Original Article

A study of the prevalence of nuclear, cortical, posterior subcapsular, mixed lens opacities in age-related cataractous population

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Abstract

Background: The purpose of the study was to study the prevalence of various subtypes of lens opacities in a clinic-based age-related cataractous population. We also evaluated the effect of age and axial length (AXL) on different types of cataract.

Methods: This observational clinic-based study was carried out on 2448 patients above 40 years of age with age-related cataracts. Only one eye of each subject was randomly selected for the study. The study population was categorised according to age (in terms of decade) and AXL as axial hypermetropes <23.40 mm, emmetropes 23.40–23.90 mm and myopes >23.90 mm.

Results: Mixed cataract (52.9%) was the most frequently encountered type of cataract followed by nuclear (22.2%), posterior subcapsular (18.9%) and cortical (6.0%). In eyes >50 years, mixed cataract was most common (59.2%), while in eyes between 40–50 years, posterior subcapsular cataract (PSC) was more common (48.7%). In eyes >50 years of age, mixed cataracts were more common compared to isolated cataracts (odds ratio: 1.48, 95% confidence interval: 1.24–1.78). In eyes <50 years, in hypermetropes and emmetropes PSC (57.5% and 57.8%), while in myopes nuclear cataract emerged as a predominant category (39.4%).

Conclusions: The most commonly observed type of cataract was the mixed type. In younger age groups, isolated cataracts were predominant (PSC being the most frequently observed type). Mixed cataracts were predominant in older age groups. In eyes below 50 years, PSC was predominant in axial hypermetropes and emmetropes, while in those with axial myopia, nuclear cataract was predominant.

Keywords: Age, lens opacities, prevalence

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INTRODUCTION

Almost 80% of blindness and nearly all treatable blindness in India[1,2] have been attributed to cataract, a disease that is far less common a cause of blindness in developed nations. Even after over a decade of sustained emphasis on cataract eradication, age-related cataract remains the most common

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cause of blindness in India. A recent population-based study[3] in the state of Andhra Pradesh in southern India reported that cataract was the cause of nearly 45% of current blindness. Epidemiologic details on this disease are limited and inadequate.[4-6] Epidemiological studies have suggested an early onset and higher prevalence of cataract amongst persons of Indian descent compared with populations in the West and elsewhere in the developing world.[7-9] Surveys in northern India have found senile cataract appearing and steadily increasing after age 30, with a prevalence of 13.36% among persons aged 30 and older.[10-12]

Reports on population-based study help us understand the overall prevalence of the disease. On the other hand, such study of clinic-based population helps healthcare provide to sketch how to modify the healthcare. We have studied the prevalence of various forms of cataract in a cross-section of eyes in a clinic-based cataractous population. We are presenting data on the prevalence of specific types of opacities by age and axial length (AXL).

MATERIAL AND METHODS

This observational clinic-based study of 2448 eyes of 2448 patients with bilateral age-related cataracts was undertaken between June 2003 and December 2004 at Ahmedabad, in the state of Gujarat in India. The Iladevi Cataract and IOL Research Centre, where the study was carried out, was established in 1991 for providing tertiary care services, especially for those with cataract. The clinic caters to patients from various parts of the country. Annually, 8000 patients including old and new cases are seen at the clinic and cataract constitutes 5000 of these. On an average, 1500 eyes undergo cataract surgery annually.

The study involved eyes with bilateral age-related cataracts in those aged above 40 years. Institutional review board approved the study. Each subject signed a consent form before enrolling for the study. Healthy eyes with uncomplicated cataracts in those between 40 and 80 years of age were included in the study. A single eye of each patient was randomly selected to avoid correlation effect in the statistical analysis. Eyes younger than 40 years and eyes with ocular risk factors for the development of cataract (e.g., retinitis pigmentosa, previous ocular surgery, diabetic retinopathy, retinal detachment, pseudoexfoliation, glaucoma, history of uveitis, white mature cataract and posterior polar) were excluded. Eyes which had a history of using systemic or topical steroids for various reasons and those which could not attain 7 mm dilation were also excluded from the study. The patient selection was as follows: Each clinic day, the first 20 consecutive patients over 40 years of age were evaluated for cataract. After dilation of the pupil, first ten patients who fit the inclusion criteria were selected for the study. A trained observer recorded the observations and measurements for each eye. Measurement of AXL was obtained with an OcuScan (Alcon laboratories, Texas, USA) A-scan biometry. AXL was determined until ten acceptable values were generated for each eye and an average value was obtained from this.

