ORIGINAL ARTICLE

PREVALENCE OF UNCORRECTED REFRACTIVE ERRORS IN ADULTS AGED 30 YEARS AND ABOVE IN A RURAL POPULATION IN PAKISTAN

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Background: Uncorrected refractive errors are a leading cause of visual disability globally. This population-based study was done to estimate the prevalence of uncorrected refractive errors in adults aged 30 years and above of village Pawakah, Khyber Pakhtunkhwa (KPK), Pakistan. **Methods**: It was a cross-sectional survey in which 1000 individuals were included randomly. All the individuals were screened for uncorrected refractive errors and those whose visual acuity (VA) was found to be less than 6/6 were refracted. In whom refraction was found to be unsatisfactory (i.e., a best corrected visual acuity of <6/6) further examination was done to establish the cause for the subnormal vision. **Results:** A total of 917 subjects participated in the survey (response rate 92%). The prevalence of uncorrected refractive errors was found to be 23.97% among males and 20% among females. The prevalence of visually disabling refractive errors was 6.89% in males and 5.71% in females. The prevalence was seen to increase with age, with maximum prevalence in 51–60 years age group. Hypermetropia (10.14%) was found to be the commonest refractive error followed by Myopia (6.00%) and Astigmatism (5.6%). The prevalence of Presbyopia was 57.5% (60.45% in males and 55.23% in females). Poor affordability was the commonest barrier to the use of spectacles, followed by unawareness. Cataract was the commonest reason for impaired vision after refractive correction. The prevalence of blindness was 1.96% (1.53% in males and 2.28% in females) in this community with cataract as the commonest cause. **Conclusions:** Despite being the most easily avoidable cause of subnormal vision uncorrected refractive errors still account for a major proportion of the burden of decreased vision in this area. Effective measures for the screening and affordable correction of uncorrected refractive errors need to be incorporated into the health care delivery system.

Keywords: Prevalence**,** Refractive errors, adult population, myopia, hyperopia, astigmatism

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INTRODUCTION

Uncorrected refractive errors are a leading cause of avoidable visual disability globally and no age, gender or ethnic group is exempt from its visually disabling effects.[1,2]

Lack of refractive correction bears important consequences for the individual and the community in terms of lost education and employment opportunities, compromised quality of life, and decreased socioeconomic productivity. Therefore, refractive errors have been identified as a priority area of the global initiative for the prevention of avoidable blindness under the 'Vision 2020 right to sight' programme.[3]

Refractive errors have been shown to affect approximately one third of those aged 40 years and above in the US and Western Europe and one fifth of the Australians in the same age group.[4] In the developing countries too, refractive errors affect a significant part of the population.[5–9] According to an estimate 2.3 billion people worldwide have refractive errors out of which only 1.8 billion have access to diagnostic facilities and affordable refractive correction, therefore, approximately 500 million people, (mostly in the developing countries) are left with uncorrected refractive errors resulting in blindness and visual impairment.[10]

Children and young adults with refractive errors, middle age people with presbyopia and elderly people with aphakia and pseudophakia are the main groups that most frequently need refractive correction.[1]

The national survey on the prevalence of blindness and its causes reported refractive errors as a major cause of visual loss in Pakistan.[7] Results of the survey showed that in eyes with visual acuity of <6/18 refractive errors caused as much visual loss as cataract.[11]

This study was conducted to estimate the prevalence of refractive errors in the adult population aged 30 years and above of a rural settlement (Pawakah) in the Khyber Pakhtunkhwa Province.

MATERIAL AND METHODS

Ethical approval was obtained from the institutional ethical committee and the study followed the tenets of the Declaration of Helsinki. Informed verbal consent was obtained from all study participants.

The study was conducted at village Pawakah of Tehsil Peshawar, Khyber Pakhtunkhwa, Pakistan. It was a cross-sectional population-based survey. Adults aged 30 years and above were included in the study. In light of the guidelines for the assessment of refractive errors by WHO[1] and the objectives of the study a comprehensive questionnaire was designed and later field-tested in the pilot study done at the outpatient department of Khyber Institute of Ophthalmic Medical Sciences (KIOMS), Peshawar.

