Bali Medical Journal (BMJ) 2012, Volume 1, Number 3: 101-107
PRINT-ISSN.2089-1180, E-ISSN.2302-2914

CHARACTERISTIC OF PATIENTS WITH REFRACTIVE DISORDER AT EYE CLINIC OF SANGLAH GENERAL HOSPITAL DENPASAR, BALI-INDONESIA
Period of 1st January – 31st December 2011

Handayani-Ariestanti, T., Supradnya-Anom, I G.N, and Pemayun-Dewayani, C. I.

Department of Ophthalmology, Faculty of Medicine, Udayana University Denpasar Bali-Indonesia

Objective: Refractive disorders are one of the most common causes of visual impairment worldwide and become the second leading cause of blindness that can be cured. This study aims to know the characteristic of refractive errors patients in Sanglah General Hospital in the period of 1st January until 31st December 2011. **Method**: This is a retrospective analytical descriptive study. Data were collected retrospectively from patient's medical records with refractive errors and shown as frequency and percentage. Visual acuity before and after corrections were investigated and analyzed using McNemar Test. **Results**: from 579 patients, the most common diagnosis was astigmatism (40.1%), 63% were woman, 39.7% were older than 40 years old, and 60.2% live in Denpasar. In myopia cases, 69.7% patients were woman and 25.1% were between 11-20 years old. In astigmatism cases, 63.4% were woman, 57% were older than 40 years old. Of the hypermetropic cases, 61,3% were woman, 79.5% were older than 40 years. Among presbyopia cases, 53.2% patients were woman with 84.4% were older than 40 years. In McNemar test, there were a significant difference between visual acuity before and after correction in both eyes (p=0.0001). Most astigmatism was with the rule cases on both eyes. On the right eye 54.3% shows mild astigmatism, whereas on the left eye 50.8% shows moderate astigmatism. In hypermetropic cases 92.4% are mild degrees. While 55.5% presbyopic patients need additional glasses of +1.00 D up to +2.00 D. About 97.9% patients with refractive error were given glasses prescription. **Conclusion:** mostly refractive errors patient are woman and the most common diagnosis is astigmatism. There were significant differences of visual acuity before and after correction on both eyes (p=0.001).

Keywords: refractive error, visual acuity, eyeglasses

INTRODUCTION

Refractive disorders are one of the most common causes of visual impairment worldwide and become the second leading cause of blindness that can be cured.[1] Refractive disorders were divided into myopia (near sightedness), hypermetropia (far sightedness), astigmatism and presbyopia. In general, refractive disorders were due to abnormal curvature of the cornea and lens, refractive power imbalances of the eye with the axis length of the eyeball.[2]

Myopia is a condition in which the light - parallel rays entering the eye without accommodation, focal point falls in front of the retina. Hypermetropia is a refraction disorder of the eye condition in which parallel rays strength refracted far enough so the focal point is behind the retina. Astigmatism is a refractive disorder in which parallel rays entering the eye without accommodation refracted more than one point (at some point, either in front of, behind, or a combination of both that is in front of and behind the retina). Presbyopia is a refractive disorders due to abnormal development associated with age, in which accommodation to see close object slowly decreased.[2]

World Health Organization (WHO) states, that there are 45 million people who are blind worldwide, and 135 million with low vision. It is estimated that refractive disorders causing about 8 million people (18%) of the cause's global blindness become blind.[3] Approximately 51% of the population in the United States used tools for refractive disorders. While in Asia such as Japan, Singapore, and Taiwan, the percentage is approximately 44%. In Australia, the prevalence of refractive disorders 17%, in Brazil is estimated at 6.4% between the ages of 12-59 years.[4]

The survey of Senses Sight and Hearing in eight provinces in Indonesia during 1993-1996 reported that the blindness prevalence was 1.5% and as much as 0.14% caused by refractive disorders. Number of patients suffered from refractive disorders in Indonesia almost 25% of the