The procedure for the assessment of cataract in the present study is described here. After dilation of the pupil with 1% tropicamide (Sunways Pvt. Ltd, India) and 2.5% phenylephrine hydrochloride eye drops (Sunways Pvt. Ltd, India), the patient was examined with a slit lamp. A single observer was used so as to avoid bias and to maintain reliability and consistency. The methodology adopted for evaluating the type of cataract was standardised in terms of illumination and magnification. The type of cataract was categorised in the following manner: nuclear, cortical and posterior subcapsular cataract (PSC) and a combination of these as mixed cataract. Nuclear cataract was observed under oblique illumination, and a slit beam was fixed at 1 mm width and height at 14 mm with ×12 magnification where the slit lamp was placed at an angle of 30° to 45°. The retroillumination was used to assess cortical cataract and PSC. The retroillumination slit beam was fixed at 1 mm width and height at 14 mm at ×12 magnification. The illumination was kept at 100%. The cortical cataract and PSC appeared as darkly shaded interruptions of reddish orange reflex.

Statistical analysis

The study population was broadly categorized according to age (in terms of decade) and AXL and was further subdivided into axial hypermetropes <23.40 mm, emmetropes 23.40–23.90 and myopes >23.90 mm, respectively. The odds ratio, test of proportion, logistic regression and Chi-square tests were used to estimate the prevalence of specific types of opacities with reference to age and AXL. Statistical analysis was done using the statistical software IBM SPSS Statistics version 26 (IBM Corp. Somers NY, USA).

RESULTS

The mean age of 2448 study subject was 43.10 ± 19.91 (range: 40–80) years. The mean AXL recorded was 23.47 ± 1.61 mm. The prevalence of different types of cataract was 22.2% nuclear cataract, 6.0% cortical cataract, 18.9% PSC and 52.9% mixed cataract ($P < 0.001$). The

prevalence of the various types of cataract in different age groups is given in Table 1. In eyes below 49 years, PSC was more often encountered than other types of cataract. The analysis with the test of proportion revealed PSC to be predominant in eyes between 40 and 49 years when compared to other types of cataract, and it was statistically significant ($P < 0.001$). Between 50 and 59 years, 60 and 69 years and 70 years and above, the test of proportion revealed that the mixed type of cataract was predominant and it was statistically significant ($P < 0.001$). In eyes of 50 years and above, mixed cataracts were predominant rather than the isolated type of cataract (odds ratio [OR]: 1.48, confidence interval [CI]: 1.24–1.78). This implies that the chances of patients aged above 50 years having isolated cataract are lower by 48% when compared to their chances of having mixed cataract. In eyes below 50 years, the prevalence of isolated cataracts was predominant (OR: 1.17, CI: 1.08–1.26).

The general prevalence of different types of cataract in hypermetropes, emmetropes and myopes according to AXL is shown in Table 2. Overall, the prevalence of mixed cataract was predominant in all the three groups of AXL and its distribution was the same in all the three groups. Further, after mixed cataract, the prevalence of nuclear cataract was predominant in the myopic group, while PSC was predominant in the emmetropic group. In the 40–49-year age group, in hypermetropes and emmetropes, PSC emerged as a predominant category, whereas in the 50–59-year age group and at 60 years and above, mixed cataract emerged as a prominent type. While in the 40–49-year age group, nuclear cataract emerged as a predominant category in myopes, in the 50–59-year age groups and at 60 years and above, mixed cataract emerged as a prominent type (Table 3). When the chances of occurrence of nuclear cataract against PSC were compared for the 40–49-year age group with other age groups and also to the three groups of AXL, it was found that the chances of PSC occurring were 7.7 times higher than the chances of nuclear cataract occurring ($P < 0.001$). Furthermore, with every increase in the AXL group, there was a decline of 39% in the odds of PSC occurring (OR: 0.61, $P < 0.001$).

