Original Article

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Prevalence of Cataract Type in Relation to Axial Length in Subjects with Myopia in Southern Part of Rajasthan

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Abstract

Background: Cataract is a leading disease with increasing age of visual impairment in and around the Southern part of Rajasthan. Hence, this study was carried out for understanding the type as well as densities of cataract in relation to axial length in cases with myopia in southern part of Rajasthan. *Methods:* This prospective randomized observational case-control study of 200 eyes in the age group of > 40 years with age-related cataracts was carried out. Myopia subjects with an AXL of > 24.0 mm were taken as cases (n=100 eyes) and subjects with emmetropia with AXL ranging between 21.0–23.99 mm were considered as controls (n = 100 eyes), fulfilling our inclusion and exclusion criteria. *Results:* On comparison with emmetropic eyes and myopic eyes, they were associated with an increased prevalence of nuclear (OR: 3.64, 95% confidence interval [CI]: 3.72–6.69), but not with cortical (OR: 0.58, 95% CI: 0.68–1.08) and PSC (OR: 0.40, 95% CI: 0.56-1.01). On myopia, there was a significant association between myopia and nuclear cataract (OR: 3.8, 95% CI 2.9–5.2). Subjects between 40–50 years of age, nuclear sclerosis was predominant. *Conclusion:* Myopic eyes were associated with increased prevalence of nuclear cataract and the density of cataract was also higher in patients with higher axial length. There was significant association between axial length and PSCC ($p<0.05$).

Keywords: Myopia; Emmetropia; Cataract; Axial Length

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Introduction

Cataract is a single largest cause of visual impairment with increasing age of visual impairment in both the developing and developed countries. As the life expectancy is increasing the prevalence of senile cataract is also increasing in an aging population, the impact of age related cataract are expected to increase. Hence, understanding etiopathogenesis and risk factors for cataract is important to eliminate avoidable blindness due to cataract. It is well documented in population based studies that nuclear cataract, may lead to a myopic shift in refraction with age. However, it is not clear whether myopia predisposes to cataract formation or the other way. In our project on visual impairment, myopia was associated to the development of cortical cataract, whereas this association was not observed in any other population based studies. It is reported that early-onset myopia (defined as self-reported history of distance spectacle use before the age of 20 years) was related to posterior subcapsular (PSC) cataract, whereas non significant association was found between incident PSC cataract and baseline refraction. Even if myopia is considered a risk factor for certain subtypes of cataract, it is not clear if a threshold effect exists.

The relationship between cataract and axial length (AL) is less studied. Tanjong Pagar [2] showed no correlation between any cataract subtype and axial length. However, Kubo *et al*. [3] reported an increased severity of nuclear cataract was associated with a longer axial length. Lim *et al*. [4] stated that a longer axial length was a risk factor for progression of lenticular opacity.

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Studies on data of axial length showed further insights into the cause of mechanisms of the relationship of myopia with cataract [5,6]. In this study we aim to describe the associations of axial length and myopia with age related cataract, and to determine in a population based study of people aged 40 to 80 years the threshold effect of refraction on age-related cataract.

Aims and Objective

To study the prevalence of type as well as densities of cataract in relation to axial length in cases with myopia in southern part of Rajasthan.

Materials and Methods

This prospective randomized observational case-control study was conducted on patients attending the outdoor of Department of Ophthalmology in RNT Medical College, Udaipur between November 2017–October 2018. Every patient was screened with the inclusion and exclusion criteria of this study and detailed history taking, followed by complete ocular examination.

- External ocular examination
- Visual acuity distance and for near vision with snellens chart
- Refraction and correction
- Slit lamp examination
- Intraocular pressure
- Fundoscopy
- A scan
- B scan

Inclusion Criteria

The study includes all myopic patients (axial length > 24 mm), age groups above 40 yrs, came to eye OPD for cataract surgery.

Exclusion Criteria

The study will exclude.

- Eyes with ocular risk factors for the development of cataract (eg, retinitis pigmentosa)
- Diabetes/raised IOP /ocular trauma
- Retinal detachment
- Uveitis and vitreous hemorrhage
- Patient using systemic or topical steroid for various reasons for >3 months
- Those with history of intraocular surgery
- Lasik/PRK
- Prophylactic laser photocoagulation or cryo-treatment
- Pupillary dilation < 7 mm.