Correspondence: Anom, I. G. N.
Address: Department of Ophthalmology, Faculty of Medicine, Udayana University Denpasar Bali-Indonesia

population.[3] Sirlan (2006) in West Java get number of blindness prevalence 3.6%, with a rate refractive disorders of 2.8%.[5] Ciner, et al (1998) found the prevalence of visual impairment due to refractive disorders were 22.1% while 10% of school-age children (5-19 years old) were suffered from refractive disorders.[6] Bastanta (2010) obtain the prevalence of patients with disorders of refraction about 6.2%.[7] Suharjo (2006) obtain the prevalence of refractive disorders was the first rank in diseases of the eye.[8]

Management of patients with refractive disorders until now is correction with eyeglasses, contact lenses and refractive surgery and laser. The purpose of management of these disorders is to provide the best visual acuity with best correction. Patients with refractive disorders have a good prognosis, unless with abnormalities in the posterior segment.[2]

This study aims to determine the characteristics of patients with refraction disorders in Sanglah General Hospital Denpasar, Bali-Indonesia during a period of January 2011 to December 2011.

MATERIALS AND METHOD

This is a retrospective research on refractive disorders medical records data of patients who came to the Eye Clinic Sanglah General Hospital Hospital, Bali-Indonesia during the period of January 1 to December 31, 2011.

In this research, a number of 579 patients diagnosed with refractive disorders during the period January 1 through December 31, 2011 that has a complete medical record were included. Patients with a history of surgery and eye disease other than refractive disorders were excluded.

The observed variable are the type of refractive disorders, age, gender, residence, the visual acuity before correction, visual acuity after correction, astigmatism type, degree of refractive disorders, and patients that were given glasses prescription. Data were analyzed using descriptive analysis. The data obtained are categorical data, which use frequency and percentage on the analysis. McNemar test used for analysis of categorical data comparison of the two - paired groups.

RESULTS

Patients with refractive disorders who come into Sanglah Hospital Eye Clinic qualified as research sample for the period January 1, 2011 until December 31, 2011 are as many 579 patients.

Refractive Disorder Patients Based on Diagnosis

Data in Table 1 shows that the most common refractive disorders diagnosis is astigmatism, found in 232 patients (40.1%) of 579 patients.

Table 1
Distribution of Refractive Disorder Patients Based on Diagnosis (n=579 patients)

Type of Refractive Disorder	Count	Percentage
Myopia	227	39.2
Hypermetropia	93	16.1
Astigmatism	232	40.1
Presbyopia	225	38.9

Characteristics of the Research Subjects

Based on Table 2, it is obtained that the refractive disorders patients who visited Sanglah Hospital were dominated by women, 365 patients (63%), and 214 patients (37%) were men, for all of diagnosis.

Patients with refractive disorders who visited Sanglah Hospital mostly aged over 40 years (39.7%), while children aged 1-10 years is smallest the number of people with refractive disorders (9.3%). Most refractive disorders patients lived in Denpasar (60.2%), while Jembrana and others (outside Bali) were the area where the least number of patients came to Sanglah Hospital.

In the Myopia cases, most patients are female (156 patients or 69.7%); mostly aged 11-20 years. In the astigmatism cases, it is obtained 147 patients are female (63.4%), mostly over the age of 40 years. In hypermetropia cases, more patients are women (57 patients or 61.3%), and 74 patients (79.5%) are aged over 40 years. In presbyopia cases most patients, are female (116 patients or 53.2%), most patients are over the age of 40 years (184 patients or 84.4%), and 34 patients (15.6%) are at the age of 30-40 years group.

Visual Acuity After and Before Correction

Data in Table 3 showed the visual acuity before and after correction. It is obtained, that the visual acuity before correction in the right eye of 280 eyes were normal (48.4%), whereas impaired visual acuity were found in 299 (51.6%) eyes. In the left eye, it is obtained that the visual acuity of 295 eyes (50.9%), were normal visual acuity whereas impaired visual acuity were 284 (49.1%) eyes.

