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Study on prevalence of Retinal Detachments among myopes and non-myopes

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Abstract:
Background: *Myopia is one of the most prevalent disorders of the eye. It is a spherical refractive error caused by excessive refractive power and/or axial lengthening of the eye, thus resulting in the anterior displacement of focus from the retina. It is found that the risks of retinal abnormalities such as peripheral retinal degeneration or breaks, rhegmatogenous retinal detachments, lacquer cracks, and choroidal abnormalities like chorioretinal degeneration , sub-foveal choroidal neovascularization increases with the degree of myopia and with the increase in axial length. Rhegmatogenous retinal detachment (RRD) refers to the separation of the inner neurosensory retina from the outer retinal pigment epithelium resulting from one or more full thickness retinal breaks. The lifetime risk of retinal detachment is more than 20-fold higher in myopes than for emmetropes. Higher degrees of myopia are associated with detachments at younger ages of onset than emmetropia or hypermetropia.****Materials & Methods:*** *In this analytical (observational) hospital-based, cross-sectional study, 100 patients were taken as sample. The study was conducted in the outpatient department of Ophthalmology, Dr. PSIMS & RF hospital, Chinnavutapally, Andhra Pradesh. The total duration of the study was 3 months (September 2022- November 2022)which included recruitment of participants and data analysis. The investigator fully explained the benefits and risks of participation in the study to each participant possible, along with the data confidentiality, the right to participation, no compensation as it was an observational study and done in routine course of time.****Results:*** *In our present study, we have included a total of 300 patients (600 eyes) among which 160 are myopes (320 eyes) and 140 are non-myopes (280 eyes). Among myopes and non-myopes,majority of the patients were in the range of 21 to 20 years with 35.37% and 36.47% respectively.There was a higher frequency of male patients among both the groups and this difference was not statistically significant. The male to female ratio among myopes was 1.2:1 and among non-myopes was 1.12:1.The prevalence of retinal detachments was found to be 12 among myopes (7.5%) and 4 among non-myopes (2.5%) and this outcome was not statistically significant (p>0.05).*

Keywords:*myopia, myopes, non-myopes, retinal detachment, refractive error*

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I. Introduction

Uncorrected refractive error is the leading cause of visual impairment around the world **(1)**with myopia being the most common refractive error. **(2)** It causes visual impairment in both children and adults that can usually be corrected with the help of optical aids such as spectacles and contact lenses, or through surgical means. High myopia may result in comorbidities such as retinal detachment, dense cataract, glaucoma, and subretinal neovascularization which are associated with significantly increased risks of severe and irreversible vision loss. **(3)**In myopic eyes, the large volume of the eyeball induces rhegmatogenous retinal detachment through the earlier occurrence of posterior vitreous detachment, the presence of lattice degeneration, and thinner retina than that observed in emmetropic eyes. (4) The socioeconomic impact of blindness and visual impairment from myopia is considerable, as it typically affects individuals during their productive years. **(5)**Myopia is defined as a refractive error in which rays of light entering the eye parallel to the optic axis are brought to a focus in front of the retina when ocular accommodation is at rest. This usually occurs due to lengthening of the eyeball antero-posteriorly (Axial myopia) or due to an overly curved cornea and/or a lens with increased optical power (Refractive myopia). It is also referred to as near-sightedness. It can also be defined quantitatively based on the refractive error as follows: i) Myopia: A condition in which the spherical equivalent refractive error of an eye is ≤ -0.50 D when ocular accommodation is relaxed. ii) Low myopia: A condition in which the spherical equivalent refractive error of an eye is ≤ -0.50 and > 6.00 D when ocular accommodation is relaxed. iii) High myopia: A condition in which the spherical equivalent refractive error of an eye is ≥-6.00 D when ocular accommodation is relaxed. iv) Pre-myopia: A refractive state of an eye of ≤ +0.75 D and > -0.50 D in children where a combination of baseline refraction, age, and other quantifiable risk factors provide a sufficient

likelihood of future development of myopia to merit preventative interventions. [6] Based on the META-PM Classification, Pathological myopia is defined as the presence of myopic maculopathy equal to or more severe than diffuse chorioretinal atrophy. Myopic maculopathy includes diffuse chorioretinal atrophy, patchy chorioretinal atrophy, lacquer cracks, myopic choroidal neovascularization (myopic CNV), and CNV-related macular atrophy. [7,8]