Those patients were considered as study/case subjects who were having an AXL <21 mm; using systemic or topical steroids for various reasons for >3 months, with a h/o intraocular surgery; ocular trauma; raised intraocular pressure; uveitis; pseudoexfoliation; diabetes mellitus; total cataract; LASIK/PRK; prophylactic laser photocoagulation; or cryo-treatment were excluded from the study.

Methods of data collection (Sampling procedure)

Two hundred eyes in the age group of ≥ 40 years with age-related cataracts were studied. Myopia subjects with an AXL of ≥ 24.0 mm were taken as cases (n = 100 eyes) and subjects with emmetropia with AXL ranging between 21.0–23.99 mm were considered as controls (n = 100 eyes). Informed consent was taken from all the cases before enrolling them in the study. Healthy eyes with uncomplicated cataracts of subjects 40 years and older were included in the study.

An analysis of each cataract type in cases with myopia and emmetropia, and the resulting odds ratio (OR) at 95% confidence intervals are divided into two groups. We assessed the probability of occurrence of a nuclear cataract with other types of cataract in cases with myopia and those with emmetropia. The probability of occurrence of nuclear cataract and PSC with other types of cataract; and nuclear cataract versus PSC in subjects with myopia and emmetropia was analyzed. Prevalence of different types of cataract according to AXL measurements in cases with myopia only were studied. The prevalence of different grades of nuclear cataract according to AXL measurements in cases with myopia were analyzed.

A prospective observational case-control study fulfilling the mentioned inclusion and exclusion criteria with age group of 40 years and above with age-related cataracts for objective assessment of cataract-Slit lamp Based classification system.

Lens Opacity classification system-II (LOCS - ll) was used.

Ophthalmological Examination

Patients entering the record are taken detailed history and subjected to following ophthalmic assessment:

- *Refraction*

An initial estimate of the refraction (Sphere, cylinder and axis) was measured using an autorefractor. Refraction was determined by subjective refraction. Autorefraction readings were used as the starting point and refinement of sphere, cylinder and axis was performed until the best corrected visual acuity was obtained. Refractive error was expressed as spherical equivalent (SE). Emmetropia was defined as -0.5 diopter (D) ≤ SE + 0.5 diopter. Hyperopia was defined as SE > + 0.5D. Myopia was defined as SE less than –0.5 D.

- *NCT*

Non-contact tonometers (NCT) use a puff of air to create an applanation event on the cornea, the changes in the characteristics of the corneal light reflex so produced, being measured electronically. The NCT, with its associated low cross infection risk, was used in this study to record intraocular pressure with good sensitivity and specificity and good patient compliance.

- *Slit lamp examination*

We examined the patient after dilatation of the pupil with 1% tropicamide and 2.5% phenylephrine hydrochloride eye drops, with a slit-lamp. Details of lens opacity was noted for its presence or absence (if present - type of cataract and density of nuclear cataract was noted). The methodology adopted for evaluating the type and density of the cataract was standardized in terms of illumination and magnification. The type of cataract was categorized in the following manner: cortical, nuclear, PSC and a combination as mixed cataract. Clear lens assessment was performed using oblique illumination. To avoid biasness and to maintain reliability and consistency single observer was used. Retroillumination was used to assess cortical cataract and PSC cataract. The retroillumination slit-lamp beam was fixed at 14 mm height, 1 mm width, using a 12x magnification. The illumination was kept at 100%. Nuclear cataract was assessed under oblique illumination and a slit beam was fixed at 14 mm height and 1 mm width, with 12x magnification and the slit-lamp was placed at an angle of 30 to 45°. The cortical and PSC cataract opacities appeared as darkly shaded interruptions of reddish-orange reflex. Observations and measurements were noted for each eye. Density of the nucleus was measured according to the LOCS-II classification. The rating scheme for nuclear density was primarily based on the consistency/color of the nucleus: grade 1: soft; grade 2: semi-soft (white, or yellowish white or yellowish green); grade 3: medium (yellow); grade 4: hard nuclei (amber color); grade 5: rock hard (black color or brunescent).

- *Fundoscopy*

Dilated fundus examination using a slit lamp biomicroscope and a non contact 78D lens was done to rule out exclusion criterion like DM retinopathy/ glaucoma, retinal detachment, retinitis pigmentosa.