Correlation between Visual Acuity Before and After Correction

The majority (80.7%) visual acuity after correction in the right eye and the left reached 6/6. It was found that 19.3% of visual acuity in the right eye and 16.1% of visual acuity in the left eye did not achieve 6/6. Based on Table 4, The McNemar Test analysis showed a significant difference between visual acuity before and after correction of the right and left eye (right eye $p = 0.0001$; left eye $p = 0.001$).

Table 2
Characteristics of Patients with Refractive Disorder by Age, Gender, and Region (n=579 patients)

Characteristic	Diagnose								Total	
	M	%	A	%	H	%	P	%	Sum	%
Gender										
Male	71	31.3	85	36.6	36	38.7	102	46.8	214	37.0
Female	156	69.7	147	63.4	57	61.3	116	53.2	365	63.0
Age (years)										
1-10	24	10.6	35	15.1	1	1.1	0	0.0	54	9.3
11-20	57	25.1	48	20.7	5	5.4	0	0.0	100	17.3
21-30	52	23.0	39	16.8	0	0.0	0	0.0	81	14.0
31-40	46	20.3	53	22.9	13	14.0	34	15.6	114	19.7
> 40	48	21.1	57	24.5	74	79.5	184	84.4	230	39.7
Region										
Denpasar	141	62.1	138	59.5	60	64.4	124	56.9	349	60.2
Badung	30	13.2	34	14.7	9	9.7	33	15.1	81	60.2
Gianyar	8	3.5	11	4.7	7	7.5	18	8.3	45	14.0
Karangasem	16	7.1	20	8.6	7	7.5	17	7.8	30	7.8
Tabanan	3	1.3	1	0.4	2	2.2	4	1.8	29	5.2
Klungkung	7	3.1	7	3.0	2	2.2	5	2.3	17	5.0
Bangli	11	4.9	14	6.0	6	6.5	11	5.1	8	3.0
Buleleng	4	1.8	1	0.4	0	0.0	2	0.9	8	1.4
Jembrana	5	2.2	4	1.7	0	0.0	2	0.9	6	1.0
Others	2	0.8	2	1.0	0	0.0	2	0.9	6	1.0

Remarks
M = myopia, A = astigmatism, H = hypermetropia, P = presbyopia

Table 3
Visual Acuity Before and After Correction of the Refractive Disorder Patients (n=579 patients)

Visual Acuity	Right Eye		Left Eye	
	Count	(%)	Count	(%)
Before Correction				
Normal	280	48.4	295	50.9
Impaired	299	51.6	284	49.1
After Correction				
6/6	467	80.7	486	83.9
<6/6	112	19.3	93	16.1

Table 4
Correlation between Visual Acuity Before and After Correction

Visual Acuity Before Correction	Visual Acuity After Correction			
	Right Eye		Left Eye	
	6/6	<6/6	6,6	<6/6
Normal	273	7	288	7
Impaired Vision	194	105	198	86
p	0.001		0.001	

Table 5
Distribution of Myopia Patients Based on the Myopia Degree

Myopia Degree	Right Eye		Left Eye	
	Count	(%)	Count	(%)
Mild	135	70.0	138	71.9
Medium	30	15.5	35	18.2
Severe	28	14.5	19	9.9
Total	193	100	192	100

Table 6
Distribution of Astigmatism Patients Based on Types and Degrees of Astigmatism

Visual Acuity Before Correction	Visual Acuity After Correction			
	Right Eye		Left Eye	
	6/6	<6/6	6.6	<6/6
Normal	273	7	288	7
Impaired Vision	194	105	198	86
p	0.001		0.001	

Degrees of the Hypermetropia Patients

Based on Table 3.7, it is obtained that most of the hypermetropia patients constitute of mild hypermetropia, i.e. 92.4% in the right eye and 93.1% in the left eye.

Table 7
Distribution of the Hypermetropia Patients Based on Degrees of Hypermetropia

Degrees of Hypermetropia	Right Eye		Left Eye	
	Count	(%)	Count	(%)
Mild	85	92.4	81	93.1
Medium	4	4.3	4	4.6
Severe	3	3.3	2	2.3
Total	92	100	87	100

Presbyopia Patients Additional Glasses Size

Based on Table 8, it is obtained that most (59.1%) of the presbyopia patients need additional glasses for near work activity range sized +1.00 to +2.00 D, meanwhile 40.9% patients need additional glasses sized more than +2.00 D.

