



A COMPARATIVE CLINICAL STUDY ON PREVALENCE OF PRESBYOPIA WITH AND WITHOUT REFRACTIVE ERRORS AMONG THE PATIENTS ATTENDING O.P.D. IN A TERTIARY CARE HOSPITAL IN ASSAM.

Dr. Moushumi Majumder*	Associate Professor, Department Of Ophthalmology, Assam Medical College; Dibrugarh, Assam, India. *Corresponding Author
Dr. Neha Verma	Post Pg Doctor Under Directorate Of Medical Education Assam, India.
Dr. Kiran Borah	Post-graduate Student, Department Of Ophthalmology, Assam Medical College; Dibrugarh, Assam, India.
Dr. Nurnehar Sultana	Post-graduate Student, Department Of Ophthalmology, Assam Medical College; Dibrugarh, Assam, India.

ABSTRACT

Aims & Objectives: - To study the prevalence of presbyopia with and without Refractive Errors among the patients attending O.P.D. of Assam Medical College, Dibrugarh for ophthalmic problems. **Materials & Methods:**-This is a Prospective study conducted on 1,000 patients from November, 2022 to June, 2023. The study was conducted based on the O.P.D. Procedures, Darkroom procedures, and Ophthalmoscopic Examinations. **Results:-** Out of 1,000 patients, 30% had myopia with and without astigmatism, 19.40% had hypermetropia with and without astigmatism, and 18% were found to have astigmatism only. The incidence of Presbyopia both with and without Refractive Error was found to be high among 40-49 years of age group. Also, the incidence of Presbyopia with and without Refractive Error was found to be high in females. **Conclusion:-** The prevalence of Presbyopia with and without Refractive Error is higher in females than in males.

KEYWORDS : O.P.D. & Dark Room procedures, Presbyopia with and without Refractive Error, Gender, Education stream, Spectacle, Assam.

INTRODUCTION:-

The human eye is an Optical instrument which can be compared with a camera as below:-

- Eyelids act as the shutter of the camera.
- The cornea and crystalline lens act as the focusing system of the camera.
- Iris acts as a diaphragm that regulates the size of the aperture (pupil) and therefore the amount of light entering the eye.
- The choroid helps in forming the darkened interior of the camera.
- The retina acts as a light-sensitive plate or film on which the image is formed.

The functioning of the eye can be considered to be analogous to a **close-circuit Colour TV system**^[1,24]. The optic nerve and its connections convey the details of the image to the occipital region of the cerebral cortex where they are processed before reaching consciousness^[1,9,37]. The compound optical system of the eye may be divided into a corneal portion, including the tear layer which separates the air from the aqueous humour, and the lens portion which separates the aqueous humour from the vitreous humour^[1,35]. The focusing system of the eye is composed of a cornea, aqueous humour, crystalline lens, and vitreous humour^[6,42,45].

These structures constitute a homocentric system of lenses, which when combined in action form a very strong system of short focal length. The total dioptric power of the eye is about + 58 D, out of which about + 43D is contributed by the cornea and + 15D by the crystalline lens^[1,27].

For practical purposes, the Optical system of the eye is considered perfect, and it is assumed that the corneal and lenticular surfaces are spherical, and their center of curvatures lie on a straight line i.e., the Optical axis^[21,41]. However, the optical system of the eye has got following imperfections:-

1. The refractive surfaces tend to be spherical.
2. The crystalline lens is usually slightly decentred and tipped concerning the axis of the cornea and the visual axis of the eye.
3. The crystalline lens consists of non-homogeneous

material.

- The media of the eye are uniformly permeable to the visible rays between **600nm. and 390nm.**^[2,8]
- The cornea absorbs rays shorter than **295nm**, which only can reach the crystalline lens^[2,37].
- The lens absorbs rays shorter than **350nm**. So, rays between **600nm. and 350nm.** can reach the retina in phakic eyes and those between **600nm. and 295nm.** in aphakic eyes^[31,33,40]. The eye is most sensitive to yellow-green light i.e., light of wavelength of **550nm**^[8,36]. The sensitivity of the eye decreases on both sides of it, so it is minimal for violet and red light^[16,24].
- The persistence of the eye is **0.1sec.** i.e., if the time interval between two successive light pulses is less than **0.1sec.** the eye cannot distinguish them separately.
- Range of sensitivity:- The human eye can detect energies of a few photons per second up to bright sunlight, a difference in sensitivity of **10¹⁵**.