Through random sampling 1000 individuals aged 30 years and above were included in the study. The survey was conducted from 28th Feb to 11th April 2005. In the field the central team was posted in a focal point and the mobile teams screened the community for refractive errors. The survey team comprised six MSc. Community Ophthalmology students, two refractionists and two ophthalmic technicians (as enumerators). All those whose presenting visual acuity was found to be <6/6 on Snellen visual acuity chart were referred to the central team for refraction. Those spectacle wearers whose presenting visual acuity was 6/6 were excluded from the study. Objective refraction (manual retinoscopy) followed by subjective verification was done as the refraction routine. If the outcome of refraction was not satisfactory then the possible cause for subnormal vision (<6/6) was noted down. Posterior segment examination was done with un-dilated pupils. Those who needed pupillary dilatation for examination, further investigation or surgical intervention were referred to KIOMS. All those above the age of 40 or those who had a complaint of difficulty in performing near vision tasks had their near vision checked and appropriate correction was prescribed.

Those with a visual acuity of 6/6 in both eyes were not referred for refraction and were considered to be emmetropic based on the criteria used previously.[12,13]

Refractive errors requiring a correction of more than 0.25 D (plus/minus/cylindrical lenses) were classified as refractive errors and were further categorized as myopia, hypermetropia, and astigmatism. Individuals having refractive error with a presenting visual acuity of <6/18 were categorized as having visually disabling refractive error (VDRE). For all such categorization the WHO–defined categories for visual impairment and blindness were used.[14]

Myopia was classified as low to moderate (less than–5.00D), high myopia (>-5.00 to -10.00) and extreme high myopia (>-10.00D).[15]

Astigmatism was measured in minus cylinders. If the required minus cylinder was at 180°/0°±15° then the astigmatism was termed as with-the –rule (WTR), if the axis of the minus cylinder was 90°±15° then it was termed as against-the-rule (ATR) astigmatism and if the axis was 20°–70° and 110°–160°, i.e., between that of WTR and ATR then it was classified as oblique astigmatism.[12] Sample size calculation, data entry and analysis were done in Epi info 6.

RESULTS

Out of a total of 1000 individuals from the Pawakah village 917 people participated in the study. Of these 525 (57.25%) were females and 392 (42.75%) were males. The overall response rate was 91.7% with 87.11% among the males and 95.45% among the females.

Mean age of the study population was 46.19 years (range=30–105 years). Among the women mean age was 43.99 years while in men it was 47.25 years. Most of the people examined were of the 30–40 years age group (421 subjects; 45.9%) comprising of 139 (33%) males and 282 (67%) females. Females were found to be more than the males in 30–40 & 41–50 years age groups. The refractive assessment of each eye was done separately (Table-1). With regard to refractive state of the eye the data for the right eye and the left eye did not differ significantly (p=0.149) therefore for further analysis data of the right eye was used.

Overall prevalence of uncorrected refractive errors in the study population was 21.7% (199), 95% CI 19.44–24.36%. The prevalence among males was 23.97% (94) 95% CI interval 19.75–28.19% and among females it was 20% (105): 95% CI 16.58–23.42%. The difference in the overall prevalence of refractive errors among males and females was not significant (p=0.11). The prevalence of refractive errors with respect to age distribution is given in table-2. The prevalence was lowest in the 30–40 year age group and highest in the 51–60 year age group. The number of individuals in the >70 year age group was too small for any meaningful comparison. Age and gender based analysis of the prevalence of refractive errors in the study population is given in table-3.

