hospital by Bekibele and Olusanya,[39] over a period of two years, reported rural dwelling as a risk factor for an increased prevalence of vernal keratoconjunctivitis and atopic keratoconjunctivitis which are the severe forms of allergic conjunctivitis. This is in keeping with our study as more of the moderate and severe forms were found in the rural region. On the contrary, Miyazaki *et al*.[40] in Japan reported increased severity in the urban population due to air pollution mostly from Nitric oxide that can be gotten from the exhaust pipes of automobiles. The advanced industrialisation in Japan may explain this difference. Duke *et al*.[41] reported a higher prevalence of the mild forms of vernal keratoconjunctivitis among children in Calabar which is in keeping with the urban findings documented in this study. Further studies to identify allergens and corroborate with the severity of diseases will shed more light on the pattern observed in this study.

A majority (70.6%) of affected children in our study population never had any form of treatment for allergic conjunctivitis. Most of them were seen among those residing in the rural area. This is in keeping with observations by Kumah *et al*.[42] who reported that 70% of their study population with allergic conjunctivitis in a community-based study were also untreated.

The lack of treatment of the rural schoolchildren may be responsible for the disease progression into moderate and severe forms. Studies have documented a reduction in the severity of allergic conjunctivitis following commencement of treatment.[43,44] Other reason for the large number of untreated cases may be poor access to health-care facilities in the rural area. Worthy of note is the difference in the presence of eye care facilities in the study location. The urban location had about 16 eye care facilities whereas the rural area had about 3 eye care centres. From verbal information, only one of the three centres in the rural location had ophthalmologists visiting at the time of this study. Furthermore, poor access to medicines may be from other reasons such as poverty and general lack of awareness.[45]

Conclusion

This study demonstrated a significant difference in the severity of allergic conjunctivitis with children from the rural region having more of moderate and severe forms of the disease. The most common associated ocular morbidity was refractive error and majority of affected children, especially in the rural areas, were untreated.

Limitations of the study

The use of noncycloplegic refraction in these children might have underestimated the true refractive state of the younger children, especially those with hyperopia. In addition, the nonutilisation of a slit-lamp biomicroscope for the ocular examination may have missed microscopic cornea abnormalities such as pannus, early keratoconus, and elevated intraocular pressure without structural optic nerve changes

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Conflicts of interest

There are no conflicts of interest.

References

1. Salmon J. Clinical Ophthalmology: A Systematic Approach. Edinburgh, london, New York, oxford, philadelphia, St Louis, Sydney, Toronto: Elseiver Health Sciences; 2020.
2. Leonardi A, Bogacka E, Fauquert JL, Kowalski ML, Groblewska A, Jedrzejczak-Czechowicz M, *et al.* Ocular allergy: Recognizing and diagnosing hypersensitivity disorders of the ocular surface. Allergy 2012;67:1327-37.
3. Wade PD, Iwuora AN, Lopez L, Muhammad MA. Allergic conjunctivitis at Sheikh Zayed regional eye care center, Gambia. J Ophthalmic Vis Res