Table 1: Distribution of different types of cataract based on age groups

Type of cataract	40-49 years No. (%)	50-59 years No. (%)	60-69 years No. (%)	≥70 years No. (%)	Total No. (%)
Nuclear	121 (19.0)	110 (20.5)	191 (22.5)	121 (28.5)	543 (22.2)
Cortical	32 (5.0)	45 (8.4)	57 (6.7)	13 (3.1)	147 (6.0)
PSC	310 (48.7)	70 (13.0)	60 (7.1)	23 (5.4)	463 (18.9)
Mixed	173 (27.2)	312 (58.1)	542 (63.8)	268 (63.1)	1295 (52.9)

No.=Number of eyes; PSC=Posterior subcapsular cataract

Table 2: Distribution of different types of cataract based on refractive error

Type of cataract	Hypermetropes No. (%)	Emmetropes No. (%)	Myopes No. (%)	Total No. (%)
Nuclear	253 (19.9)	70 (16.2)	220 (29.4)	543 (22.2)
Cortical	82 (6.5)	20 (4.6)	45 (6.0)	147 (6.0)
PSC	251 (19.8)	115 (26.7)	97 (13.0)	463 (19.0)
Mixed	683 (53.8)	226 (52.4)	386 (51.6)	1295 (52.9)

No.=Number of eyes; PSC=Posterior subcapsular cataract

Table 3: Distribution of different types of cataract based on age groups and refractive error

Age group (years)	Type	Hypermetropes No. (%)	Emmetropes No. (%)	Myopes No. (%)	Total No. (%)
40-49	Nuclear	27 (9.2)	20 (13.0)	74 (39.4)	121 (19.0)
	Cortical	20 (6.8)	6 (3.9)	6 (3.2)	32 (5.0)
	PSC	169 (57.5)	89 (57.8)	52 (27.7)	310 (48.7)
	Mixed	78 (26.5)	39 (25.3)	56 (29.8)	173 (27.2)
50-59	Nuclear	44 (16.2)	12 (16.9)	54 (27.8)	110 (20.5)
	Cortical	23 (8.5)	4 (5.6)	18 (9.3)	45 (8.4)
	PSC	33 (12.1)	15 (21.1)	22 (11.3)	70 (13.0)
	Mixed	172 (63.2)	40 (56.3)	100 (51.5)	312 (58.1)
60-69	Nuclear	111 (23.6)	22 (17.1)	58 (23.2)	191 (22.5)
	Cortical	33 (7.0)	7 (5.4)	17 (6.8)	57 (6.7)
	PSC	34 (7.2)	9 (7.0)	17 (6.8)	60 (7.1)
	Mixed	293 (62.2)	91 (70.5)	158 (63.2)	542 (63.8)
70 and above	Nuclear	71 (30.6)	16 (20.8)	34 (29.3)	121 (28.5)
	Cortical	6 (2.6)	3 (3.9)	4 (3.4)	13 (3.1)
	PSC	15 (6.5)	2 (2.6)	6 (5.2)	23 (5.4)
	Mixed	140 (60.3)	56 (72.7)	72 (62.1)	268 (63.1)

No.=Number of eyes; PSC=Posterior subcapsular cataract

DISCUSSION

It is difficult to compare the results of different studies that have explored the distribution of cataract types in the general population because of the differences in age structures, study designs, lens classification systems and definitions of cataract. In the present study, we found that mixed cataract was more prevalent in older age-related cataractous population. In the Framingham Eye study while estimating the prevalence rates of nuclear and cortical cataract and PSC in persons between 52 and 85 years, it was found that the proportion with more than one type of cataract increased from 26.5% for ages 52–64 years to 47.1% for ages 75–85 years.[13] In another population study based on the prevalence of lens opacities in those aged 40 years or more, it was documented that the most common type of cataract was the mixed type of cataract followed by nuclear only, cortical only and PSC only.[14] In another study on the prevalence of cataract in a rural Indonesian population aged 21 years or older, it was found that the most common type of cataract was mixed cataract followed by nuclear only and cortical only.[15] In the same study[15] in those below 40 years of age, cortical cataract was found to be the most common type. However, in the present study, we found PSC to be more prevalent in younger patients.

Often the marked differences between cataract prevalence rates between countries can be broadly attributed to differences in environment and/or differences in genetics (i.e., race). There is evidence that race influences type and prevalence of cataract, but the extent of this influence is unclear and warrants further investigation.[16] In terms of environmental influences, ultraviolet light is one of the most consistently cited risk factors for the development of opacity, especially cortical cataract and PSC.[17-19] In the present study, in younger age groups, it is likely that our subjects might have been exposed to high levels of sunlight. Further as expected, the prevalence of mixed cataract increased with age. We believe age is likely to be representative of other variables such as duration of exposure to ultraviolet light.