Definition:-

Emmetropia (Optically Normal Eye) can be defined as a state of refraction when the parallel rays of light coming from infinity are focused on the sensitive layer of the retina with the accommodation being at rest^[1,5]. An Emmetropic eye will have a clear image of a distant object without any internal adjustment of its optics. While the axial length of most Emmetropic eyes is approx. is 24mm^[15,18]. A larger eye can be an Emmetropic eye if its Optical Components are weaker, and a smaller eye can be Emmetropic if its optical components are stronger^[29,32]. Emmetropia may be optically normal, but it is no more Biologically normal than would be the universal attainment of a uniform height of **5 feet to 6 inches**^[16,39].

The eye has 3 Principal axes:-

- i. The Optical Axis,
- ii. The Visual Axis and
- iii. The Fixation Axis.

The eye has 3 Visual angles:-

- i. Angle Alpha,
- ii. Angle Gamma and
- iii. Angle Kappa.

Presbyopia (eyesight of old age) is not a refractive error of refraction but the condition of physiological insufficiency of accommodation, leading to failing vision for nearby^(1,4). It focuses on near vision loss only but does not relate to visual requirements. It is the most common physiological change occurring in the adult eye and it is thought to cause universal near vision impairment with advancing age^(2,3). Presbyopia is an age-related inability due to a decrease in the accommodative power of a crystalline lens with increasing age leading to presbyopia⁽²⁾. Presbyopia, an age-related inability to focus on near objects due to loss of accommodative amplitude, is believed to be extremely prevalent or nearly universal in individuals above the age of **40 years**^(3,6). One aspect of presbyopia that has been overlooked is the correction habit and the impact of the combination of corrections of quality of vision and lifestyle.

The pathophysiology of presbyopia is due to a decrease in accommodative power of a crystalline lens with increasing age, leading to presbyopia which occurs due to:-

- i. Decrease in elasticity and plasticity of the crystalline lens (which results from age-related sclerosis), and
- ii. Age-related decrease in the power of ciliary muscles.

Premature Presbyopia can occur due to:-

- i) Uncorrected hypermetropia,
- ii) General debility causing pre-senile weakness of ciliary muscle,
- iii) Premature sclerosis of the crystalline lens, and
- iv) Chronic Simple Glaucoma.

The **Symptoms** of Presbyopia are: - a) Difficulty in near vision (to start in the evening and dim light and later even in good light). b) Asthenopia symptoms due to fatigue of the ciliary muscles have also been complained of after reading or doing any near work.

The basic Principles for Presbyopic Correction are:-

- i) To find out the refractive error for distance and first correct it.
- ii) Find out the presbyopic correction needed in each eye separately and add it to the distant correction.
- iii) Near point should be fixed by taking due consideration for the profession of the patient.
- iv) The weakest convex lens with which an individual can be clearly at the point should be prescribed since overcorrection will also result in asthenopia symptoms.

Ammetropia (a condition of refractive error) is defined as a state of refraction, wherein the parallel rays of light coming from infinity (with the accommodation at rest) are focused either in front or behind the sensitive layer of the retina in one or both the meridian^(1,3). The ammetropia includes myopia, hypermetropia, and astigmatism.

The cause of the **Refractive Error** is unknown but may run in the families. It may be due to the mismatches between the axial length and focusing power of the eye (primarily the cornea and the lens)^(1,4). Hyperopia is at risk for angle-closure glaucoma. Myopia shows an oblique optic disc with exposed sclera viewed as a white crescent. The refractive error varies, but up to **20%** of patients are myopic and **75%** require prescriptions between **-0.50** and **+8.00 Diopters**. **65%** of all refractive prescriptions are for the **Presbyope**⁽⁴⁾. Uncorrected distance refractive error is the most common cause of visual impairment and the second most common cause of blindness in the world.

Myopia or short-sightedness is a type of refractive error in which parallel rays of light coming from infinity are focused in front of the retina when accommodation is at rest^(1,3). Asthenopic symptoms may occur in patients with a small

degree of myopia. The majority of cases merely result in variants in the frequency curve of axial length and curvature. The myopic eyes typically are large and prominent, with a deep anterior chamber, large and slight sluggishly reacting pupil, with normal fundus, and rarely temporal myopic crescent, the error does not exceed **6 to 8 Diopters**, and myopia is confirmed by performing retinoscopy^(3,8).