A retinal break can be categorized as a tear or a hole; which may be associated with symptoms or may be asymptomatic.[9] The term "retinal detachment" refers to the separation of the neurosensory retina (NSR) from the underlying retinal pigment epithelium (RPE). These two layers are derived from the neuroectoderm that lines the optic vesicle during embryogenesis. As the optic vesicle invaginates to form the optic cup, the two layers come in apposition. The outer layer differentiates into the RPE and the inner into the NSR. There are no real anatomic junctions between the cells of the two layers. Hence, the forces of attachment of the NSR to RPE are weak, and once overwhelmed, a retinal detachment occurs, re-establishing the potential space between the two layers. [4] Retinal detachment (RD) is broadly classified into three types based on the etiology and clinical appearance: 1. Rhegmatogenous retinal detachment (RRD) where the RD develops due to a retinal break ('rhegma'= rent or a fissure), 2. Tractional retinal detachments (TRD) occur due to pre-retinal membrane formation and scarring that pulls the retina from its attachment,3. Exudative retinal detachments occur due to abnormalities in water transport across the bed of the retina (retinal pigment epithelium) or its blood supply. [10] Besides the early occurrence of PVD in myopes, lattice degeneration is more common and the retina is thinner in myopic patients than in emmetropes which makes retinal breaks and detachment a more frequent occurrence. [11,12,13]

II. Material & Methods

This analytical (observational) hospital-based, cross-sectional study was carried out on patients of OPD in Department of Ophthalmology at Dr.Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation Hospital, Chinaavutapally, Gannavaram, Andhra Pradesh from September 2022 to November 2022. A total 300 subjects (both male and females) of age above 10 years were included in this study.

Study Design: Analytical (observational) hospital-based, cross-sectional study

Study Location: This was a tertiary care teaching hospital based study done in Department of Ophthalmology at Dr. Pinnamaneni Siddhartha Institute of Medical Sciences & Research Foundation Hospital, Chinaavutapally, Gannavaram, Andhra Pradesh.

Study Duration:3 months **(**September 2022 to November 2022)

Sample size: 300 patients

Sample size calculation: The sample size was estimated on the basis of a single proportion design. A total of 300 participants were recruited for the completion of the study (160 myopes and 140 non-myopes). The following formula was used for calculating the adequate sample size $n=Z^2P(1-P)/d^2$ where n is the sample size, Z is the static corresponding to the level of confidence (Z=1.96), P is the expected Prevalence (P= 0.45), **d** is the precision (d=0.05)

Inclusion criteria:

1. Male and female patients, aged between 11-60 years.
2. Patients with myopia more than -1.00 D (study group) were included as the cases and non-myopes (emmetropes and hypermetropies) were included as the comparison group.

Exclusion criteria:

1. Patients with hazy media whose fundus could not be examined and patients with any other eye diseases, such as nuclear sclerosis more than grade III.
2. Corneal conditions such as opacity, keratopathy, ulcers, keratitis, etc.
3. Patients with other eye conditions such as glaucoma were excluded from the study.
4. Pseudophakic patients with thick posterior capsular opacities were excluded from the study.
5. Patients with a history of any ocular trauma were excluded from the study.
6. Patients with vitreous haemorrhage, pre retinal haemorrhage, retinal haemorrhage.

