
STATISTICAL ANALYSIS ON REFRACTIVE ERRORS IN DIFFERENT AGE GROUPS

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Abstract: This paper aims to evaluate the difference in refractive errors of two age groups of people in Chennai. A cross-sectional study has been designed to evaluate refractive error of 2409 patients in two different private hospitals (Sankara Nethralaya and Appaswamy hospitals). A complete eye examination has been carried out in all patients including Cyclo agent, Slit lamp and Keratometry. Two sample t-tests have been performed to analyze incidence of refractive error in right eye and left eye, males and females, and age below 16 years and above 16 years. Out of 2409 patients, refractive error is present more in male patients compared to female patients. Refractive error of both left and right eyes is significantly different between two age groups namely below 16 years and above 16 years. Astigmatism is significant in both the age groups. Refractive error is significant in both the age groups. Moreover, refractive error in right eye is more than that of left eye.

Keywords: Refractive Error, Myopia, Hyperopia, Astigmatism, Two Sample T-Test.

Introduction: The eye is an organ that detects light and sends signals along the optic nerve to the brain. In humans, the eye is a valuable sense organ that gives us the ability to see. It allows for light perception and vision, including the ability to differentiate between colors and depth. Although small in size, the eye is a very complex organ. The eye is approximately 1 inch wide, 1 inch deep and 0.9 inches tall. The human eye has a 200-degree viewing angle and can see 10 million colors and shades.

Importance of the Eye: Eyes are very important for the human body. The brain processes the raw data from the eyes to make sense of what one sees around him/her compared to one's knowledge of the world around him/her. The brain interprets what it receives from the eyes. Without our eyes and the complex processing of visual information by our brains, we would neither be able to make sense of writing, art or photos, nor understand as much as we do from limited visual information.

The eye allows us to see and interpret the shapes, colors, and dimensions of objects in the world by processing the light they reflect or emit. The eye is able to detect bright light or dim light, but it cannot sense an object when light is absent.

Cycloplegia inhibits the accommodative power of the eye by blocking the action of the ciliary muscle, allowing the static or objective refractive error of the eye to be measured. The best way to obtain paralysis of accommodation is to use Cycloplegic drugs like CTC, HA+T, ROP, T and T+. Cycloplegic drugs are called anticholinergic because they block the muscarinic action of acetylcholine. This action inhibits cholinergic stimulation of the iris sphincter and ciliary muscle, which results in Cycloplegia.

Sensory evaluation is a special ophthalmologic procedure that may be performed in addition to the complete eye examination. Sensory evaluation will control the eye movement of 6 extra ocular muscles. The evaluation will result in fusion, diplopia, suppressions (left, right and alternate), etc., and the methods used for sensory evaluation are Randot, Titmus fly, etc.

Keratometry is used to check the corneal curvature of the eyes. Keratometer is an instrument used to check the horizontal and vertical curvature of the cornea. Children who have cylindrical power would undergo keratometric test. Children who possess 44.00 - 45.00 in keratometric test are having normal

corneal curvature and children who have other than normal range are said to have abnormal corneal curvature.

Key Terms: OD is an abbreviation for Oculus Dexter, Latin for right eye from the patient's point of view. Oculus means eye.

- OS is an abbreviation for Oculus Sinister, Latin for left eye from the patient's point of view.
- OU is an abbreviation for Oculus Uterque, Latin for both eyes.
- SPH (Sphere): Amount of lens power in dioptres required to correct near-sightedness (myopia) or far-sightedness (hypermetropia). Correction is equal in all meridians of eye.
- CYL (Cylinder): Amount of lens power for astigmatism. A cylindrical correction corrects astigmatic refractive error of the eye by adding or subtracting power cylindrically in a meridian specified by the prescribed axis. If number has minus (-) sign, it is Myopic astigmatism. If number has plus (+) sign, it is Hypermetropic astigmatism.
- Axis: The lens meridian that is 90 degrees away from the meridian that contains the cylinder power. 90 degree indicates with the rule astigmatism and 180 degree indicates against the rule astigmatism.

