Pattern and Prevalence of Refractive Error and Secondary Visual Impairment in Patients Attending a Tertiary Hospital in Dhulikhel, Nepal

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ABSTRACT

Background

Uncorrected refractive error is one of the most important causes of visual impairment worldwide.

Objective

To ascertain the pattern and prevalence of refractive error and secondary visual impairment in subjects attending Ophthalmology department.

Method

A prospective hospital-based study was designed where presenting visual acuity, age of presentation, refractive status, best corrected visual acuity and status of visual impairment were assessed in participants, ages ranging from 3-39 years presenting to the Ophthalmology department of Dhulikhel Hospital, Kathmandu University Hospital. History of use of spectacle was noted and participants were categorized into different visual impairment categories as per their presenting visual acuity.

Result

Out of a total of 4500 total clients examined during the study period, 388 (8.62%) had refractive error where 219 (56.44%) were females and 169 (43.56%) were males. Mean age at presentation was 22.70±7.69 years (range, 3-39 years). Astigmatism was the most common subtype seen in 373 eyes (48.06%), followed by myopia (366 eyes, 47.16%) and hypermetropia (31 eyes, 4.0%). Only 40.50% subjects who required refractive correction were using spectacle. 62.37% (242 clients) had some of visual impairment during their presentation. There was statistically significant improvement in visual acuity after refractive correction (p=0.00).

Conclusion

Uncorrected refractive error is one of the most important causes of visual impairment. Lack of awareness, infrequent ocular examination and lack of community or preschool vision screening were the main causes for the late presentation and significant visual impairment associated with the condition. Social stigma, economical limitation and negative counseling and attitudes about spectacle wear were primary factors behind the unsatisfactory spectacle use.

KEY WORDS

Astigmatism, Refractive correction, Refractive error, Visual impairment

INTRODUCTION

Uncorrected refractive errors are common cause of visual impairment and blindness worldwide. 2.3 billion people are estimated to be living with this problem.[1] Realizing the burden it can cause to the world and it's easy management, the World Health Organization has adopted the correction of refractive errors in developed and developing countries as one of the main priorities in its "Vision 2020: the right to sight" initiative.[2] According to mid-term review of Nepal Blindness Survey 2010, an estimated 1,013,041 children less than 16 years of age (prevalence among under 16 age group assumed to be 10% based on different studies varying from 3 to 20%); 1,164,053 persons between 16-35 years of age have uncorrected refractive error for distance (estimated prevalence 15%).

Uncorrected or lately corrected refractive error may cause amblyopia and other complications. Visual health directly affects school achievement, economic productivity and as a whole quality of life.[3] Their educational and social interactions may get hindered and overall development will be degraded. Uncorrected refractive errors are thought to be important cause of poor academic performances and high dropouts from schools. Even when spectacles are prescribed and made, people have unwillingness to wear them because of stigma, ignorance and negative parental attitudes etc. Negative parental/familial attitude to wearing spectacles by the needy is a major barrier to refractive correction.

METHODS

A hospital based cross sectional study was carried out among patients of age 3 to less than 40 years, who visited Ophthalmology department of Kathmandu University Teaching Hospital from July 1, 2016 to December 30, 2016 (total of six months). Subjects not willing to participate in the study, subjects having other ocular morbidities (other than refractive error) in the eye responsible for diminished vision like any retinopathy, squint, significant cataract, aphakia, pseudophakia and others were excluded from the study. Informed and written consents were taken from all subjects and his/her attendants after briefing the purpose of the study.

Assessment included the followings:

a) Presenting visual acuity and best corrected visual acuity for distance were measured in different charts (Log MAR charts, Sheridan Gardiner chart and Kay picture chart) as per the co-operation level of the subjects. Visual acuity in the subjects who could read out the alphabets were tested in Log MAR chart specially designed to measure at 10 feet under normal room illumination. It was an alphabet chart having a consistent number of five letters in each row. There was a geometric progression of 0.1 log unit in each line. For the subjects, who were just the beginners in preschool and could not read out alphabets were tested in Sheridan Gardiner chart (tested at 20 feet) and Kay picture chart (tested at 10 feet).

Presenting visual acuity was noted as the patient presented, aided or unaided. History of spectacle use was noted. Best corrected visual acuity was noted after refractive correction in all the cases and cycloplegic correction in all pediatric cases (less than 16 years) and some required adult subjects.

b) Objective and subjective refraction was done for best achievable acuity with glass for distant vision. Both objective and subjective refraction were carried out by optometrists. Cycloplegic refraction was carried out with cyclopentolate eye drop (1%) following Havner's dose. Patients were subjected to streak retinoscopy at a working distance of 50 centimeters performed with the help of Heine Streak Retinoscope. Subjective refraction was done after 3 days of wet retinoscopy and spectacles were prescribed as per the acceptance.