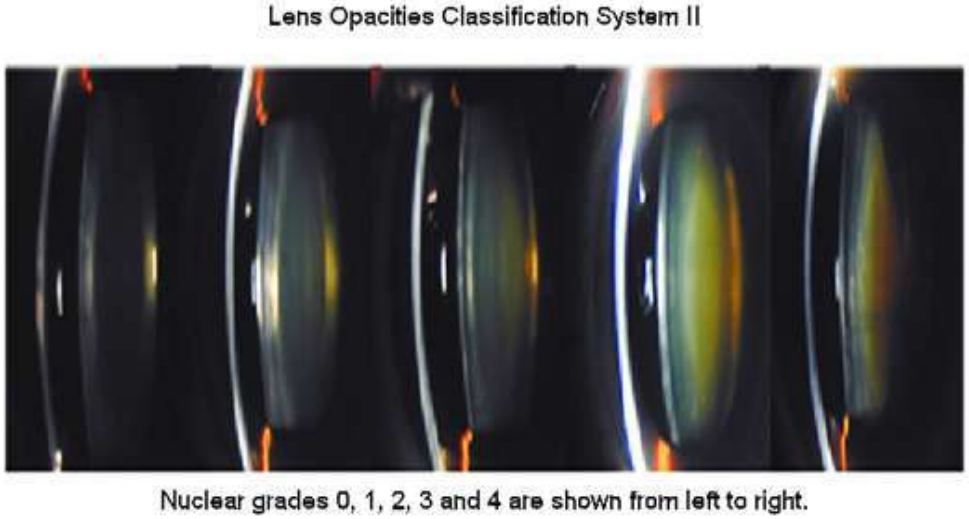


Fig. 1:

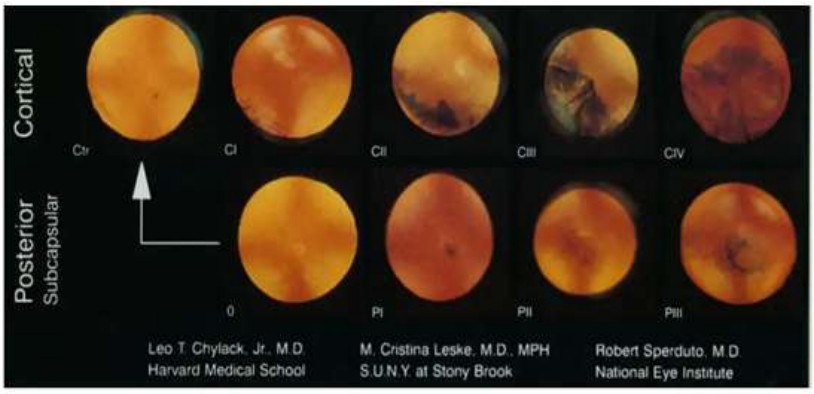


Fig. 2: Cortical and PSC Cataracts in Retroillumination

- *A scan*

Before dilatation of the pupil an AXL measurement was taken. Ocular dimensions including AXL were measured with an A-scan ultrasound with a high frequency (10 MHz) and low energy ultrasonic pulses emitted by the probe. AXL was determined until five acceptable values were generated for each eye and an average value was obtained from this.