Hypermetropia or long-sightedness is the refractive state of the eye wherein parallel rays of light coming from infinity are focused behind the retina with the accommodation being at rest^(1,4). It may result from acquired cortical sclerosis, posterior subluxation of the lens, congenital or acquired absence of a lens, surgically over-corrected myopia, patients with third nerve palsy, and internal ophthalmoplegia^(2,9). Asthenopia symptoms may or may not occur in patients with hypermetropia. The hypermetropic eyes are small, small cornea, shallow anterior chamber, and fundus showing papillitis or pseudo-papillitis, with shot-silk retinal appearance, A-scan biometry shows the short anterior-posterior length of the eyeball^(3,14).

Astigmatism is a type of refractive error wherein the refraction varies in the different meridians^(1,3). Consequently, the rays of light entering the eye cannot converge to a point focus but from a focal lens. Broadly there are two types of Astigmatism: - Regular and Irregular. Regular astigmatism is characterized by regular changes of uniformity, from one meridian to another meridian of refractive power^(3,9). It includes defective vision, blurring of objects, proportionately elongated appearances of objects along dull eye aches.

Purpose of Approach of Presbyopia with and without Refractive Error Patients:-

By the **5th** decade of life, there is only a concurrent drop in accommodative gain thus reducing near-image quality and resulting in the apparent acceleration of symptoms in the early Presbyopes^(24,30,36). To detect presbyopia with and without refractive error early, to improve the patient's discomfort and prevent further visual disturbance easily by use of a visual correction method such as spectacles thus improving the quality of vision and lifestyle and thus achieving a **BCVA 6/6**^(20,26). It should also be able to maintain the correction throughout the remaining decades of the life of the individual without much further intervention, with the eye always being emmetropic.

MATERIALS AND METHODS:-

Aims and Objectives:-

- To find the prevalence of Presbyopia with and without Refractive Error patients in between the **40-80** years of age group seeking attention for ophthalmic problems.
- Early detection of Presbyopia with and without Refractive Error and their treatment.
- To find out the visual outcome after correction of the presbyopia with and without refractive error.
- To find out the visual outcome after correction of Presbyopia with and without Refractive Error and suggest recommendations for initiating the correct countermeasures.

Methodology:-

We randomly selected **1,000** patients from the Outpatient Clinic of Assam Medical College and Hospital Dibrugarh; Assam.

Type of Study:- A Hospital-Based Prospective Study.

Place of Study:- O.P.D. (Outpatient Department) of Ophthalmology, Assam Medical College & Hospital, Dibrugarh; Assam.

Study Duration:- 8 Months.

Screening of Patients:- Individuals of the age group **40-80 Years** who presented with symptoms and signs of Presbyopia with and without Refractive Error like difficulty in vision (both distance and near), headache, eye ache, blurring of vision, watering, tiredness, and ocular discomfort were selected.

Inclusion Criteria:-

1. Presbyopia with and without Refractive Error.
2. Age group of **40-80 Years**.
3. Both the gender.
4. Informed consent.

Exclusion criteria: -

1. Below **40 years** and above **80 years** of age group.
2. Patients with Corneal ulcer and opacity, fundus pathology, eye injury and cataract, and any infective conditions.
3. Any other disease affecting the visual dysfunction including neurological visual impairment.
4. Allergic to 1% Atropine, 2% Homatropine, 1% Cyclopentolate, and 10% Phenylephrine (elderly patients).
5. Any tumours and malignant cases and patients undergoing any intra-ocular and extra-ocular surgeries.

Diagnosis:-

Patient history:-

Symptoms:-

- a) Presenting complaints: - Difficulty in vision (distance and near), blurring of vision, diplopia, headache, and watering.
- b) Exacerbating conditions: - Prolonged working hours on computer, reading, watching TV, etc.
- c) Ocular history details: - Topical medications used, cataract, allergic eye diseases, prior cataract surgery, refractive surgery, keratoplasty, etc.
- d) Medical history details: - Diplopia, Diabetes Mellitus, Hypertension, any Neurological and Fundus Pathology.
- e) Educational history: -Primary schooling, Secondary schooling, Higher secondary schooling, Graduation, Post-Graduation, and others.
- f) Occupational history: -Labourer (Daily wage earner), Cultivator, Homemaker, Businessman, Teacher, Official worker, Executives, Professionals, and others.