Procedure methodology: Subjects for this study were recruited from amongst aged between 11 and 60 years, who visited the Ophthalmology department of Dr. PSIMS & RF. 160 myopic patients and 140 non-myopic patients (total 300 patients) meeting the inclusion criteria mentioned above were chosen for the study. This study was approved by the hospital's Institutional Ethical Committee and was carried out in accordance with the ICMR Guidelines for biomedical research in human subjects, 2006. Informed consent was obtained from each subject before enrolment. A detailed ocular and systemic history was taken. Patients enrolled in this study underwent a comprehensive ophthalmologic examination. The assessment, in order, included:

1) Intraocular pressure measurement using Schiotz tonometer. 2) Best-corrected visual acuity documentation using Snellen's chart and Near vision documentation using Jaeger's chart.In astigmatism, the spherical

equivalent value was considered, which was obtained by adding half the cylinder value to the spherical value. As detachment of the retina often prevents the accurate measurement of the degree of myopia by retinoscopy, it was decided to use the last best-corrected visual acuity worn by the patient before the onset of the retinal detachment as the measure of his refractive error.
Following this, a drop of 1% Tropicamide and 2.5% Phenylephrine hydrochloride was instilled in each eye of these patients, 3 times at 15-minute intervals to dilate the pupil for detailed further examination which included the following:3)Slit-lamp examination for Nuclear Sclerosis grading and to rule out thick posterior capsular opacities in pseudophakic patients and corneal conditions such as keratitis, ulcers, opacities 4) Retinoscopy 5)Direct and Indirect ophthalmoscopy

Statistical analysis: The data was collected, entered, and analysed using EPI Info 7.1. The qualitative data were expressed by percentages. The quantitative data were expressed in terms of mean and standard deviations. Chi-square test/ Fisher's exact test was applied to observe the differences between proportions. Independent t-test was applied to check any significant difference between the mean and standard deviations. Odds ratio was calculated to express the strength of association between independent and dependent variables. P-value<0.05 was considered significant.

III. RESULTS

In this study, we have included a total of 300 patients (600 eyes) among which 160 are myopes (320 eyes) and 140 are non-myopes (280 eyes).

FIGURE:1

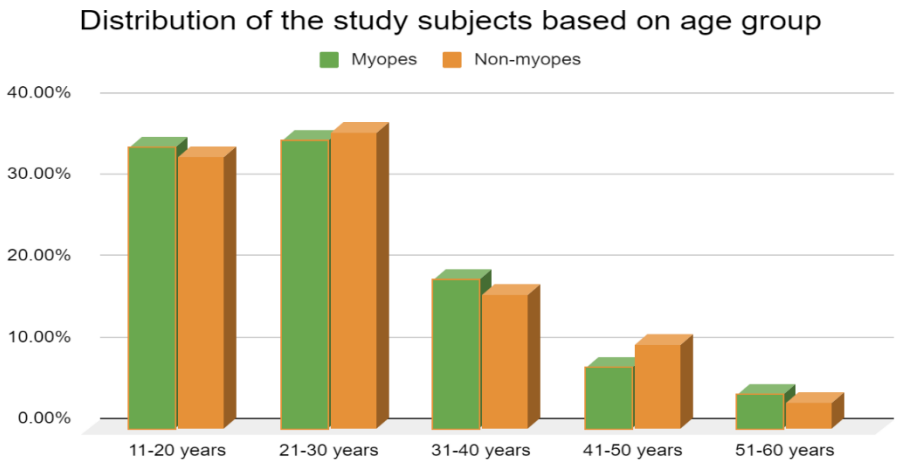


TABLE 1: Distribution of the study subjects based on gender

GENDER	Myopes		Non-myopes	
	No^r	%	No^r	%
FEMALE	68	45.3%	70	46.6%
MALE	82	54.7%	80	53.4%
TOTAL	150	100.00%	150	100%

According to the study results, there was a higher frequency of male patients among both the groups and this difference was not statistically significant. The male to female ratio among myopes was 1.2:1 and among non-myopes was 1.14:1.