- B scan - if fundoscopy is not possible

Fig. 3: A-scan probe

Fig. 4: A-scan Biometry

Results

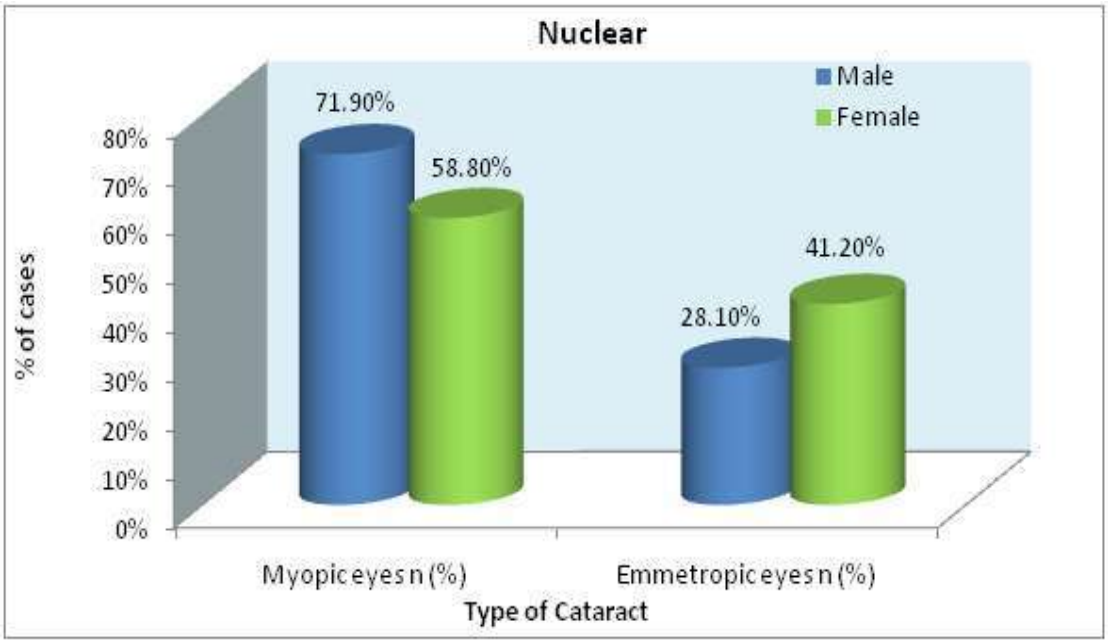
Sixty one percent of the subjects had nuclear cataract, 1% had Cortical Cataract, 6.0% had PSC, 18% subjects had Nuclear + PSC and 14% had Mixed Cataract. In patients aged above 40 years, nuclear cataract was more often encountered with myopia (Table 1).

Table 1: Prevalence of types of cataracts in Emmetropic and myopic group

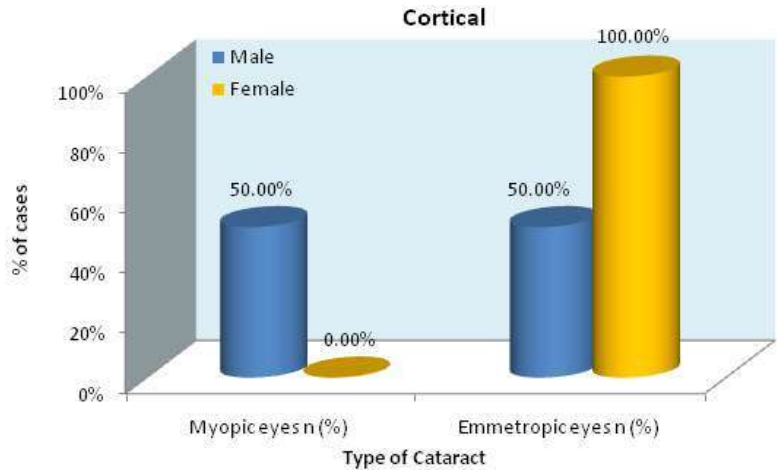
Type of cataract	Myopic Eyes n (%)	Emmetropic Eyes n (%)	Significance
Nuclear	61 (61.00%)	30 (30.00%)	p < 0.001
Cortical	1 (1.00%)	5 (5.00%)	p < 0.001
PSC	6 (6.00%)	14 (14.00%)	p < 0.001
Nuclear + PSC	18 (18.00%)	29 (29.00%)	p = 0.290
Mixed (nuclear + cortical + PSC)	14 (14.00%)	22 (22.00%)	p < 0.001

Table 2 : Distribution of different types of cataracts between emmetropic and genders myopic group.

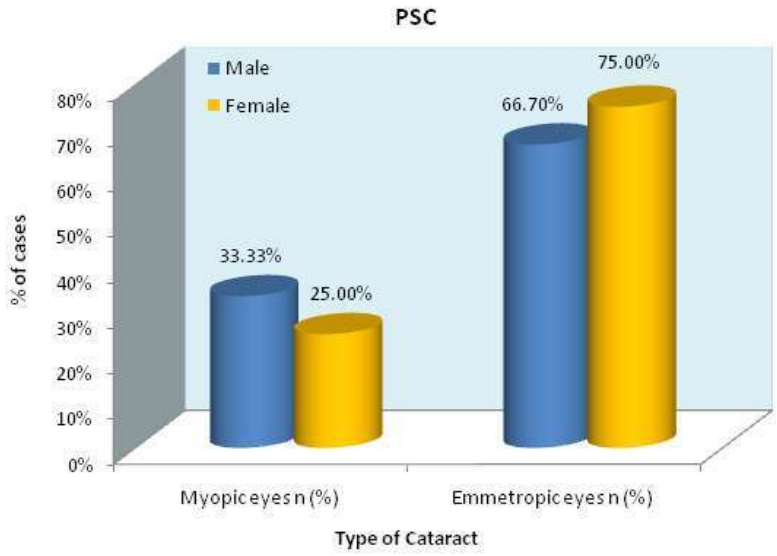
Type of Cataract	Gender	Myopic eyes n (%)	Emmetropic eyes n (%)	Significance
Nuclear	Male	41 (71.9%)	16 (28.1%)	*p* < 0.001
	Female	20 (58.8%)	14 (41.2%)	
Cortical	Male	1 (50.0%)	1 (50.0%)	*p* = 0.051
	Female	0	4 (100%)	
PSC	Male	4 (33.3%)	8 (66.7%)	*p* = 0.698
	Female	2 (25.0%)	6 (75.0%)	
Nuclear + PSC	Male	9 (36.0%)	16 (64.0%)	*p* = 0.698
	Female	9 (40.9%)	13 (59.1%)	
Mixed (nuclear + cortical + PSC)	Male	8 (40.0%)	12 (60.0%)	*P*=0.305
	Female	6 (37.5%)	10 (62.5%)	