The prevalence of visually disabling refractive errors was 6.22% in the study population, i.e., 28.64% of the refractive errors were visually disabling (presenting VA<6/18). With regard to the prevalence of refractive errors in terms of myopia, hypermetropia, and astigmatism, hypermetropia was

found to be the commonest refractive error with a prevalence of 10.14% (93) [95% CI 8.3–12.3 %] accounting for 46.73% of all the refractive errors. Myopia and astigmatism with a prevalence of 6% (55) [95% CI 4.46–7.54%] and 5.6% (51) [95% CI 4.2–7.3%] had near similar distribution, i.e., 27.64% and 25.63%. Mean spherical refractive error was 1.728 D (0.25D–14D). The prevalence of myopia was found to be more in men than in women, i.e., 9.18 % (36) and 3.61% (19) respectively with statistically significant difference (p=0.02). The prevalence of hypermetropia and astigmatism was more in females than males [9.94% (39);10.28% (54), 5.10% (19);6.09% (32) p=0.01]. The prevalence of myopia increased with increasing age as shown in figure-1. The pattern was similar in males and females. The lowest prevalence was seen in the 41–50 years age group [4.5% (11)] and the highest among the 51–60 years group [8.8% (11)]. Myopia when further classified according to the degree of myopia as low- to-moderate (<-5.00D), high (≥5.00 to ≤-10.00D) and extreme high (>10.00D) yielded a prevalence of 5.56% (51), 0.33% (3) and 0.10% (1) respectively.

Stratified analysis by gender did not yield any significant difference among males and females (p=0.76). Hypermetropia, the most prevalent of all refractive errors also increased with increasing age. The lowest prevalence was seen in the >70 years age group followed by 30–40 years age group [3.32% (14)] and the peak was observed in the 51–60 years age group [25.16% (32)]. The number of individuals in the 61–70 and >70 years age group was not enough to establish a strong statistical correlation but the decline in hypermetropia in the >60 years population seems to correlate with the increase in the prevalence of nuclear sclerosis, cataract and myopia in these age groups. This trend was observed to be similar in both the genders. In terms of degree of hypermetropia the prevalence of hypermetropia of +0.25 to +1.00 D was 5.8% (54) and +1.25 to +3.00 D was 4.25% (39).

The prevalence of astigmatism increased with the increasing age. Lowest prevalence was observed across youngest age group, i.e., 30–40 years [5.4% (23)] and the prevalence reached peak in 61–70 years age group [8.75% (7)]. The trend was similar among both the genders but more pronounced among males. The astigmatism was measured in minus cylinders and the mean cylindrical error was –0.97 D. Nineteen individuals with astigmatism had hypermetropia (37.25%) while 17 had myopia (33.33%). Mean spherical equivalent was 1.549 D. In terms of degree of astigmatism 3.82% (35) had 0.25–1.00 D, 1.42% (13) had 1.25–2.00D and 0.33% (3) had 2.25–3.00D of astigmatism (measured in minus cylinder).

In terms of: with-the-rule; against –the-rule and oblique astigmatism, against the rule astigmatism (ATR) was the commonest type of astigmatism [49.02% (25)] followed by oblique astigmatism [29.41% (15)] and the least common type was with the rule (WTR) [21.57% (11)]. The prevalence was similar in males and females (p=0.74). The prevalence of ATR astigmatism increased with the age as shown in table-4.

The prevalence of Presbyopia was 57.5% (60.45% in males and 55.23% in females). Only 17% of the presbyopes were using spectacles. The commonest barrier to the use of spectacles was poor affordability, followed by unawareness.

Myopia was the commonest cause of visually disabling refractive errors (46%) followed by hypermetropia (31%) and astigmatism (23%). Among those who had refractive errors (199) the best-corrected visual acuity (BCVA) of 6/6 was achieved in 88.94% (177) of cases. Ninety-five percent (190) belonged to the "mild or no visual impairment" category after refractive correction while 4.52% (9) still remained in the visual impairment category.

No case of severe visual impairment or blindness was noted after refractive correction. Twenty-two subjects had unsatisfactory refraction (BCVA was less than 6/6). The most common reason for no further improvement in visual acuity after refraction was cataract [54.56% (12)] followed by retinal diseases [22.72% (5)], optic nerve diseases including glaucomatous optic neuropathy [4.54% (1)] and those who needed further investigations [18.18%(4)].