2012;7:24-8.
4. Kim Y, Oh I, Lee J, Sim CS, Oh YS, Lee JH. Astigmatism associated with allergic conjunctivitis in urban school children. J Ophthalmol 2019;2019:9453872. Available from: https://doi.org/10.1155/2019/9453872.
5. Wu MM, Yau GS, Lee JW, Wong AL, Tam VT, Yuen CY. Retrospective review on the use of topical cyclosporin a 0.05% for paediatric allergic conjunctivitis in Hong Kong Chinese. Scientific World Journal 2014;2014:396987.
6. Shoji J, Inada N, Sawa M. Evaluation of novel scoring system named 5-5-5 exacerbation grading scale for allergic conjunctivitis disease. Allergol Int 2009;58:591-7.
7. Vichyanond P, Pacharn P, Pleyer U, Leonardi A. Vernal keratoconjunctivitis: A severe allergic eye disease with remodeling changes. Pediatr Allergy Immunol 2014;25:314-22.
8. Malu KN. Allergic conjunctivitis in Jos-Nigeria. Niger Med J 2014;55:166-70.
9. Sen P, Jain S, Mohan A, Shah C, Sen A, Jain E. Pattern of steroid misuse in vernal keratoconjunctivitis resulting in steroid induced glaucoma and visual disability in Indian rural population: An important public health problem in pediatric age group. Indian J Ophthalmol 2019;67:1650-5.
10. Okoye OI, Aghaji AE, Ikojo IN. Visual loss in a school for the blind in Nigeria. Niger J Med 2009;18:306-10.
11. Fasasi MK, Abdul Kabir AA, Hamza BA, Richard AI, Sadiat SE, Abdulfattah I. Allergic conjunctivitis in a tertiary eye hospital, Nigeria. J Kathmandu Med Coll 2015;3:149-52.
12. Fauquert JL. Diagnosing and managing allergic conjunctivitis in childhood: The allergist's perspective. Pediatr Allergy Immunol 2019;30:405-14.
13. Gilbert C, Minto H, Morjaria P, Khan I. Standard guidelines for comprehensive school eye health programs. Sightsavers International, London: London School of Hygiene and Tropical Medicine, Brien Holden Vision Institute. 2016.
14. Marmamula S, Keeffe JE, Narsaiah S, Khanna RC, Rao GN. Population-based assessment of sensitivity and specificity of a pinhole for detection of significant refractive errors in the community. Clin Exp Optom 2014;97:523-7.
15. Gupta N, Aung T, Congdon N, Dada T, Lerner F, Olawoye S. International council of ophthalmology. In: ICO Guidelines for Glaucoma Eye Care. San Francisco,California, USA: International Council of Ophthalmology; 2016.
16. Bhadauria M. Diagnosing glaucoma. Community Eye Health 2019;32:S7-8.
17. Kirkwood BR. Essentials of Medical Statistics. 2nd ed. Massachusetts,USA: Blackwell Scientific Publications; 1988. p. 413-28.
18. La Rosa M, Lionetti E, Reibaldi M, Russo A, Longo A, Leonardi S, *et al.* Allergic conjunctivitis: A comprehensive review of the literature. Ital J Pediatr 2013;39:18.
19. Bielory L, Friedlaender MH. Allergic conjunctivitis. Immunol Allergy Clin North Am 2008;28:43-58, vi.
20. Fisal N, Agha S. Conjunctivitis among rural and urban school children in Erbil governorate Iraq. Diyala J Med 2020;18:58-68.
21. Bielory L, Katelaris CH, Lightman S, Naclerio RM. Treating the ocular component of allergic rhinoconjunctivitis and related eye disorders. MedGenMed 2007;9:35.
22. Ajaiyeoba AI, Isawumi MA, Adeoye AO, Oluleye TS. Prevalence and causes of eye diseases amongst students in south-western Nigeria. Ann Afr Med 2006;5:197-203.
23. Adegbehingbe OA. Ocular Co-morbidity in Patients with Refractive Errors in Nigeria. Niger J Ophthalmol 2011;19:19-24.
24. Maduka-Okafor FC, Okoye O, Ezegwui I, Oguego NC, Okoye OI, Udeh N, *et al.* Refractive error and visual impairment among school children: Result of a south-eastern Nigerian regional survey. Clin Ophthalmol 2021;15:2345-53.