The following criteria were used to classify the refractive error.

a) Hypermetropia: if refractive error is of magnitude ≥+0.50 D. This was further classified as low hypermetropia (>+0.50D to <+ 3.0D), moderate hypermetropia (>+3.0 D to <+6.0D) and high hypermetropia (>+6.0D).

b) Myopia: if refractive error is of magnitude ≥-0.50D. This was further classified as low myopia (>-0.50D to <-3.0D), moderate myopia (>-3.0D to <-6.0D) and high myopia (>-6.0D).

c) Astigmatism: any cylindrical error ≥±0.5. Astigmatism was further classified as simple myopic astigmatism, simple hyperopic astigmatism, compound hypermetropic astigmatism, compound myopic astigmatism and mixed astigmatism.

Astigmatism was further classified as "with the rule "when myopic astigmatism had axis at 180±30 degrees or hypermetropic astigmatism had axis at 90±30 degrees and "against the rule" when myopic astigmatism had axis at 90±30 degrees or hypermetropic astigmatism had axis at 180±30 degrees. If the axis of astigmatism was within >30 to <60 or >120 to <150 degrees, it was considered as oblique astigmatism.

Visual impairment due to uncorrected refractive error was classified according to the presenting visual acuity which might be the uncorrected (visual acuity in uncorrected refractive error) and corrected (visual acuity with present correction in patients using spectacle). Visual impairment was further (4) classified as:

Normal Vision- 20/10-20/25

Mild Visual Impairment- 20/28-20/60

Moderate Visual Impairment- 20/70 – 20/160

Severe Visual Impairment- 20/200- 20/400

Profound Visual Impairment – 20/500-20/1000

Near Total Visual Impairment - < 20/1000

Total Visual Impairment – No light Perception

Visual acuity for the classification of visual impairment was taken of better eye with best correction.

c) Detail Binocular vision evaluation was performed in all cases to exclude the cases with reduced visual acuity due to strabismus, eccentric fixation and other binocular single vision disorders those can affect visual acuity. Alignment of eyes was assessed by Hirschberg's test, Krimsky test and cover/uncover test. Cover/uncover test was performed with the help of an occluder and a fixation target for near (33 cm) and distance (6 m). Prism cover test was performed for those having phoria or tropia. Fixation Pattern was assessed by the Linkz star configuration of the standard Heine's direct Ophthalmoscope. Binocularity in the cases was assessed using red-green glass and worth four dot test (WFD) after full correction of refractive error if any present.

d) Anterior segment and Fundus were assessed with the help of Haag-Strait Slit lamp to rule out any physical and organic causes. Fundus was evaluated after dilation with the Cycloplegics.

Use of optical correction previously was also noted. The Log MAR values for presenting visual acuity and Best corrected visual acuity was noted and analyzed to see mean improvement in visual acuity after best correction.

Responses were anonymized and participants (subjects and/or parents) were made aware of this fact before participation in the study. The data collected will not be accessible to anyone else, other than the researcher. The names and status of all the participants will be strictly confidential.

Written consent was taken from each subject and parent prior enrolling in the study and ethical clearance was obtained from the Institutional Review Committee (IRC-KUSMS) before conducting this study. The study protocol adhered to the provision of the Declaration of Helsinki for research involving human subjects.

Data was entered and analyzed on SPSS 16 version. Descriptive tabulations and chi-square tests were applied to generate descriptive information from qualitative data assuming normalcy. Univariate predictors of mean test scores were assessed using the t-test. The confidential interval was considered at 95% level.

RESULTS

There were 4,500 total clients those fulfilled our inclusion criteria during the time of the study (from July 1 to December 30). There were 388 patients with refractive error. Hence, the prevalence of refractive error in the study population is 8.62%.

The mean age of presentation was 22.70 ± 7.69 years, range (3-39 years).

Refractive error was more prevailed in females compared to males. Out of the total, there were 219 females (56.44%) and 169 males (43.56%) with refractive error.

In our study, astigmatism (48.06%) and simple myopia (47.16%) were the commonest type of refractive errors observed. There were total 366 myopic eyes and 31 hypermetropic eyes.

Low degree of Myopia was the most prevailed one in 258 eyes (70.49% of total myopic eyes), followed by moderate myopia in 84 eyes (22.95% of total myopic eyes) and high myopia in 24 eyes (6.56% of total myopic eyes).