Examination of Presbyopia with and without Refractive Errors

- 1) External Ocular Examination.
- 2) Slit Lamp Examination.
- 3) Snellen's Vision Box.
- 4) Trial Box Containing Different Lenses.
- 5) Trial Frame.
- 6) Retinoscope.
- 7) Astigmatic Fan.
- 8) Jackson's Cross Cylinder.
- 9) Keratometer.
- 10) Computerised Auto refractometer.
- 11) Synaptophore (as required in selective cases).
- 12) Ocular Surface Dye Staining:- Fluorescein, Rose Bengal, or Lissamine Green dye to assess the extent of ocular damage.
- 13) I.O.P by Applanation Tonometer (as required in selective cases).
- 14) Direct and Indirect Ophthalmoscopy
- 15) Mydriatic and Cycloplegic Drugs.

Schirmer Test:- It is a useful clinical test for the rate of tear formation, given by Schirmer in 1903. Schirmer-I test is performed by **5 mm. x 35 mm.** The strip of **Whatman-41** filter paper and the conjunctival sac is anesthetized to eliminate reflex tearing and thereby measure basic tear secretion. Schirmer-II test is performed with a mechanical irritant to evaluate reflex tearing after stimulating the nasal mucosa. In

females aged below **30 years**, the rate of secretion is more than those above **30 years**. The Stenopaeic Slit Test is done while checking the correction of astigmatism.

Pin-Hole Test:- The retina, neural pathways, and central nervous system all contribute to the patient's visual acuity in addition to the dioptric apparatus of the eye. It is performed to differentiate between impairment of vision due to abnormality of the dioptric apparatus and impairment of vision due to retinal or neurological disease. A good standard of illumination has been used while carrying out the test. The test also has therapeutic implications. Both objective and subjective methods of refraction were carried out during the study. For objective refraction, the Retinoscopy Sciascopy or Shadow test was used as the method of neutralization.

Epidemiology:-

The scenario in India: - There are only 2 published reports on the prevalence of refractive error with presbyopia among hospital-based populations from South India and the prevalence varies between **63.7%** and **70.2%** ^(7,8,14,26). African studies on the prevalence of refractive error with presbyopia are lower than in the Asian population and it is between **10%** and **40%** ^(9,10,13,43).

RESULTS AND OBSERVATIONS:-

A total of **1,000** patients having symptoms of Presbyopia with and without Refractive Error were enrolled in our study. **888 (88.80%)** patients were found to have refractive error and **112 (11.20%)** patients without refractive error.

Table 1:- Age Distribution.

Age Group	Total Samples	Affected Samples With Refractive Error	%(Percentage) Affected With Refractive Error	Affected Samples Without Refractive Error	%(Percentage) Affected Without Refractive Error
40-49 Years	493	398	44.81	95	84.82
50-59 Years	320	304	34.23	16	14.28
60-69 Years	138	137	15.42	1	0.89
70+ Years	49	49	5.51	0	0
Total	1,000	888	88.80%	112	11.20%

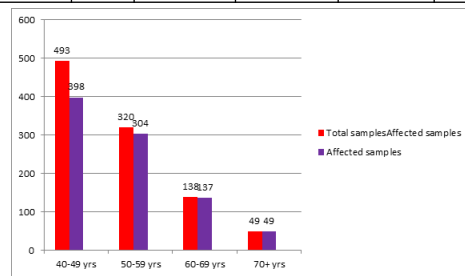


Fig 1. (a). Distribution of affected samples with Refractive Error among the various age groups.

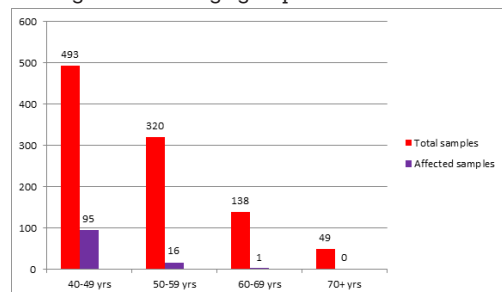


Fig.1. (b). Distribution of affected samples without refractive error among the various age groups.