TABLE 2: Distribution of study subjects based on refractive errors in myopic patients (Right eye)

Refractive errors	Females		Males		TOTAL	
	No^r	%	No^r	%	No^r	%
≥-1.0 Ds to <-3.0 Ds	43	63.23	49	59.75	92	61.33
≥-3.0 Ds to <-6.0 Ds	20	29.42	24	29.26	44	29.34

≥-6.0 Ds	5	7.35	9	10.99	14	9.33
Total	68	100	82	100	150	100

TABLE:3 Distribution of study subjects based on refractive errors in myopic patients (Left eye)

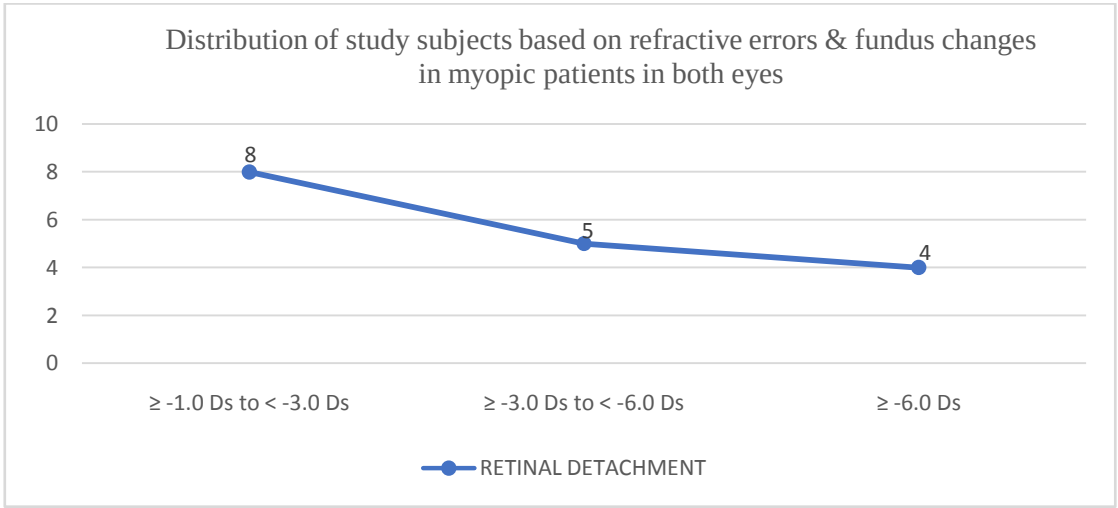
Refractive errors	Females		Males		TOTAL	
	No^r	%	No^r	%	No^r	%
≥-1.0 Ds to <-3.0 Ds	42	61.76	47	57.31	89	59.33
≥-3.0 Ds to <-6.0 Ds	19	27.94	26	31.7	45	30.0
≥-6.0 Ds	7	10.3	9	10.99	16	10.67
Total	68	100	82	100	150	100

TABLE 4:Distribution of study subjects based on refractive errors in Myopic& non-myopic patients

RETINAL CHANGES	MYOPES			NON-MYOPES		
	NO.OF EYES AFFECTED	TOTAL NO.OF EYES	PREVALENCE	NO.OF EYES AFFECTED	TOTAL NO.OF EYES	PREVALENCE
RETINAL DETACHMENT	17	300	5.66%	7	300	2.33%

TABLE 5: Distribution of study subjects based on refractive errors& fundus changes in myopic patients in both eyes

FUNDUS CHANGES	≥ -1.0 Ds to < -3.0 Ds				≥ -3.0 Ds to < -6.0 Ds				≥ -6.0 Ds			
	RIGHT EYE		LEFT EYE		RIGHT EYE		LEFT EYE		RIGHT EYE		LEFT EYE	
	No^r	%	No^r	%	No^r	%	No^r	%	No^r	%	No^r	%
RETINAL DETACHMENT	4	23.52	4	23.52	2	11.76	3	17.64	2	11.76	2	11.76



IV. DISCUSSION

Myopia, also referred to as near-sightedness is one of the most common ocular disorders. It is a public health issue causing visual impairment in both children and adults and can be considered a worldwide threat to visual health. One of the leading causes of visual impairment is an uncorrected refractive error, mainly myopia. Rhegmatogenous retinal detachment (RRD) is the separation of the neurosensory retina from the underlying retinal pigment epithelium (RPE) by fluid traversing from the vitreous cavity into the subretinal space via a retinal defect. The time interval between the formation of a retinal break and the subsequent development of a retinal detachment is highly variable and often unpredictable.