Among hyperopes, low hyperopia was the most prevailed in 23 eyes (74.20% of total hyperopic eyes), followed by moderate and high hyperopia each with 4 eyes (12.90% of total hyperopic eyes).

Compound myopic astigmatism was the most frequent among the population with astigmatism. (Table 1)

Table 1. Distribution of refractive error

Type of refractive error	Number of Right eyes	% (N=388 eyes)	Number of left eyes	% (N=388 eyes)	Total no. of eyes	% (N=776 eyes)
Simple Myopia	**184**	**47.4**	**182**	**46.9**	**366**	**47.16**
Simple Hyperme-tropia	15	3.9	16	4.1	31	4.00
Astigmatism	**187**	**48.20**	**186**	**47.94**	**373**	**48.06**
CMA	115	29.64	115	29.64	230	29.64
SMA	52	13.40	55	14.18	107	13.79
SHA	6	1.54	7	1.80	13	1.67
Mixed	6	1.54	3	0.77	9	1.16
CHA	5	1.29	3	0.77	8	1.03
Oblique	3	0.77	3	0.77	6	0.77
Emmetropic	2	0.51	4	1.03	6	0.77
Total	388	100	388	100	776	100

The refractive error was more prevailed in the age group of 15 to 20 years followed by 21 to 26 years. In both the age groups simple myopia was widespread and the degree of myopia observed more frequently was low to moderate. On the other hand, astigmatism was found to be more common at the age of 27 years and above. (Table 2)

There was no such wide variation in the distribution of subtypes of refractive error among male and female subjects. Astigmatism was the most prevalent refractive error followed by myopia in both male and female. Compound Myopic Astigmatism was the most prevalent subtype of astigmatism in both male and female subjects (31.06% in males and 28.54% in females). Myopia prevalence was more among males (49.41% in males and 44.98% in females).

Low degree of myopia was more common in males (36.39%)

Table 2. Degree of Refractive error in various age groups

Age group	Low myopia	Moderate myopia	High myopia	Low hypermetropia	Moderate hypermetropia	High Hypermetropia	Astigmatism	Emmetropic
3-8	**3**	**2**	**0**	**2**	**2**	**2**	**11**	**0**
9-14	25	8	3	10	2	2	36	0
15-20	**99**	**23**	**0**	**5**	**0**	**0**	**95**	**2**
21-26	**68**	**44**	**13**	**2**	**0**	**0**	**85**	**0**
27-32	42	5	4	0	0	0	75	2
33-39	22	2	4	4	0	0	70	2
Total	259	84	24	23	4	4	372	6

than in females (30.82%). In female subjects, low degree of hypermetropia was more common (4.11%) than in males (0.89%). There were scanty cases with high refractive error.

Among the population studied, it was striking to find a very low number using spectacles (40.50%, n=157) at the time of presentation. The prevalence of spectacle wear was not satisfactory as 59.50% (n=231) of the participants didn't use spectacle prior to the examination.

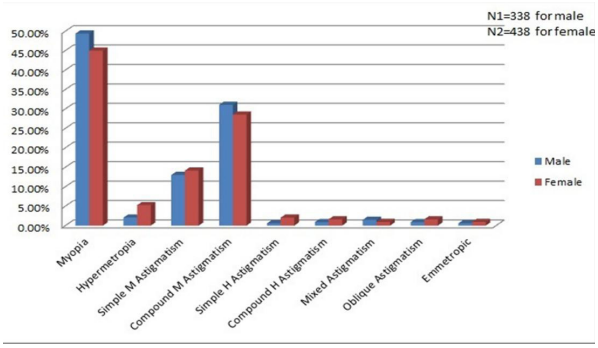

Figure 1. Comparison of types of refractive error among male and female

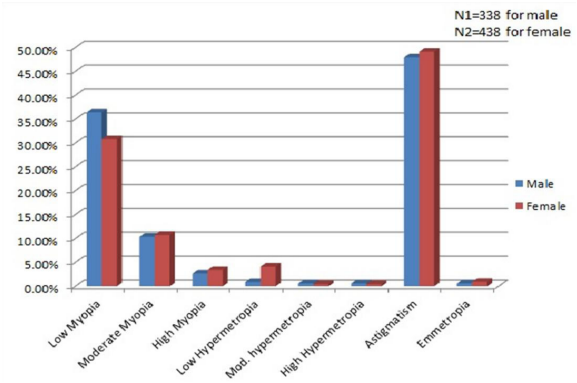

Figure 2. Comparison of degree of refractive error among male and female

Spectacle use history being unsatisfactory, suggests most of the patients were having reduced vision and hence were having some form of visual impairment. One hundred forty six patients (37.63%) were grouped as having normal vision. These patients might have refractive error in only one eye and/ or had error of low magnitude. 26.54% patients (N=103) had mild visual impairment followed by severe visual impairment in 61 patients (15.72%), moderate visual impairment in 52 patients (13.41%), profound visual impairment in 21 patients (5.41%) and near total visual impairment in 5 patients (1.29%).