Table 2:- Gender Distribution.

Sex	Total Sample	Affected Sample With Refractive Error	% (percentage) Affected With Refractive Error	Affected Sample Without Refractive Error	% (percentage) Affected Without Refractive Error
Male	493	440	49.54	53	47.32
Female	507	448	50.45	59	52.67
Total	1,000	888	88.80%	112	11.20%

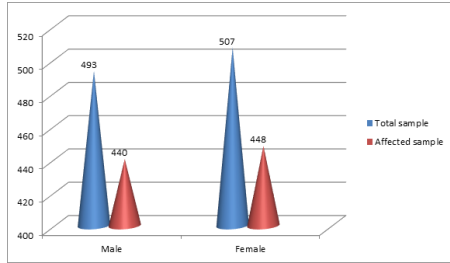


Fig 2. (a). Distribution of affected samples with Refractive Error among the various gender groups.

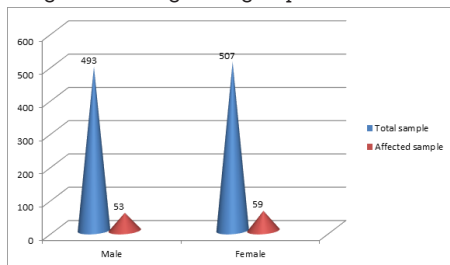


Fig.2. (b). Distribution of affected samples without Refractive Error among the various gender groups.

Table 3: Frequency of symptoms among the affected population at first presentation.

Symptoms	Total number	Affected Sample With Refractive Error	% (Percentage) Affected With Refractive Error	Affected Sample Without Refractive Error	% (Percentage) Sample Without Refractive Error
Diminution Of vision	657	625	70	32	28.57
Headache	62	52	5.8	10	8.92
Eye ache	38	35	3.9	3	2.67
Blurring of vision	37	30	3.37	7	6.25
Watering	114	100	11.26	14	12.5
Any E.N.T. problems	15	5	0.56	10	8.92
Itching	42	27	3.04	15	13.39
Burning sensation	31	11	1.23	20	17.85
FB sensation	4	3	0.33	1	0.89
Total	1,000	888	88.80%	112	11.20%

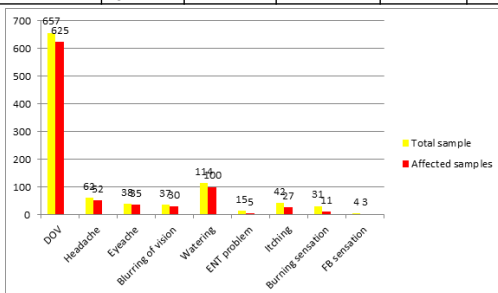


Fig. 3. (a). Frequency of other ocular symptoms among affected population with Refractive Error at first presentation.

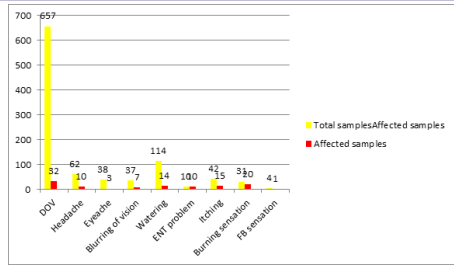


Fig. 3. (b). Frequency of other ocular symptoms among the affected population without Refractive Error at first presentation.

Table 4: Educational status among affected patients.

Educational Status of the patients	Total Patients	Affected Samples With Refractive Error	% (Percentage) Affected With Refractive Error	Affected Sample Without Refractive Error	% (Percentage) Affected Without Refractive Error
Primary schooling	62	58	6.56	4	3.44
Secondary schooling	369	335	37.89	34	30.35
Higher Secondary	244	204	23.07	40	34.48
Graduation	158	135	15.27	23	19.82
Post. Graduation	15	13	1.46	2	1.72
Others	152	143	16.17	9	7.75
TOTAL	1,000	888	88.80%	112	11.20%

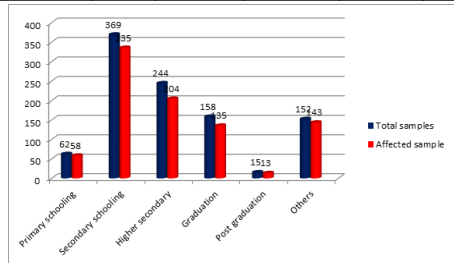


Fig. 4. (a). Educational status among affected patients with Refractive Error.

