Original Article

Prevalence and causes of visual impairment among adults aged 15–49 years in a rural area of north India - A population-based study

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Purpose: Very few studies have been conducted in India and other parts of the world on visual impairment among individuals aged 15–49 years. This study was conducted to determine the prevalence, causes, and associated factors of visual impairment among adults aged 15–49 years in a rural population of Jhajjar district, Haryana, north India. **Methods:** A population-based cross-sectional study was conducted in two blocks of Jhajjar district. A total of 34 villages were selected using probability proportionate to size sampling method. Adults aged 15–49 years were selected using compact segment cluster sampling approach. As part of the house-to-house survey, presenting visual acuity using screening chart corresponding to five "E" 6/12 optotypes was measured along with collection of other demographic details. The optometrists performed detailed eye assessment including repeat measurement of visual acuity using retro-illuminated conventional logMAR tumbling "E" charts, torch light examination, and non-cycloplegic refraction at a clinic site within the village to ascertain visual impairment and its cause. **Results:** Of 5,470 enumerated adults, 5,117 (94%) completed all study procedures. The age- and sex-adjusted prevalence of visual impairment was found to be 1.85% [95% confidence interval (CI): 1.48, 2.23] and blindness was 0.09% (95% CI: 0.01, 0.18). The age- and sex-adjusted prevalence of unilateral visual impairment was 1.11% (95% CI: 0.81, 1.41). Uncorrected refractive errors (84%) contributed maximum to visual impairment in this age group. The visual impairment in study participants was found to be associated with age and educational status. **Conclusion:** At the community level, uncorrected refractive errors contribute largely to visual impairment in the age group of 15–49 years.

Key words: Adults, Jhajjar, prevalence, rural, visual impairment

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Globally, it is estimated that there are 441 million visually impaired people encompassing range of impairment from mild levels to blindness. The majority of these are living in south Asian countries which include India. More than one-fifth of visual impairment is contributed by people in the age group of 0–49 years.[1] The National Sample Survey Organization Survey 2002 reported the prevalence of low vision in India as 0.27% with higher prevalence in rural (0.30%) compared with urban parts (0.19%). An increasing trend of visual impairment was also reported in the same study.[2] Visual impairment in the young and productive age group has social and economic implications.[3]

The World Health Assembly (2013) proposed that assessment of causes and prevalence of visual impairment is required to track the progress toward universalization of eye health and eliminating avoidable causes of visual impairment by the year 2020.[4,5] Currently, various methods are in use for rapid assessment of visual impairment, but largely these methods are used for older adults (50 years and above).[6] Very few studies have been conducted in India and other parts of the world among those aged 15–49 years. As it is the most productive age group in terms of nation's economy and accounts for more than half of India's population, necessary evidence is required to address the burden of visual impairment in this age group.

This study aimed to find the prevalence and causes of visual impairment in the population aged 15–49 years in a rural district of north India. Secondarily, it determined its association with various sociodemographic variables.

Methods

This is a population-based cross-sectional study done in Jhajjar district of Haryana. The rural population of this district is 0.7 million. This district has five subdistricts. Assuming prevalence of visual impairment in the target age group as 2.7%, relative precision 25%, design effect 2, and non-response 10%, a minimum of 5,124 adults were needed in this study.[7] The two subdistricts (Bahadurgarh and Jhajjar) were selected randomly through lottery method. These two subdistricts were largest in terms of population size (combined rural population was 399,259) and covered 56% of the rural population of the

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district. Within these subdistricts, selection of village was done according to probability proportionate to size. A total of 34 villages were selected in this study. Each village was broken down to segments of 400-–600 population. One compact segment was selected randomly from each village. All adults between 15 and 49 years of age were enumerated in this segment through house-to-house survey by social worker and health assistant. It was ensured that at least 140–160 participants in the target age group were selected from each cluster. All target adults living in the study area for more than 6 months and consenting to study procedures were included in the study. Visitors to study households were excluded. This study was conducted between January and May 2014.