There are four common types of refractive errors:

- Myopia (short sightedness)
- Hypermetropia (long sightedness)
- Astigmatism
- Presbyopia

Myopia is a condition in which the person is unable to see distant objects clearly, but can see near objects well. This condition is caused when rays of light are focused in front of the retina instead of on it. This happens when the eyeball is more elongated than normal or if the curvature of the cornea is very steep. There are three types of myopia namely, low, moderate and high myopia.

Hypermetropia is a condition in which the person is unable to see both near and distant objects well. In this condition, the light rays are focused behind the retina instead of on it. Although hypermetropia can be detected at any age, it generally becomes apparent with increasing age. There are three types of hypermetropia namely, low, moderate and high hypermetropia.

Astigmatism: A precise, single point of focus of light on the retina is a prerequisite for clear vision. However, in astigmatism, two or more foci of light are focused on the retina due to the abnormalities of the refracting surface, thus causing problems with vision. A person with astigmatism is likely to complain of headache or eye strain along with blurred vision.

Presbyopia: The eye is unable to focus near objects. The problem is caused by the aging of the lens and the accommodating system, which fail to focus near objects on the retina. People with Presbyopia find it increasingly difficult to read the newspaper at their usual working distance in dim light and tend to keep it at a distance to make out the letters.

Sample Size and Study Design: A cross-sectional study was conducted on 2409 patients in two private hospitals in Chennai. 1907 patients in Sankara Nethralaya hospital were below 16 years of age and 502 patients in Appaswamy hospital were above 16 years of age. Among these private hospital patients, 54.42% were males and 45.58 % were females. Chennai is the capital of the Indian state of Tamil Nadu. Chennai is the largest commercial and industrial center of South India as well as a cultural, economic and educational center. Chennai's 2017 population is now estimated at 1,04,35,000.

Distribution of Refractive Errors in Two Private Hospitals by Age and Sex:

Sankara Nethralaya Hospital		
Age	Male	Female
1-4	12	7
5-8	226	182
9-12	423	313
13-16	418	326
Total	1079	828

Appaswamy Hospital		
Age	Male	Female
17-26	38	37
27-36	32	40
37-46	32	63
47-56	59	76
57-66	45	31
67-76	16	19
77-86	9	2
Above 86	1	2
Total	232	270

Statistical Analysis: All data were entered in the MINITAB version 16.0 for evaluation. The presents of refractive error in both male and female patients and both right and left eyes were analyzed using pie diagram. Two sample t-tests were performed to analyze whether there is significant difference in refractive error between the two age groups namely below and above 16 years.

Pie Chart of Refractive Errors According To Gender of Patients:

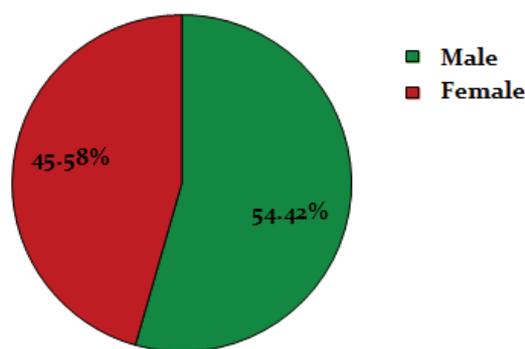


Figure (a)

From Figure (a), among the patients 54.42% are male patients and 45.58% are female patients.

Pie Chart of Refractive Errors in Male Patients:

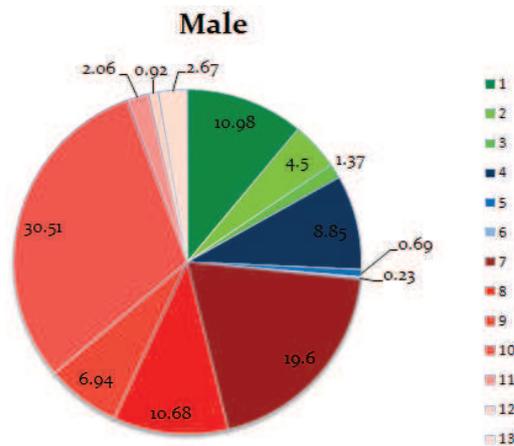


Figure (b)