Table 8
Distribution of the Presbyopia Patients Based on the Additional Glasses Size

Size of reading glasses	Sum	(%)
+ 1.00 until +2.00 D	133	59.1
> +2.00 D	92	40.9
Total	225	100

Glasses Prescription

Based on Table 9, it is obtained that the refractive disorder patients that were given prescription glasses were 564 patients (97.9%), meanwhile the ones that were not given prescription glasses were 15 patients (2.6%).

Table 9
Percentage of the Refractive Disorder Patients that were Given Prescription Glasses

Glasses Prescription	Count	(%)
Yes	564	97.9
No	15	2.6
Total	579	100

DISCUSSION

Bastanta (2010) get the highest percentage of refractive disorders in women is about 58.3%. Votranica (2012) get the same result as much as 58.9% in women.[7] Based on data registers in eye clinic Sanglah Hospital during the period 1 January through 31 December 2011, more refractive disorders found in women (63.0%) than men (37.0%). This result also found in all diagnosis. These results are probably due to more attention to women's health, resulting in faster check-up if there are complaints about their health. Bastanta (2010) also obtained the highest percentage in the 45-64 years age group by the number of 97 patients (34.3%). Anastasia et al (2010) find no significant difference between age groups and refractive disorders. In this study, most refractive disorders was found in the age group over 40 years that is equal to 39.7%.[9] This result is likely due to presbyopia, which is usually obtained at age 40 years.

In this study, the majority of patients lived in Denpasar for all of diagnosis. This is likely due to the location of Sanglah Hospital is in Denpasar, so the mileage could be covered by the public. Denpasar is the capital of the province that has the most access to eye care in Bali. Sanglah Hospital is the main referral hospital in Denpasar with more complete facilities so that many patients come to the Sanglah Hospital.

Hartanto et al (2010) obtain refractive disorders are myopia with largest percentage of 58.15%. Saw (2003) in Sumatara, Wu in the United States and Bastanta (2010) also find that most refractive disorders are myopia. This study showed that the most diagnosis of refractive disorders in the eye clinic Sanglah Hospital from 1 January to 31 December 2011is astigmatism, which is equal to 40.1%. The different results obtained from this study were probably due to astigmatism myopia patients classified into the diagnosis of astigmatism.

Hartanto et al (2010) found 23.05% cases with uncorrected refractive disorders period 2002-2003. Based on descriptive statistics result in this study visual acuity before correction on the right eye mostly impaired, whereas mainly normal on left eye.[10] Visual acuity after correction, mainly can achieve 6/6 in both eyes, whereas less than 6/6 was 19.3% on the right eye, 16.1% on the left eye. Based on the analysis of McNemar test, there was significant association between visual acuity before and after correction with $p = 0.0001$ in both eyes. This shows that most refractive disorders come to the eye clinic can be corrected with visual aids. A small percentage of patients do not achieve the maximum visual acuity. This is likely due to amblyopia, which predispose to amblyopia are high myopia, high astigmatism, high hypermetropia (AAO 2010-2011).[11]

Of all the patients with refraction disorders 97.9% prescribed glasses, while 2.1% were not given prescription glasses. Patients who are not given glasses prescription are probably because there are amblyopia and or require further examination so that the provision of spectacles postponed.

Lee et al (2010) reported the prevalence of myopia is higher in women than in men.[12] Anastasia et al (2010) found no significant differences between the sexes.[9] Arbaatun (2010) find significant association between sexes and

incidence of myopia.[13] In this study, patients with myopia are higher in women (69.7%). This is probably because women tend to have smaller eye size than the men that will affect the eyeball tissue including refractive media (Leeson, 1996).[14]

Lam et al (2004) obtain the prevalence of myopia at age older than 12 years old is 54.4%.[15] Tiharyo (2008) states in Greece aged between 15-18 years as much as 36.8%.[16] Kleinstein in the United States get 9.2% in children aged between 5-17.[17]

In this study, the frequency of myopia was highest at age group 11-20 years (25.1%). This is probably because of this age group is group of school children, so more near work activities, and the influence of easily accessible computer technology today that make the excess of using eye to see near object will affect the power of accommodation, causing increased incidence of myopia and myopia progression. It is also possible for children under 10 years old often do not realize decreasing of their visual acuity, often without complain even when the eyes are tired and blind.