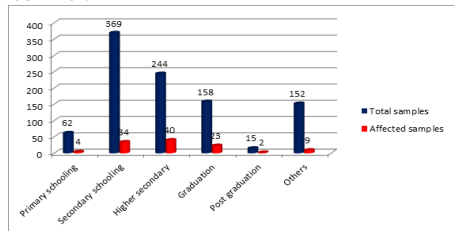


Fig. 4. (b). Educational status among affected patients without Refractive Error.

Table 5: Occupational status among affected patients.

Occupational Status	Total	Affected Samples With Refractive Error	% (Percentage) Affected With Refractive Error	Affected Samples Without Refractive Error	% (Percentage) Affected Without Refractive Error
Health worker	11	8	0.90	3	2.58
Tailor	21	21	2.37	0	0.00
Daily worker	86	80	9.04	6	5.17
TE worker	18	16	1.80	2	1.72
Anganwadi Worker	10	9	1.01	1	0.86

Asha worker	4	3	0.33	1	0.86
Housewife	334	295	33.37	39	33.62
Teacher	83	73	8.25	10	8.62
Army	13	12	1.35	1	0.86
Business	141	127	14.36	14	1.52
Shopkeeper	14	14	1.58	0	0.00
Contractor	1	1	0.11	0	0.00
Driver	36	27	3.05	9	8.03
Farmer	88	78	8.82	10	8.62
Sweeper	1	1	0.11	0	0.00
Retired	6	6	0.16	0	0.00
School clerk	1	0	0	1	0.86
Carpenter	9	9	1.01	0	0.00
Construction worker	2	2	0.22	0	0.00
Nurse	10	8	0.90	2	1.72
Office worker	3	3	0.33	0	0.00
Bank worker	4	4	0.45	0	0.00
Service	66	62	7.01	4	3.57
Politician	3	1	0.11	2	1.72
Lab worker	2	1	0.11	1	0.86
Mechanic	12	11	1.23	1	0.86
Laundry	2	1	0.11	1	0.86
Manager	2	0	0	2	1.72
Postmaster	1	1	0.11	0	0.00
Govt employee	2	2	0.22	0	0.00
Forest officer	1	1	0.11	0	0.00
Maid	1	1	0.11	0	0.00
Cook	7	7	0.78	0	0.00
Doctor	1	1	0.11	0	0.00
Painter	1	0	0	1	0.86
Electrician	2	1	0.11	1	0.86
NGO worker	1	1	0.11	0	0.00
Total	1,000	888	88.80%	112	11.20%

PC and Laptop use	106	86	9.68	20	17.85
Watching Television	261	221	24.88	40	35.71
Reading	288	256	28.82	32	28.57
None	165	150	16.89	15	13.39
TOTAL	1,000	888	88.80%	112	11.20%

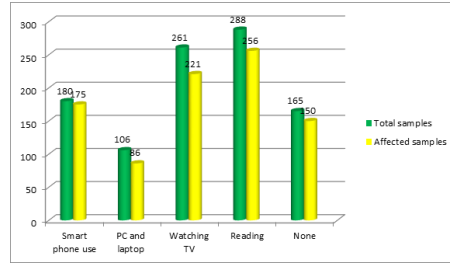


Fig. 6. (a) Distribution according to most preferred time activities with Refractive Error.

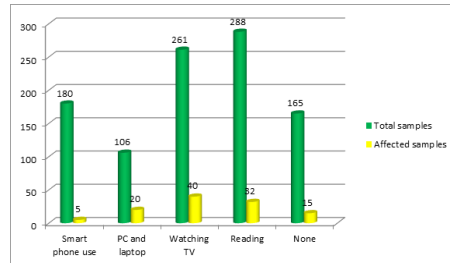


Fig. 6. (b) Distribution according to most preferred time activities without Refractive Error.

Table 7:- Distribution of Presbyopia with different types of Refractive Errors.