1-Low Myopia, 2- Moderate Myopia, 3-High Myopia, 4- Low Hypermetropia, 5-Moderate Hypermetropia, 6-High Hypermetropia, 7-Low Myopic Astigmatism, 8-Moderate Myopic Astigmatism, 9- High Myopic Astigmatism, 10- Low Hypermetropic Astigmatism, 11- Moderate Hypermetropic Astigmatism, 12- High Hypermetropic Astigmatism, 13- No power.

From Figure (b), among male patients 16.85% have myopia, 9.77% have hypermetropia and 69.39% have astigmatism.

Pie Chart of Refractive Errors in Female Patients:

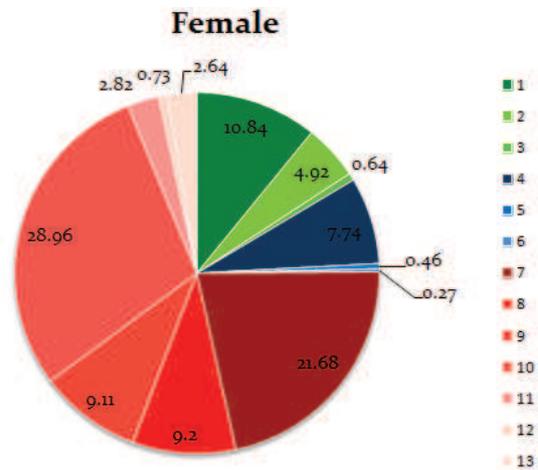


Figure (c)

From Figure (c), among female patients 16.4% have myopia, 8.47% have hypermetropia and 72.5% have astigmatism.

Pie Chart of Refractive Errors in Right Eye (OD) of Patients:

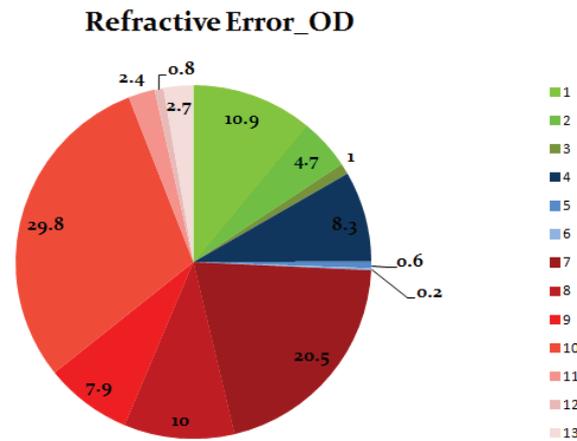


Figure (d)

From Figure (d), in right eye (both male and female patients) 16.6% have myopia, 9.1% have hypermetropia and 71.4% have astigmatism. In right eye, low hypermetropic astigmatism is maximum (29.8%) and high Hypermetropia is minimum (0.2%).

Pie Chart of Refractive Errors in Left Eye (OS) of Patients:

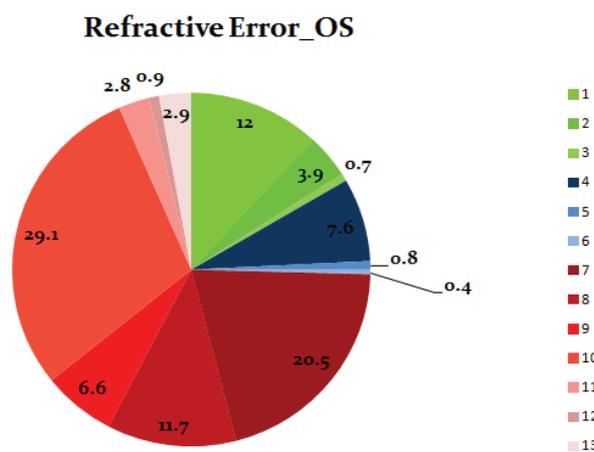


Figure (e)

From Figure (e), in left eye (both male and female patients) 16.6% have myopia, 8.8% have hypermetropia and 71.6% have astigmatism. In left eye, low hypermetropic astigmatism is maximum (29.1%) and high Hypermetropia is minimum (0.4%).