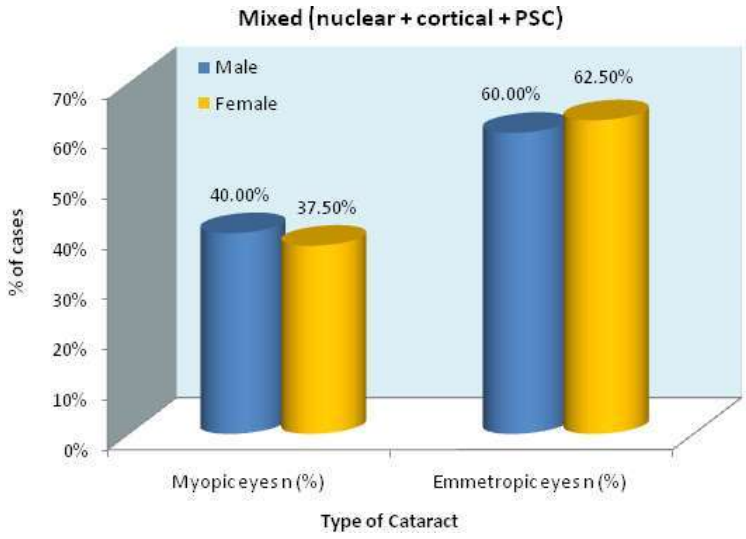
Graph 1: Distribution of different types of cataracts between emmetropic and genders myopic group.



Graph 2: Prevalence of cortical cataracts between genders myopic and emmetropic group.



Graph 3: Prevalence of PSC cataracts between emmetropic and genders myopic group.



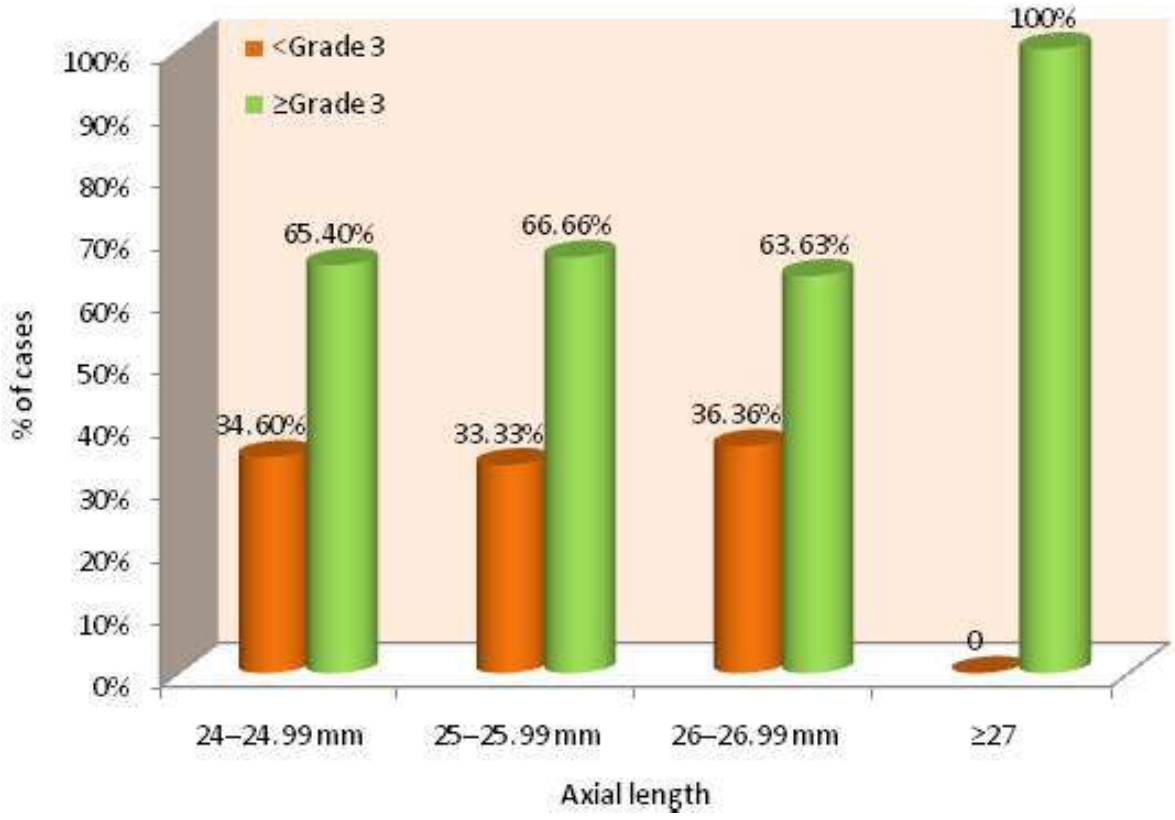
Graph 4: Prevalence of Mixed cataracts between emmetropic and genders myopic group.