Data collection procedures

The data collection was undertaken by two teams each comprising one optometrist, social worker, and health assistant. The teams were trained in all data collection procedures and were experienced in vision examination. Kappa was measured (was found >0.6) for all survey procedures between the same level of observers to minimize interobserver bias. Initially, house-to-house visit was done for enumeration. The initial screening was conducted by a health assistant, with the support of a social worker. All participants underwent visual acuity testing using screening chart corresponding to five "E" 6/12 optotypes. Correct identification of four letters out of five was considered as pass criteria. Vision testing was done at 4 m distance. Presenting visual acuity was considered as vision with spectacles, if using spectacles for distance vision. All participants with visual acuity less than 6/12 in either eye or using spectacles were referred to temporary makeshift clinic. Optometrists performed detailed eye assessment including measurement of visual acuity using retro-illuminated conventional logMAR tumbling "E" charts, torch light examination, and non-cycloplegic refraction. Lens was assessed using torch light. A pupil that clearly appeared grey or white when examined with oblique light was noted as obvious lens opacity and cataract. Causes of visual impairment were also noted as uncorrected refractive errors, cataract, and others using standard World Health Organization (WHO) methodology for surveys on visual impairment.[8]

Quality assurance and standardization of all study procedures and equipment was done throughout the conduct of the study. Pilot testing of all the procedures was done at another village that was not included in this study. The investigating team consisted of epidemiologist and ophthalmologist who supervised all procedures. The epidemiologist finalized the study compact segment within each cluster village and central location site for detailed clinical examination by the optometrist maximizing access and participation within the study. Random checks to households were done to examine the information collected from household members and their visual status. The ophthalmologist also examined randomly eyes of visually impaired persons to cross-check findings of optometrists. Ten percent of all participants' forms and recorded findings were rechecked by epidemiologist and ophthalmologist, including those with normal visual acuity at the initial time of screening at household level.

Operational definitions used in this study are given below:

- Below poverty line (BPL): A family with monthly income less than US$ 4.6 (INR 300) and confirmed by presence of BPL ration card.[9]
- Visual impairment: Presenting visual acuity less than 6/12 in better eye.
- Mild visual impairment: Presenting visual acuity <6/12 and ≥6/18 in better eye.
- Moderate visual impairment: Presenting visual acuity <6/18 and ≥6/60 in better eye.
- Severe visual impairment: Presenting visual acuity <6/60 and ≥3/60 in better eye.
- Blindness: Presenting visual acuity <3/60 in better eye as defined by WHO.
- Unilateral visual impairment: Presenting visual acuity worse than 6/12 in one eye but better or equal to 6/12 in other eye. Those with bilateral visual impairment were not considered for this parameter.
- Uncorrected refractive error: When the presenting visual acuity was less than 6/12 but improved to 6/12 or better on subjective refraction.
- Cataract: Opacity of crystalline lens in the pupillary area seen with torch light.
- Other causes of visual impairment: All other causes apart from uncorrected refractive error and cataract were included in this.

Ethics approval

This was taken from the Institute Ethics Committee of All India Institute of Medical Sciences, New Delhi. The study procedures confirmed to the principles laid by Declaration of Helsinki. Written informed consent was obtained from the head of household for all participants within the household that were enrolled in the study.

Data analysis

Data entry was done in Microsoft access database with inbuilt validation and consistency checks. Analysis was done using STATA v12 (Stata, College Station, TX, USA). The results were expressed in terms of proportion with 95% confidence intervals (CIs). Analysis was done for unilateral and bilateral visual impairment separately. Multivariate logistic regression was done using survey analysis (*svy* commands) to account for cluster design. Associated factors with visual impairment are presented as odds ratio with 95% CIs.

Results

A total of 5,470 adults in the age group of 15–49 years were enumerated in the study from 34 clusters of rural Jhajjar. Of these, 5,220 (95.4%) were examined at household level. A total of 4,352 participants were found to have presenting visual acuity >6/12 in both eyes and 868 participants were referred for further examination due to referral reasons, namely, visual acuity <6/12 in any eye or history of spectacle use. Of the referred participants, 765 reached the clinic for re-examination. Thus, a total of 5,117 (93.54%) adults (including 4,352 with normal presenting visual acuity at the household level) have been included in this study to estimate the prevalence of visual impairment. Among these, 55% were in the age group of 15–29 years and 52% were males. The mean age (standard deviation) of participants examined was 29.4 (±9.4) years. The majority of the participants (44.3%) were educated up to secondary level and belonged to above poverty line category. Details of enumerated and examined participants are presented in Table 1.