In the study by Suharjo et al and Tiharyo et al (2002), found patients with myopia in urban areas are higher than in rural areas.[8,16] In this study, people with myopia mostly lived in Denpasar, the capital city of Bali that easier access of computer technology and books. The lot of activity to see near object and information technology influences the population of myopia in urban areas higher than in the rural areas.

Garcia (2005) in Brazil estimates that 6.4% patients aged between 12-59 suffered from myopia around -1.00 D.[18] Kempen in Australia get 8.4% of children aged 4-12 years old suffered from myopia more than -0.50 D, 16.4% were aged 40 years or older suffered from myopia around -1.00 D.[19] Tiharyo (2008) stated 2.6% of Western Europe's population aged 40 or more have suffered from myopia approximately -1.00 D.[16] Chandran, get in countries like China, India and Malaysia, 41% of adults suffered from Myopia up to -1.00 D.[20] In this study, the majority of cases were mild myopia. Currently, the authors have not found the theory and reason why there were more on the mild myopia.

Fozailoff (2011) obtain the prevalence of astigmatism in children Hispanic and African-American, was greater in men than in women in the Hispanic, while in the African American group there was not significant difference.[21] Hashemi et al (2011) find higher prevalence of astigmatism in men. In this study, patients with astigmatism are higher in women (63.4%).[22] This result is probably because women pay more attention to their health so they come to the hospital sooner if there is something wrong with their health.

Raju (2004) get 9.80% type of WTR astigmatism, and 77.44% type of ATR astigmatism.[23] Hashemi et al (2011) obtain the prevalence of WTR astigmatism 12.6%, ATR astigmatism 25.9%, while 10.6% oblique.[22] Shih et al (2004) get the type of astigmatism in school children in 1995 was 83.3% WTR astigmatism, 16,6% ATR astigmatism, 0.1% oblique astigmatism, 89.8% WTR astigmatism, 9.7% ATR astigmatism, 0,4% oblique astigmatism.[24] Hashemi (2011) get astigmatism increases with age.[22]

This study was found that astigmatism is higher at age over 40 years which (24.5%) and the most type of astigmatism is WTR astigmatism (62.4%) on the right eye and 64.9% on the left eye. This is likely due to stronger vertical corneal curvature than horizontal cornea in most of the people.

David (2009) states that 44% of the general population has more than -0.50 D of astigmatism, 10% more than -1.00 D, and 8% more than -1.50 D.[25] Shih et al (2004) obtain half of the school children do not have astigmatism, astigmatism, one third has astigmatism less than -1.00 D, 11% has astigmatism between -1.00 s / d -3.00 D, less than 2% has astigmatism more than -3.00 D.[24] In this study, there was more mild astigmatism on the right eye, while more moderate astigmatism on the left eye. Currently, the author has not found the theory and reason why there was more mild astigmatism on the right eye, while more moderate astigmatism on the left eye.

Raju (2004) obtain hypermetropia higher in women.[23] This is likely due to environmental factors that common happen in the tropic area. Jonasson et al (2000) obtain the increasing prevalence of hypermetropia with increasing age.[26] The prevalence of hypermetropia reaches its lowest point around age 24 months but increased and remained higher after that age. In this study, hypermetropia higher in women, and more in the age group over 40 years. This is probably due to axial length in women shorter than men, and because of the latent hypermetropia that arise due to decreased amplitude of accommodation.