Table 3: Distribution of different types of cataracts in myopic and emmetropic group in different age groups.

	40 - 49 yrs of age		50 – 59 yrs of age		60 – 69 yrs of age		≥ 70 yrs of age	
Type of cataract	**Myopia**	**Emmetropia**	**Myopia**	**Emmetropia**	**Myopia**	**Emmetropia**	**Myopia**	**Emmetropia**
Nuclear	11 (61.1)%	3 (16.7%)	24 (64.9%)	11 (33.3%)	18 (62.0%)	10 (29.4%)	8 (50.0%)	6 (40.0%)
Cortical	0	1 (5.5%)	0	1 (3.0%)	0	2 (5.9%)	1 (6.2%)	1 (6.7%)
PSC	4 (22.2%)	8 (44.4%)	1 (2.70%)	4 (12.1%)	1 (3.40%)	2 (5.9%)	0	0
Nuclear + PSC	3 (16.7%)	4 (22.2%)	8 (21.6%)	5 (15.1%)	5 (17.2%)	15 (44.1%)	2 (12.5%)	5 (33.3%)
Mixed (nuclear + cortical + PSC)	0	2(11.1%)	4 (10.8%)	12 (36.4%)	5 (17.2%)	5 (14.7%)	5 (31.3%)	3 (20.0%)

Table 4: Distribution of different types of cataracts in myopic eyes with increase in axial length

Type	**24–24.99 mm**	**25–25.99 mm**	**26.00–26.99 mm**	**≥ 27.00 mm**
Nuclear	34 (59.6%)	17 (62.9%)	4 (57.14%)	6 (66.66%)
Cortical	1 (1.75%)	0	0	0
PSC	4 (7.0%)	1 (3.70%)	1 (14.3%)	0
Nuclear + PSC	10 (17.5%)	5 (18.5%)	1 (14.3%)	2 (22.22%)
Mixed (nuclear + cortical + PSC)	8 (14.0%)	4 (14.8%)	1 (14.3%)	1 (11.11%)



Graph 5: Distribution of different grades of cataracts according to axial length in myopic group

Discussion

A detailed evaluation of the relationship between myopia and the type of cataract were attempted by very few population-based studies. The prevalence between cataract and high myopia has been well established and an association between cataract and simple myopia is suggested. Anecdotal evidence and clinic-based studies have suggested that myopia, particularly severe and pathologic myopia, may increase the risk of cataract. The visual impairment project showed a strong cross-sectional association between nuclear opacity and myopia.

The associations of myopia with the cataract subtypes (cortical, nuclear, and PSC) in the GEE models (Table 1). Compared with myopic eyes and emmetropic eyes were associated with an increased prevalence of nuclear (OR: 3.64, 95% confidence interval [CI]: 3.72–6.69), but not with cortical (OR: 0.58, 95% CI: 0.68–1.08) and PSC (OR: 0.40, 95% CI: 0.56–1.01). As axial length increased (i.e., increasing myopia), there was an increased OR, similar to Armstrong[1] end of nuclear cataract ($p < 0.001$).