The age and sex prevalence of visual impairment in our study population was 1.85% (95% CI: 1.48, 2.23), with the majority having mild visual impairment [Table 2]. The age-adjusted prevalence of visual impairment in men and women was 1.36% (95% CI: 0.91, 1.82) and 2.36% (95% CI: 1.76, 2.97), respectively. When segregated into different age categories, it was found that the majority (52%) of visually impaired participants were in the age group of 40–49 years. In all, 53 participants additionally were detected to have unilateral visual impairment, with age- and sex-adjusted prevalence of 1.11% (95% CI: 0.81, 1.41). The age-adjusted prevalence of unilateral visual impairment in men and women was 1.07% (95% CI: 0.67, 1.49) and 1.15% (95% CI: 0.72, 1.59), respectively.

On multivariate analysis, age and education were found to be significantly associated with visual impairment. Those in the age group of 40–49 years were four times more likely to have visual impairment [adjusted odds ratio (aOR) 4.3, 95% CI: 1.9, 9.1] compared with participants in the age group of 15–29 years. Education was found to be inversely related to visual impairment. Participants educated up to secondary levels and higher secondary levels had 40% and 30% lesser odds of visual impairment compared with illiterate adults, respectively [Table 3]. For unilateral visual impairment, only increasing age was found to be significantly associated in multivariate analysis. Participants 40–49 years of age had six times higher odds [aOR 6.0, 95% CI: 3.2, 11.2] of unilateral visual impairment compared with adults aged 15–29 years [Table 4].

Uncorrected refractive error was the most common cause of visual impairment (83.5%) followed by other causes (11%) and cataract (5.5%). When segregated according to age and gender, uncorrected refractive errors remained the most common cause of visual impairment followed by other causes and cataract across all age groups and gender [Table 5]. Uncorrected refractive errors remained the most common cause of unilateral visual impairment in all age groups and gender [Table 5].

Table 1: Sociodemographic characteristics

Variable	Enumerated adults, *n*=5470 (%)	Examined adults, *n*=5117 (%)
Age (years)		
15-29	2880 (52.6)	2799 (54.7)
30-39	1493 (27.3)	1398 (27.3)
40-49	1097 (20.1)	920 (18.0)
Gender		
Men	2872 (52.5)	2649 (51.8)
Women	2592 (47.5)	2468 (48.2)
Marital status		
Married	3555 (64.9)	3272 (63.9)
Single (unmarried/widower)	1915 (35.0)	1845 (36.1)
Occupation		
Housework	2106 (38.5)	2001 (39.1)
Laborer - agricultural/non-agricultural	1110 (20.3)	999 (19.5)
Office/skilled work	946 (17.3)	852 (16.6)
Student	1178 (21.5)	1144 (22.4)
Unemployed/not working	130(2.4)	121 (2.4)
Education		
Illiterate	446 (8.2)	405 (7.9)
Primary (up to 5th class)	458 (8.4)	414 (8.1)
Secondary (up to 10th class)	2426 (44.4)	2269 (44.3)
Senior secondary and above	2140 (39.1)	2029 (39.6)
Poverty line		
Above poverty line	4323 (79.0)	4023 (78.6)
Below poverty line	1147 (20.9)	1094 (21.4)

Discussion

To best of our knowledge, this is the first population-based study conducted within the district of Jhajjar of north India. This study gave insights to epidemiological data on the level of visual impairment among adults aged 15–49 years in Jhajjar district. There is paucity of literature on magnitude of visual impairment within India in this age group. A large number of studies in the past have been done in age group of 50 years and above with little focus on most productive age group, owing to large sample size requirements for studying people in age group of 15–49 years.[10,11] We found the prevalence of bilateral visual impairment in this age group as 1.8% and unilateral visual impairment as 1%. Our estimates are lower than another study conducted in a rural south Indian site (2.7%, 95% CI: 2.1, 3.3) and outside – Mozambique with prevalence of visual impairment in this age group as 3.5% (95% CI: 2.7, 4.2).[7,12]