25. Iqbal F, Khalil I, Zahid M. Prevalence of refractive errors in school going children in district Faisalabad, Pakistan. Adv Ophthalmol Vis Syst 2020;10:4-6.
26. Balasopoulou A, Kokkinos P, Pagoulatos D, Plotas P, Makri OE, Georgakopoulos CD, *et al.* A molecular epidemiological analysis of adenoviruses from excess conjunctivitis cases. BMC Ophthalmol 2017;17:51.
27. Wei CC, Kung YJ, Chen CS, Chang CY, Lin CJ, Tien PT, *et al.* Allergic Conjunctivitis-induced retinal inflammation promotes myopia progression. EBioMedicine 2018;28:274-86.
28. Singh AJ, Loh RS, Bradbury JA. Demographic study of paediatric allergic conjunctivitis within a multiethnic patient population. Br J Ophthalmol 2003;87:1195-6.
29. Al-Akily SA, Bamashmus MA. Ocular complications of severe vernal keratoconjunctivitis (VKC) in Yemen. Saudi J Ophthalmol 2011;25:291-4.
30. Smith AF, Pitt AD, Rodruiguez AE, Alio JL, Marti N, Teus M, *et al.* The economic and quality of life impact of seasonal allergic conjunctivitis in a Spanish setting. Ophthalmic Epidemiol 2005;12:233-42.
31. Pitt AD, Smith AF, Lindsell L, Voon LW, Rose PW, Bron AJ. Economic and quality-of-life impact of seasonal allergic conjunctivitis in Oxfordshire. Ophthalmic Epidemiol 2004;11:17-33.
32. Horwood J, Waylen A, Herrick D, Williams C, Wolke D. Common visual defects and peer victimization in children. Invest Ophthalmol Vis Sci 2005;46:1177-81.
33. Onakpoya OH, Adeoye AO. Childhood eye diseases in southwestern Nigeria: A tertiary hospital study. Clinics (Sao Paulo) 2009;64:947-52.
34. Kahol P, Thakur M, Gupta A, Saini SK. Prevalence, morbidity and treatment seeking behavior for allergic conjunctivitis in children in a North Indian community. Clin Epidemiol Glob Health 2019;7:239-45.
35. Feng Y, Wang X, Wang F, Liu R, Chen L, Wu S, *et al.* The prevalence of ocular allergy and comorbidities in Chinese school children in Shanghai. Biomed Res Int 2017;2017:7190987. Available from: https://doi.org/10.1155/2017/7190987.
36. Desalu OO, Adeoti AO, Ojuawo OB, Aladesanmi AO, Oguntoye MS, Afolayan OJ, *et al.* Urban-rural differences in the epidemiology of asthma and allergies in Nigeria: A population-based study. J Asthma Allergy 2021;14:1389-97.
37. Rosario N, Bielory L. Epidemiology of allergic conjunctivitis. Curr Opin Allergy Clin Immunol 2011;11:471-6.
38. Bielory L. Allergic conjunctivitis and the impact of allergic rhinitis. Curr Allergy Asthma Rep 2010;10:122-34.
39. Bekibele CO, Olusanya BA. Chronic allergic conjunctivitis: An evaluation of environmental risk factors. Asian J Ophthalmol 2006;8:147-50.
40. Miyazaki D, Fukagawa K, Fukushima A, Fujishima H, Uchio E, Ebihara N, *et al.* Air pollution significantly associated with severe ocular allergic inflammatory diseases. Sci Rep 2019;9:18205.
41. Duke RE, Odey F, De Smedt S. Vernal keratoconjunctivitis in public primary school children in Nigeria: Prevalence and nomenclature. Epidemiol Res Int 2016;2016:1-6.
42. Kumah DB, Lartey SY, Yemanyi F, Boateng EG, Awuah E. Prevalence of allergic conjunctivitis among basic school children in the Kumasi Metropolis (Ghana): A community-based cross-sectional study. BMC Ophthalmol 2015;15:69.
43. Wan Q, Tang J, Han Y, Wang D, Ye H. Therapeutic effect of 0.1% tacrolimus eye drops in the tarsal form of vernal keratoconjunctivitis. Ophthalmic Res 2018;59:126-34.
44. Leonardi A, Doan S, Amrane M, Ismail D, Montero J, Nemeth, *et al*. A randomized, controlled trial of cyclosporine a cationic emulsion in pediatric vernal keratoconjunctivitis: The VEKTIS study. Ophthalmology 2019;126:671-81.
45. Ebeigbe J, Ovenseri-Ogbomo G. Barriers to utilization of eye care services in rural communities in Edo state. Borno Med J 2014;11:100-3.