Type of Refractive Error	Male	Female	%(Percentage)
Emmetropia	33	79	112(11.2%)
Presbyopia(alone)	89	125	214(21.4%)
Presbyopia + Myopia	130	170	300(30%)
Presbyopia + Hypermetropia	68	126	194(19.4%)
Presbyopia + Astigmatism	75	105	180(18%)
Total	395	605	1,000(100%)

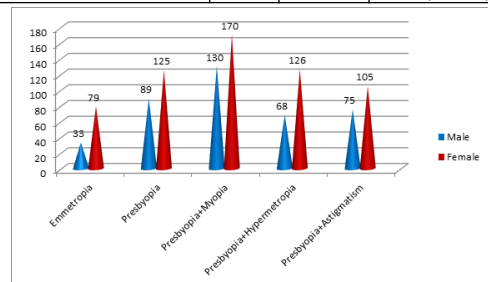


Fig.7. Distribution of Presbyopia with different types of Refractive Errors.

DISCUSSION:-

There is an increasing trend of refractive errors in India. In this study, we have found 88.80% of patients of presbyopia with refractive error and 11.20% of patients of presbyopia without refractive error. Out of the affected patients, females (50.45%) were higher than males (49.54%) in patients of presbyopia with refractive error and females (52.67%) higher than males (47.32%) in patients without refractive error.

The age group most affected was 40-49 years (44.81%) in patients with presbyopia with refractive error and also the most affected age group was 40-49 years (84.82%) in patients with presbyopia without refractive error.

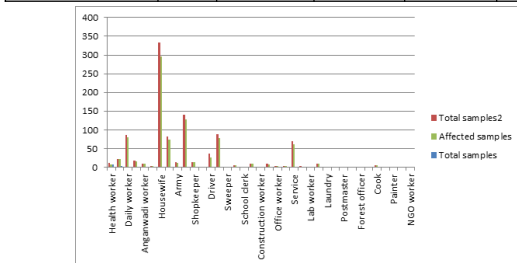


Fig. 5. (a). Occupational status among affected patients with Refractive Error.

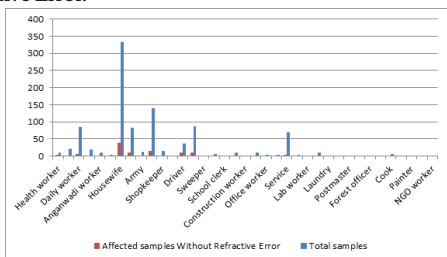


Fig. 5. (b). Occupational status among affected patients without Refractive Error.

Table 6:- Distribution according to most preferred Leisure time activities.

Activities Most Preferred	Total Patients	Affected Samples With Refractive Error	% (Percentage) With Refractive Error	Affected Samples Without Refractive Error	% (Percentage) Without Refractive Error
Smartphone use	180	175	19.70	5	4.46

In this study, the most common symptoms at presentation were found to be the diminution of vision 70% in patients of presbyopia with refractive error, and 28.57% in patients of presbyopia without refractive error.

In this study, the patients having the educational status of secondary schooling were highly affected among the presbyopia with refractive error of 37.89% and those having educational status of higher secondary among the presbyopia patients without refractive error was highest at 34.48%.

In our study, the patients having the occupational status of housewife was highest among the patients of presbyopia with a refractive error of 33.37% and also it was highest among the patients of presbyopia without a refractive error of 33.62%.

In our study, the most preferred leisure time activity of the patients was reading 28.82% followed by watching T.V. 24.88% followed by smartphone use 19.70% in patients of presbyopia with refractive error and highest among those watching T.V. 35.71% followed by reading 28.57% followed by PC and laptop use 17.85% in patients of presbyopia without refractive error.

In our study proportion of presbyopia with myopia is higher at 30% followed by presbyopia alone at 21.40% followed by presbyopia with hypermetropia at 19.40% followed by presbyopia with astigmatism at 18% followed by emmetropia with 11.20%.

CONCLUSION:-

To conclude, refractive error is a common and significant cause of visual impairment in the study population^[18,21,36,46]. Presbyopia combined with myopia is the most common refractive error followed by presbyopia alone followed by presbyopia with hypermetropia^[20,23,36]. Refractive error especially presbyopia with myopia is a common problem in the age group 40-49 years and females usually housewife by profession is commonly affected.

Excessive near work or frequent use of high-tech gadgets and smartphones in dim light or watching T.V. may be a cause of the early appearance of refractive error as well as worsening of already present refractive error^[24,26,28,32].

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