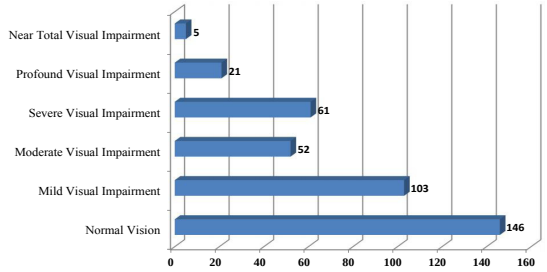

Figure 3. Visual Impairment based on presenting visual acuity

The mean presenting VA in RE was 0.44±0.42 log MAR and in LE was 0.44±0.42 log MAR (range, 0.00 log MAR -1.60 log MAR). The mean best corrected VA in RE was 0.026±0.13 log MAR (range, 0.00 log MAR-1.20 log MAR) and in LE was 0.019±0.09 log MAR (range, 0.00 log mAR-1.00 log MAR). Those cases that were not improved to normal visual acuity level (having visual impairment) were cases of amblyopia. There was significant improvement in visual acuity after spectacle correction (p<0.000).

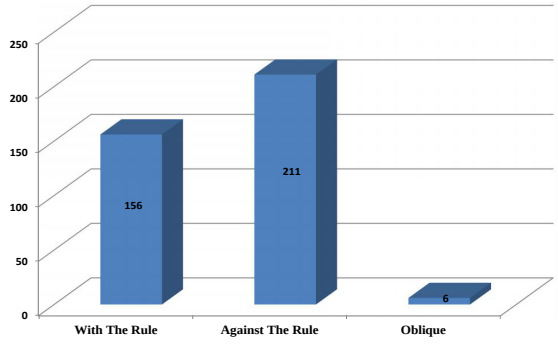

Figure 4. Distribution of different types of astigmatism

DISCUSSION

Visual Impairment secondary to uncorrected refractive error can have severe and long term consequences, such as loss of educational and employment opportunities, hindrances in economic growth for individuals, families and societies and impaired or degraded quality of life.[5] Various factors contribute for refractive errors remaining uncorrected: lack of awareness and recognition of the problem at personal and family level; non-availability and/or inability to afford refractive services; insufficient provision of affordable corrective lenses; and cultural disincentives to compliance. The prevalence of refractive error and visual impairment secondary to the uncorrected refractive error is of public health concern.[5,6] Despite its easy workout and that spectacle correction is among the most cost-effective interventions in eye care.

Prevalence of refractive error in our study is 8.62%. Similar prevalence of refractive error was seen in the any researches show wide variety of refractive error prevalence in different regions and in different ethnicities. Such wide variations of percentage in distribution of refractive errors concluded in different studies might be due to: sample size, different geographical situation, ethnic variation, nutritional status and different criteria adopted. In the Nepal Blindness survey done in 1981, prevalence of refractive error was 1.3% since then various studies have been done regarding the prevalence of refractive error.[7] In a systemic review done by Naidoo et al, the results showed that in 2010, 101.2 million (95% CI: 87.88-125.5 million) were visually impaired due to uncorrected refractive error which was 15% since 1990) which shows that uncorrected refractive error continues as the leading cause of vision impairment and the second leading causes of blindness worldwide.[8] Even though the treatment of refractive error is simple and successful, the condition is still responsible for the significant amount of visual impairment in both developing and developed countries. Large numbers of people are visually impaired due to refractive error because they are not using appropriate refractive correction. Blindness due to refractive error in any population suggests that eye care services in general in that population are inadequate since treatment of refractive error is perhaps the simplest and most effective form of eye care.

If the impact of visual impairment due to refractive error is considered in terms of blind-person-years, the person becoming visually impaired due to refractive error at a young age, and which is not corrected would suffer many more years of visual impairment than a person becoming blind from cataract in old age and would place a greater socio-economic burden on society.[2]

In our study prevalence of refractive error was greater in female 56.44% (n=219) in comparison to males 43.56% (n=169). This finding is comparable to the study done by Tuladhar et al in 601 subjects where 40.1% (n=241) were males and 360 (59.9%) were female and contrary to the study done by Karki et al. in 1276 subjects where the refractive error was present in 51.33% (n=655) males and 48.66% (n=621) females.[9,10] These contrary findings are due to the female dominance in the presentation in the hospital in comparison to the males.