In our study, we found a greater proportion of eyes with isolated PSC in the younger age group than amongst the elderly population. In another report,[20] it was observed that PSCs appeared in eyes 10 years earlier than other types of cataract. In our previous study on young individuals undergoing cataract surgery, PSCs were the most frequent types encountered.[21] Another study has suggested that the proportion of PSC might be higher in younger individuals.[22] It has been noted that PSC was found in the eyes of those who underwent surgery and who were younger than those who had undergone surgery for other types of lens opacities.[23] We believe the increased prevalence of PSC in younger age groups could be due to increased visual disability associated with this cataract type, leading to a higher presentation for early cataract extraction surgery while with nuclear cataract, we speculate the presentation could be delayed due to compatible near visual acuity. A few reports have suggested that these marked differences between cataract prevalence in different age groups could be due to differences in the environment.[15] We believe that, apart from environmental factors, there may be certain risk factors that may be more prevalent in younger age groups. To investigate the possibility of the aetiology of cataracts being different for young adults, the incidence and prevalence of cataracts need to be followed up carefully over the coming decades.

In the present study, the associations of lens opacities with AXL were also examined. While most published articles in literature have defined myopia in terms of refractive error, we chose the AXL of the eye as a reference to define refractive errors.[24-26] To the best of our knowledge, this is the first study of its kind documenting cataract prevalence employing AXL rather than the refractive error as the criterion to define myopia, hypermetropia and emmetropes. In the present study, mixed cataract and PSC were most frequently encountered in hypermetropes and emmetropes, while in myopes, nuclear cataract was the predominant type. In all the three groups, there was a weak association with cortical cataract. Another study that used the spherical equivalent for categorising refractive errors found the nuclear cataract to be more prevalent with myopia but not cortical cataract or PSC, while in hypermetropes, it found a weak association with cortical cataract and PSC.[27]

In our series, in eyes between 40 and 50 years, PSC was predominant in axial hypermetropes and emmetropes. Further with advancing age, the prevalence of the mixed type of cataract was predominant in axial hypermetropes and emmetropes. The association between nuclear cataract and myopia has been demonstrated in population-based studies amongst adults of different ethnicities.[28,29] Cross-sectional data from different studies have provided evidence that an association exists between myopia and both nuclear and PSCs.[22,30,31] In our series on myopia in younger age groups, we found a significant association between myopia and nuclear cataract. It was previously reported that some high myopia eyes appear to suffer from early cataract development. The early onset of nuclear sclerosis has been described in some reports.[32-34] O'Donnell and Maumenee[33] first described cataract as discrete nuclear sclerosis in young eyes with axial myopia and nuclear sclerotic cataract as the cause of unexplained visual loss in eyes with axial myopia. Kaufman and Sugar[34] in their series on young eyes with high myopia, described the early onset of discrete nuclear sclerotic cataract.

The limitations of this study have to be kept in mind. First, one might expect a difference in the distribution of cataract types between the clinic population and the general population. Second, we did not follow the protocol of the Lens Opacities Classification System (LOCS)[35] for grading the cataract. Third, the impact of different types of cataract on visual acuity was not noted in the study. This could have been used in predicting the need for early cataract surgery in future.

The implications of the present study lie in identifying and characterising the types of cataract associated with increasing age. This is very important as this may facilitate the identification of the risk factors associated with the type of cataract. In our previous study, we could identify the specific type of morphology of PSC existing for different risk factors. However, further studies need to be done with different types of cataract for morphological evaluation to identify the specific risk factor. Further, young eyes, particularly those that complain of decreased visual acuity,

should be dilated to look for any subtle changes on the posterior capsule under retroillumination.

In conclusion, it can be stated that the distribution of isolated cataracts was predominant in the younger age groups. The prevalence of PSC was predominant in the younger age groups when AXL was not considered. In older age groups, the prevalence of mixed cataracts was predominant. PSC was predominant in axial hypermetropes and emmetropes, while nuclear cataract was strongly associated with axial myopia in younger age groups. Nuclear cataract and the mixed type of cataract were strongly associated with axial myopia irrespective of age.

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Conflicts of interest

There are no conflicts of interest.

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