Chung (1996) in Malaysia gets frequency of hypermetropia more than +1.25 D as much as 1.2%. Based on the degree of hypermetropia, there was more mild degree (85%) on the right eye and 81% on the left eye. Currently, the authors have not found a theory and reason why there was more mild hypermetropia found.[27]

Burke (2006) gets prevalence of presbyopia higher in women. Morny (1995) also obtain similar results. In this study, patients with presbyopia get as many as 218 (37.7%) from 579 patients, more women as much as 63.0%.[28] This result is likely due to women in Bali doing more near work activities such as making offerings and sewing, so more women go to eye care for improving their visual acuity.

Nirmalan et al (2006) reported prevalence of presbyopia at the age above 30 were 55%.[29] Duarte et al (2003) in Brazil get prevalence of presbyopia in the age group over 30 years was 55%.[30] In this study involving more age group over 40 years (84.4%), while the age group 31-40 years 15.6%. In this study, there is greater amount in the age group over 40 years is likely due to presbyopia is usually started at the age of 40 years, the reading glasses at age 40 are usually the smallest size which is +1.00 D, so it is not so lamented by patients.

Nirmalan et al (2006) showed that most (93%) patients with presbyopia have glasses. In this research, the size of reading glasses lenses mainly +1.00 until +2.00 D as much as 59.1%. This is likely because patient do many activity that see close object, and most patients aged between 40-50 years.[29]

CONCLUSION

Based on the registers of patient with refractive disorders in eye clinic Sanglah Hospital period January 1 - December 31, 2011, there were 579 patients that fulfill inclusion criteria. Of all those patients, the most are women for all of diagnosis, mostly over the age of 40 years for all of diagnosis except myopia that mainly between 11-20 year age group, mostly residing in Denpasar for all of diagnosis. The most refractive disorders diagnosis that often found is astigmatism.

The vast majority patients with myopia were mild degree in both eyes. The most type of astigmatism was WTR astigmatism. On the right eye the most astigmatism were mild degree, while the most astigmatism on the left eye were moderate. There was more mild degree of hypermetropia on both eyes. Presbyopia patients, mainly requiring reading glasses +1.00 - +2.00 D. Patient with refractive disorders were given glasses 97.9%.

Visual acuity before correction on the right eye mostly impaired, while normal on the left eye. While visual acuity after correction largely achieved 6/6 in both the right and left eye. There is a significant difference in visual acuity before and after correction on both the right eye and left eye ($p = 0.001$).

A cohort study of risk factors refraction disorder and further research to know data about refractive disorders, should be established to obtasin a clear picture of refractive disorders in Sanglah General Hospital Bali-Indonesia.