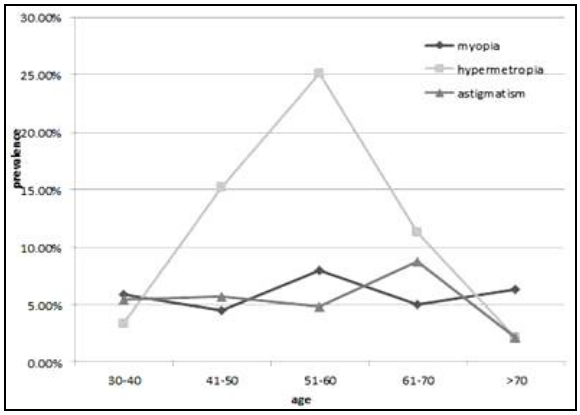

Figure-1: Prevalence of Myopia, Hypermetropia & Astigmatism across various age groups

Table-1: Prevalence of refractive errors in each eye

	Refractive status		
	Emmetropia % (n)	**Refractive errors % (n)**	**Others[2] % (n)**
Right eye	65.53 (601) CI[1]: 62.6–68.8%	21.70 (199) CI=19.44–24.36%	12.75 (117)
Left eye	66.0 (605) CI:62.8–69.00%	21.26 (195) CI=18.62–23.90%	12.75 (117)

[1]95% CI=Confidence Interval, [2]Others=aphakes, pseudophakes and those in whom retinoscopy could not be performed because of media opacities were grouped under "others".

Table-2: Prevalence of refractive errors stratified by age

Age group (years)	Prevalence of refractive errors % (n)
30–40	14.96 (63) CI[1]=11.06–18.36%
41–50	25.40 (62) CI=19.96–30.84%
51–60	39.2 (49) CI=30.65–47.75%
61–70	25 (20) CI =15.51–34.49%
>70	10.63 (5) CI=1.83–19.43%

[1] CI=95% Confidence Interval

Table-3: Gender distribution of the prevalence of refractive errors across various age group

Age group	Male % (n)	Female % (n)	*p*-value
30–40 years	20.14 (28) CI[1]=13.47–26.81%	12.41 (35) CI=8.57–16.25%	0.08
41–50 years	20.72(23) CI=13.19–28.25%	29.32 (39) CI=21.59–37.05%	0.17
51–60 years	40 (26/65) CI=28.1–51.9%	38.33 (23) CI=26.03–50.63%	0.62
61–70 years	24.48 (13/49) CI=12.45–36.51%	22.50 (7) CI=7.8–37.20%	0.01
>70 years	14.20 (4)	5.26 (1)	0.15

[1] CI=95% confidence interval

Table-4: Prevalence of different types of astigmatism across various age groups

Age	With-the-rule	Against –the-rule	Oblique
30–40	1.42% (6)	1.66% (7)	2.37% (10)
41–50	1.63% (4)	3.27% (8)	0.81% (2)
51–60	0.8% (1)	3.2% (4)	0.8% (1)
61–70	-	6.25% (5)	2.5% (2)
>70	-	2.12% (1)	-

DISCUSSION

This population-based cross-sectional study focused on the prevalence and distribution of uncorrected refractive errors in the adult rural population. Those whose refractive errors had been successfully corrected and were using their spectacles regularly were excluded hence the estimated prevalence reflects the true burden of visual impairment causes by uncorrected refractive errors. In most of the epidemiological studies auto-refractometers are used[16] but this study employed the most reliable method of assessment of refractive errors, i.e., manual refraction with subjective verification[12]. The cut off for defining refractive errors was also kept at a lower level so that an accurate assessment of true prevalence can be achieved. Most of the studies report on the magnitude of refractive error induced blindness and visual impairment while this study reports the actual prevalence of refractive errors of any degree.[1,2] The study was able to achieve a good response rate (92%).