This study was conducted on a total of 300 patients(600 eyes) out of which 140 patients (280 eyes) were non-myopic and 160 patients (320 eyes) were myopic. The participants of the study were aged from 11

years to 60 years. Among both the groups, the majority of the patients were between the age group of 21 years to 30 years; there was no significant difference between the age groups among the two groups. We found that the prevalence of retinal detachment among myopes was 5.66% and among non-myopes was 2.33%. However, this was not statistically significant. This may be because of the small sample size, the data of which cannot be extrapolated to the entire population. The estimated annual incidence of rhegmatogenous retinal detachment in the myopic population was more than 3 times that in the non-myopic population in a study conducted by *Laatikainen et al*.[14] which is consistent with our findings. According to different studies, the incidence of retinal breaks varies from 0.59 to 27%. [15,16]

In our study, it was seen that among the myopes, the majority of the retinal detachments had a refractive error lying between ≥-1 Ds to < -3Ds, and the occurrence of retinal detachments was lesser with higher refractive errors. These findings were consistent with the findings of a study conducted by *Laatikainen et al*., who found that in the group of phakic myopic retinal detachment, mild myopia (-1.0 to -3.5 D) was present in 41 %, moderate (-3.75 to -7.75 D) in 37% and high (> -8.0 D) in 22% of the eyes. [14]

According to The Eye Disease Case- Control Study Group, independent of the age, an eye with a spherical equivalent refractive error of -1 Ds to -3 Ds has a fourfold increased risk of RRD compared with an emmetropic eye, which was found to be tenfold with a refractive error of >-3 Ds. [17]According to *Alimanović-Halilović et al*., myopic refraction ranging from -3.5 to - 7.49 DSph can be considered as "critical" for the occurrence of retinal breaks and detachments. [10]*Pierro et al*. stated that the lifetime risk of retinal detachment is more than 20-fold higher in myopes than for emmetropes. [18] High myopia was also suggested to be associated with a bilateral rhegmatogenous retinal detachment by *Foster PJ et al*.[3] None of our patients had a bilateral retinal detachment.

V. Conclusion

Myopia is the most common type of refractive errors and one of the world's leading causes of blindness. Although it can be corrected with concave (minus) lenses (using spectacles or contact lenses or induced by refractive surgery), myopia is still a significant public health problem. This is so not only because of its high prevalence, but also because it is a high-risk factor of vision-threatening conditions (e.g., retinal detachment and glaucoma). Recent work from the Brien Holden Vision Institute estimates that 5 billion (50%) people will be myopic and 1 billion (10%) highly myopic by 2050. Early detection and intervention of myopia in children is the key to reducing the impact of myopia on their long-term ocular health and improving their future lives.

Retinal detachment is a sight-threatening condition that requires immediate surgical intervention, the success of which depends on early detection. It can best be diagnosed by examination of the retina using indirect ophthalmoscopy. A thorough examination of the opposite eye is of great importance as has been found by *Schepens et al*. that retinal detachment is bilateral in about 15% of myopic patients, an incidence much greater than the percentage of retinal detachment in the general population.

In our study, we found that the prevalence of retinal detachments was 2 times more in myopes (5.66%) as compared to non-myopes (2.33%). We also found the prevalence of retinal detachment was more in males as compared to females among the myopes. However, there was no significant difference between males and females. It was seen that the majority of the retinal breaks and detachments had a refractive error lying between ≥-1 Ds to < -3Ds and the occurrence of retinal breaks and detachments were lesser with higher refractive errors.

To establish an early diagnosis, it is our duty to carefully examine the peripheral retina in all myopic patients regardless of their age or sex. The high-risk patients must also be informed of the early symptoms of retinal breaks and detachment such as the occurrence of light flashes and a marked increase in floaters and be told to immediately consult an ophthalmologist. This early recognition of symptoms and immediate intervention is more likely to ensure a better visual prognosis.

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