Two-Sample t-test for testing the significance of the difference in refractive error in Right Eye (OD) of patients below and above 16 years:

Null hypothesis: There is no significant difference between refractive error in right eye of patients below and above 16 years.

Table (a)

Two-Sample T-Test and CI: Refractive errors OD SN, Refractive error OD AS				
Two-sample T for Refractive errors OD SN vs Refractive error OD AS				
	N	Mean	StDev	SE Mean
Refractive errors OD SN	1907	6.91	3.24	0.074
Refractive error OD AS	502	8.56	3.02	0.13
Difference = mu (RE OD SN) - mu (RE OD AS)				
Estimate for difference: -1.649				
95% CI for difference: (-1.963, -1.335)				
T-Test of difference = 0 (vs not =):				
T-Value = -10.30 P-Value = 0.000 DF = 2407				
Both use Pooled StDev = 3.1921				

From the output Table (a), the mean difference in refractive error in right eye, between the two age groups is -1.649 and 95% confidence interval for the mean difference in right eye is (-1.963, -1.335). The degrees of freedom are 2407. The calculated *t*-value is -10.30. Since, *p*-value (0.000) is less than the level of significance (0.05), it can be concluded that there is a statistically significant difference in refractive error in right eye (OD) between two age groups. In other words, the mean difference in refractive error in right eye between two age groups is not equal to zero.

Two-Sample *t*-test for testing the significance of the difference in refractive error in left Eye (OS) of patients below and above 16 years:

Null Hypothesis: There is no significant difference between refractive error in right eye of patients below and above 16 years.

Table (b)

Two-Sample T-Test and CI: Refractive error OS SN, Refractive error OS AS				
Two-sample T for RE OS SN vs RE OS AS				
	N	Mean	StDev	SE Mean
Refractive errors OD SN	1907	6.92	3.24	0.074
Refractive error OD AS	502	8.55	3.14	0.14
Difference = mu (RE OS SN) - mu (RE OS AS)				
Estimate for difference: -1.625				
95% CI for difference: (-1.942, -1.308)				
T-Test of difference = 0 (vs not =):				
T-Value = -10.06 P-Value = 0.000 DF = 2407				
Both use Pooled StDev = 3.2216				

From the output Table (b), the mean difference in left eye between the two groups was -1.625 with 95% confidence interval for the mean difference in left eye is -1.942 to -1.308. Here, degree of freedom is 2407. An obtained *t*-value is -10.06 and the statistical significance of independent *t*-test (*P*-value). That is, *P*-value (0.000) less than the level of significance (0.05). It can be concluded that there is a statistically significant difference in mean of right eye (OD) between two private hospitals. In other words, the mean difference in left eye between two private hospitals is not equal to zero.

Conclusion: Refractive error is one of the causes of blindness and low vision. Refractive error occurs more in male patients than in female patients. In the present study 54.42% of male patients and 45.58% of female patients are having refractive error. Refractive error in both left and right eyes is significantly different between the two age groups namely below 16 years and above 16 years. From figure (d) and figure (e), Astigmatism is has high as 71% in both left and right eyes. Refractive error is significant in both the age groups. Moreover, Refractive error occurs more in right eye than in left eye.

Doctor Advice:

- The power of the glasses may change depending on the growth of the eye ball. An eye check-up and change of glasses if necessary, has to be done once in 6 months for children less than 5 years of age and once a year there after.
- Making a child wear glasses regularly is the duty and responsibility of the parents.
- Failure to wear glasses in childhood when needed will retard the development of vision in eye.
- Children older than 15 years can use contact lenses if they don't want spectacles.
- Children over 18 years of age with stable power also have the option of LASIK, a laser refractive surgery apart from contact lenses.

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