The overall prevalence of refractive errors in this study was 21.70%. There was a remarkable increase in the prevalence of refractive errors with the increasing age which correlates with other studies as well.[9,16,17] For the analysis of refractive errors data pertaining to the right eye was used because no significant difference was noted between the two eyes and it has been reported as a valid strategy employed by other invetigators.[7,18,19]

In our study hypermetropia was found to be the commonest refractive error, followed by myopia and astigmatism. This is unlike studies from Sumatra[5], Singapore[6], India[7] and Bangladesh[9] in which myopia was the commonest refractive error. The results of national survey of Pakistan have also reported myopia to be the commonest refractive error.[16] The Eye Disease Prevalence Research group[4] also found myopia to be greater than hypermetropia in the US, Western Europe and Australian population but in this study hyperopia of greater than +3.00 D and myopia of greater than –1.00 D was taken as the defining limits and this could underestimate hyperopia. Some of these studies have included younger age groups like the Indian study which included individuals ≥15 years. The inclusion of younger subjects particularly 15–25 years individuals would show an increase in the prevalence of myopia as myopia is known to be more prevalent in this age group.[4] Another important fact is that many of these studies have used auto-refractometers for refraction, which are known to induce accommodation and the effect can be pronounced in younger adults. This can result in an underestimation of hypermetropia and overestimation of myopia. In addition to this the study from Singapore[6] and India[7] were conducted in urban populations with higher educational status, which has been shown to correlate with higher prevalence of myopia in many studies[19–21].

In this study myopia was found to be more in men than women (8.16% in males and 3.61% in females p=0.02) and it correlates with the findings reported by Bourne *et al*[9] and Hyams *et al*[22]. In the Indian study[7] no significant correlation between gender and prevalence of myopia was noted while a Finish study[20] done in rural population showed a higher prevalence of myopia in females.

The trend of increasing myopia with increasing age (>60 years) has been shown to correlate with the higher prevalence of nuclear sclerosis and nuclear cataract in the older age groups.[16,23]

In terms of low to moderate, high and extreme high myopia the prevalence in our study was 5.56%, 0.33% and 0.10%. In a study from the US the prevalence of high myopia was 3.2% and that of extreme high myopia 0.2%. In the Melbourne Visual Impairment project prevalence of high myopia was 2% and extreme myopia 0.3%.[22] The prevalence of high myopia in the study from Bangladesh (1.8%), Singapore (Indian population 2.1%) and India (4.5%) was higher than the prevalence in this study while it is comparable with a study from Saw *et al* from Sumatra (0.6%).[5] Myopia was found to be responsible for most of the visually disabling refractive errors (45%) and this correlates with other studies from the region.[2,7–9,16]

Prevalence of hypermetropia was 10.14% in our study population. The lower prevalence of

hypermetropia in 30–40 years age group, peaking in the 51–60 years group and then declining in >60 years age cohort is similar to the pattern observed in the studies from Bangladesh[9], India[7], Singapore[6] and Indonesia[5]. The prevalence of astigmatism was much lower than that reported by the National survey.[16]

The increase in prevalence of refractive errors with increasing age was also reported by other studies.[7,10,13,19] In this study against –the-rule astigmatism was found to be the commonest entity followed by oblique astigmatism and the least common variety was with-the –rule astigmatism. This finding is in accordance with the observations reported by Shah *et al*[16], Bourne *et al*[13], Attebo *et al*[19] and Dandona *et al*[8] while Pensyl *et al*[24] and McKendrick *et al*[25] reported the opposite trend. ATR astigmatism was found to increase with age - an observation reported by other studies as well.[26]

CONCLUSION

Uncorrected refractive errors still account for a large proportion of subnormal vision, blindness and visual impairment in our community. Keeping in view the avoidable nature of visual impairment caused by refractive errors, effective measures for screening and correction of refractive errors should be taken on priority basis.

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