REFERENCES

1. Dandona, R 2001. *Refractive error blindess*. Bulletin in The World Health organization 79(3): 237-243.
2. Vaughan, D. G.2000. Oftalmologi Umum. Edisi 14. Jakarta: Widya Medika. p.401-6.
3. Tsan, R. 2010. World Sight Day dan Vision 2010 di Indonesia. Available from : http://health.kompas.com/indexphp/read/2010/10/19.
4. Patu, H.I. (2010). Kelainan Refraksi. Available from: http://cpddokter.com/home/ index.php? option=com_content&task=view&id=1684&Itemid=38.
5. Sirlan, F. 2006. *Blindness Reduction Rate, is it Important to Evaluate?*. Majalah Ophtalmologica Indonesiana. Volume 3. No 3:p.241.
6. Ciner E, dkk., 2005. A survey of vision screening policy of preschool children in the United States. Survey of Ophthalmology, 43:445-457.
7. Bastanta, T. 2010. "Prevalensi Kelainan Refraksi di Poliklinik Mata RSUP H.Adam Malik dari 7 Juli2008-7 Juli 2010". Karya tulis. Univesitas Sumatera Utara.
8. Suharjo, dkk. 2002. Prevalensi Kelainan Refraksi pada Anak-anak Sekolah Dasar di Daerah Pedesaan dan Perkotaan di Yogyakarta. Pertemuan Ilmiah Tahunan Perdami ke 28. Bandung.
9. Anastasia dkk. 2010. Kelainan Refraksi pada Anak usia 3-6 tahun di Kecamatan Tallo Kota Makasar. Available from http://pasca.unhas.ac.id/jurnal/files/ af8b92fcf01bd15f027a70f7122e1ea4. pdf.
10. Hartanto dkk. 2010. Kelainan Refraksi tak Terkoreksi Penuh di RSUP Dr.Kariadi semarang Periode 1 Januari2002-31 Desember 2003. Media Medika Muda (M3) (4). p.25-30.
11. American Academy Ophthalmology (AAO). 2010-2011. Basic and Clinical Science Course, section 3,Clinical Optics. p.142.
12. Lee, at al. 2010. Myopia (Nearsightedness). Available from: http://www.Allaboutvision.com/conditions/myopia.htm.
13. Arbaatun, Farida. 2010. "Beberapa Faktor yang Berhubungan dengan Kejadian Miopia pada Usia 8-12 tahun (Study Kasus di SD Muhamadiyah Bendo, Kec. Kalibawang, Kab.Kulon Progo)". Undergraduate thesis, Universitas Diponegoro.
14. Leeson, at al. 1996. Buku ajar histologi. Edisi 5. Jakarta: EGC. p.349-350.
15. Lam, at al. 2004. Prevalence of myopia in local and international schools in Hongkong. Optom.Vis. Sci;81:317–322.
16. Tiharyo. 2008. Pertambahan Miopia pada Anak-anak Sekolah Dasar di Daerah Pedesaan dan Perkotaan di Yogyakarta. Journal Oftalmologi Indonesia Vol.6 No.2:104-12.
17. Kleinstein, R.N. et al. 2003. *Refractive error and ethnicity in children*. Arch. Ophthalmol. 121 (8):1141–7.
18. Garcia, C.A.at al. 2005. Prevalence of refractive errors in students in Northeastern Brazil. Arq Bras Oftalmol 68 (3):321–5.

19. Kempen, J.H. at al. 2004. The prevalence of refractive errors among adults in the United States, Western Europe, and Australia. Arch. Ophthalmol. 122 (4): 495–505.
20. Chandran, S. 1972. Comparative study of refractive errors in West Malaysia. Br J Ophthalmol; 56(6):492–5.
21. Fozailoff, A. 2011. Prevalence of astigmatism in 6- to 72 – month - old African American and Hispanic children: the Multi-ethnic Pediatric Eye Disease Study. Department of Ophthalmology, Doheny Eye Institute, 1450 San Pablo St, Room 4900, Los Angeles, CA 90033, USA.
22. Hashemi, H. at al. 2011. *High prevalence of astigmatisme in the 40- to 64-year-old population of Shahroud, Iran*. Clin Experiment Ophthalmol, 40(3):247-54.
23. Raju, P. 2004. Prevalence of Refractive Errors in a Rural South Indian Population Available from http://www.iovs.org/content/45/12 /4268. full
24. Shih, Y.F.at al. 2004. *The prevalence of astigmatisme in Taiwan school children*. Optom vis sci;81(2):94-8.
25. David, R. 2009. Astigmatisme, Lasik. University of Minnesota Available from:http://emedicine.medscape.com/article/1220489-overview.
26. Jonasson, F. at al. 2000. *With the rule astigmatisme is not the rule in the elderly*. Iceland-Japan Co-Working Study Groups. Acta ophthalmol scand, Dec;78(6):642-6.
27. Chung, K. M. et al. 1996. *Prevalence of visual disorders in Chinese schoolchildren*. Optom Vis Sci; 73(11):695-700.
28. Burke, A.G. 2006. *Prevalence of presbiopia in rural Tanzania: a population-based study*. Ophthalmology.113:723–7.
29. Nirmalan, P.K. at al. 2006. *A population-based assessment of presbiopia in the state of Andhra Pradesh, south India*: The Andhra Pradesh Eye Disease Study. Invest Ophthalmol Vis Sci;47: 2324–8.
30. Duarte, W.R. at al. 2003. *Prevalence of near vision deficiency and related factors: a population-based study*. Cad Saude Publica.;19: p.551–9