In our study, astigmatism (48.06%) and simple myopia (47.16%) were the commonest type of refractive errors observed. There were 397 eyes with myopia and hyperopia. There were total 366 myopic eyes and 31 hypermetropic eyes. In a study done to estimate the refractive error in Europe prevalence of myopia was 30.6%, hyperopia was 25.2% and astigmatism in 23.9 %.[11] The significant burden of refractive error is myopia. Different studies are being conducted regarding the prevalence and distribution of myopia. In comparison to prevalence rates between different studies, the definition of myopia must be noted, varying age compositions of the study population, refractive error measurement techniques and study methodology. The prevalence rates of myopia are apparently higher in Asians (Singapore, Chinese, Singapore, Malays and Indonesians) who may have been found to have genetic predisposition to myopia.[12] The prevalence rates of myopia (SE at least -0.50D) in young adults in Indonesia was 61.6%.[13] In our study the prevalence of myopia was greater in 21-26 age groups. This findings are comparable to study done at Indonesia by Saw et al. where prevalence rate of myopia (SE at least -0.5 D) in 21- to 29-year-olds in Sumatra was 61.6%.[13] And other studies done in South East Asia where the myopia rate in 16- to 25-year-old Singapore Malay military conscripts was 65%.[12] The rates of myopia were 82.2% in Singapore Chinese military conscripts (using the same definition) and 84% in 16-to 18-year-old Chinese in Taiwan.[14]

Much of the study of myopia and refractive error has been done in children than in adults. In our study, the prevalence of myopia and myopic astigmatism was greater in young adults. The findings is comparable to other studies where the prevalence rates of myopia were 34.1% in adultsaged 40 years and more, and 17% to 28.0% in adults aged 40 or more years in the United States and Australia, respectively.[15] The prevalence rates of myopia are higher in younger adults and less in elderly adults, similar to the findings of the other study in population studies like Andhra Pradesh Eye Disease Study, Beaver Dam Eye Study.[16-18]

As uncorrected refractive error is a common cause of preventable visual impairment. Despite the increasing popularity of contact lenses and refractive surgery, the use of spectacles still remains the popular method of correcting refractive errors. Patients understanding of refractive errors and their attitude towards spectacles and eye health would be expected to influence the compliance with wearing.[19] Among several surveyed populations it has been observed that only one third or less of children with visual impairment due to refractive error are wearing spectacles.[14,16,17] In our study, also among the population studied, it was striking

to find a very low number using spectacles (40.50%) at the time of presentation, although management of refractive error is very easy and economical. Spectacles are the cheapest and commonest form of correction of refractive errors. Improvement of visual acuity even in an eye (the better eye) will improve the visual impairment level. The prevalence of spectacle wear was not satisfactory as 59.50% of the participants didn't use spectacle prior to the examination. There could be many reasons for that. In study done to know the attitude and belief regarding spectacle wear common reason was that glass could cause the eyes to sunken or pushed in.[19] In our setting, cost factor and the concept of burden for the spectacles could be the main cause for non-compliance of the spectacles. After refractive correction, 97.16% of the total cases i.e. 377 cases were grouped under normal vision. Only 6 cases (1.55%) had mild visual impairment, 3 cases (0.77%) had moderate visual impairment and 2 cases (0.52%) had severe visual impairment. There was great improvement in visual acuity after refractive correction and hence many patients had normal vision after correction. Number of patients with visual impairment reduced to great extent after refractive correction.

The main limitation of the study was that it was a hospital-based study. Though, it could not generalize the refractive error prevalence and pattern in general people in the community, it spreads light over the fact that it's alarmingly increasing and has been nagged since long. A community-based study would have been a better marker for the problem. Never the less, this study may be taken as guidance for the larger community based studies. Also, etiologies and symptoms could not be correlated with the prevalence and the pattern of refractive error.

CONCLUSION

Uncorrected refractive error is one of the most important causes of visual impairment in developing countries like Nepal. This has direct effect on personal, social, academic, and professional aspects of an individual. Indirectly, it has large impact on countries socioeconomic development as well. Lack of awareness, infrequent ocular examination and lack of community or preschool vision screening were the main causes for the late presentation and significant visual impairment associated with the condition. Social stigma, economical limitation and negative counseling and attitudes about spectacle wear were primary factors behind the unsatisfactory spectacle use. Hence, owing to its easy management and dangerous consequences in an individual's life and countries development, serious actions should be taken without delay.

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