Considerable variation exists in published literature regarding what constitutes high myopia. Some authors refer to the refractive error of the eye, while others refer to the power of the implanted IOL. In some studies, an AXL of 25 mm was used to define myopia. In another study [7], myopia was defined as an AXL of 24.5 mm or more. We have defined myopia as an AXL of ≥ 24 mm. Reliable epidemiological population-based data on the prevalence of cataract in reference to AXL is not available in India. In our study, we have described only the prevalence of different types of cataract in relation to AXL. We did not, however, address the issue of the patients' accessibility to cataract surgery.

The majority of the subjects with cataract in our series of high myopia were in the age group of 50–59 years. In another report, a higher incidence of cataract was noted in subjects with myopia in the age group of 50–59 years when compared with other types of refractive error. In the present series, there was a predominance of men in the high myopia group. Similar observations regarding male preponderance were stated in a report on subjects with myopia undergoing cataract surgery. In our present study of the myopia group, we found an association between nuclear cataract and PSC, but none between cortical cataract and PSC. The Beaver Dam Eye [8] Study revealed that when age and gender data were adjusted in patients with myopia who had incurred different types of cataract, myopia was strongly related to nuclear cataract and PSC, but not to cortical cataract.

The association between nuclear cataract and myopia has been demonstrated in several population-based studies among adults of different ethnicities. In our series on myopia, we found a significant association between myopia and nuclear cataract (OR: 3.8, 95% CI 2.9–5.2). The Blue Mountains Eye Study [4,9] made a similar observation (OR: 3.3%; 95% CI 1.5–7.4). In our series of subjects between 40–50 years of age, nuclear sclerosis was predominant. In another study of subjects undergoing cataract surgery, the authors reported a preponderance of nuclear sclerotic cataracts in young subjects with high myopia. Early onset of nuclear sclerosis has been described in another report as well. The relationship between myopia and PSC is controversial. Unlike nuclear cataract, however, PSC does not appreciably effect refraction. Therefore, it has been suggested that this relationship may be causal and myopia may be a risk factor for the development of PSC. While PSC was not associated with high myopia in our series, a relationship between PSC and high myopia has been described in other studies. This premise is supported by findings from the Blue Mountains Eye Study [9] in which myopic refraction and early onset myopia were related to the increased odds for the occurrence of PSC. The Blue Mountains Eye Study[4] supports the premise that long-standing myopia is an independent risk factor for age-related cataract, particularly PSC. In our series, the prevalence of PSC in the myopia group was 6%, while this figure ranged from 24% to 40% in other studies. In our series, no association was observed between cortical cataract and myopia. Similar observations on the association between myopia and cortical cataract have been reported in other studies. In the present study, in subjects less than 49 years of age, the cataract density was higher in eyes with high myopia compared with those eyes with emmetropia. However, we found a statistically significant difference in the cataract density among subjects with myopia and emmetropia; and, as we expected, the occurrence of nuclear cataract was higher with the myopia group. O'Donnell and Maumenee [10] first described cataract as discrete nuclear sclerosis in young subjects with axial myopia and nuclear sclerotic cataract as the cause of unexplained visual loss in subjects with axial myopia. Kaufman [11] and Sugar, in their series on young subjects with high myopia, described the early onset of discrete nuclear sclerotic cataract. To our knowledge, few studies to date have proposed

different mechanisms for cataract formation in the high myopia group.

Our study has important implications. The observations documented in our clinic-based study merit detailed evaluation at the community level to gain an increased understanding of this problem. The relationship between axial myopia and the onset of cataract in young individuals is clearly established. The density of cataract was higher in the myopia group. The strength of our study is that we have defined myopia with an axial measurement rather than with a refractive measurement and also that we have reported the grade of nuclear cataract. We used standardized methods to measure AXL and to establish the density of cataract during data collection. The limitations of this study should also be considered. It was not possible to determine the temporal relationship between AXL and the type or density of cataract because of the cross-sectional nature of the study. Being a clinic-based population study, there may have been a bias during selection. The examiner knew the AXL measurements when observing the type and density of cataract.

Conclusion

Myopic eyes were associated with increased prevalence of nuclear cataract and the density of cataract was also higher in patients with higher axial length. Association was found between axial length and PSCC.

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