In our study, the maximum visual impairment in study participants was due to uncorrected refractive errors (83.5%). This is consistent with other studies.[13-15] In a study from Botucatu, Brazil, in the age group of 21–50 years, 90% of visual impairment was due to uncorrected refractive errors.[16] Within south Asia, uncorrected refractive errors were estimated to contribute high to moderate severe visual impairment – 64% (95% CI: 60.0, 70.8) and blindness – 35.4% (95% CI: 20.3, 45.9).[17] Considering the figures obtained in our study, the prevalence of uncorrected refractive

Table 2: Prevalence of different categories of visual impairment

	Presenting visual acuity in better eye	Number	Percentage	95% CI
Normal	≥6/12	5026	98.2	
Visual impairment		91	1.8	(1.4, 2.1)
Mild visual impairment	<6/12-6/18	57	1.1	(0.8, 1.4)
Moderate visual Impairment	<6/18-6/60	27	0.5	(0.3, 0.8)
Severe visual impairment	<6/60-3/60	02	0.04	(0.01, 0.09)
Blindness	<3/60	05	0.09	(0.01, 0.18)

CI: Confidence interval

Table 3: Bivariate and multivariate analyses for visual impairment

Variable (n=5117)	Visual impairment, *n* (%)	Unadjusted odds ratio (95% CI)	*P*	Adjusted odds ratio (95% CI)	*P*
Age (years)					
15-29 (*n*=2799)	28 (1.0%)	1.0		1.0	
30-39 (*n*=1398)	16 (1.1%)	1.1 (0.6, 2.3)	0.69	1.2 (0.5, 2.8)	0.65
40-49 (*n*=920)	47 (5.1%)	5.3 (3.1, 9.1)	<0.001	4.3 (1.9, 9.1)	0.001
Gender					
Male (*n*=2649)	34 (1.3%)	1.0		1.0	
Female (*n*=2468)	57 (2.3%)	1.8 (1.3, 2.0)	0.002	1.5 (0.7, 3.6)	0.28
Marital status					
Married (*n*=3272)	63 (1.9%)	1.0		1.0	
Single (unmarried/widower) (*n*=1845)	28 (1.5%)	0.8 (0.5, 1.2)	0.26	1.3 (0.6, 2.6)	0.49
Education					
Illiterate (*n*=405)	25 (6.2%)	1.0		1.0	
Primary (up to 5th class) (*n*=414)	16 (3.9%)	0.6 (0.3, 1.3)	0.23	0.9 (0.4, 2.0)	0.73
Secondary (up to10th) (*n*=2269)	32 (1.4%)	0.2 (0.1, 0.4)	<0.001	0.4 (0.2, 0.8)	0.01
Senior secondary and above (*n*=2029)	18 (0.9%)	0.1 (0.0, 0.3)	<0.001	0.3 (0.1, 0.8)	0.01

CI: Confidence interval

Table 4: Bivariate and multivariate analyses for unilateral VI

Variable (*n*=5026)*	Number with unilateral VI	Unadjusted odds ratio (95% CI)	*P*	Adjusted odds ratio (95% CI)	*P*
Age (years)					
15-29 (*n*=2771)	14 (0.5%)	1.0		1.0	
30-39 (*n*=1382)	13 (0.9%)	1.8 (0.8, 4.3)	0.14	1.8 (0.8, 4.0)	0.09
40-49 (*n*=873)	26 (3.0%)	6.0 (3.2, 11.2)	<0.001	6.0 (3.2, 11.2)	<0.001
Gender					
Male (*n*=2615)	26 (1.0%)	1.0		1.0	
Female (*n*=2411)	27 (1.1%)	1.1 (0.6, 2.0)	0.68	1.0 (0.5, 2.1)	0.78
Marital status					
Married (*n*=3209)	40 (1.2%)	1.0		1.0	
Single (unmarred widower) (*n*=1817)	13 (0.7%)	0.5 (0.2, 1.1)	0.10	1.2 (0.6, 2.3)	0.58
Education					
Illiterate (*n*=380)	06 (1.6%)	1.0		1.0	
Primary (up to 5th) (*n*=398)	08 (2.0%)	1.2 (0.3, 4.5)	0.69	1.8 (0.5, 6.2)	0.33
Secondary (up to 10th) (*n*=2237)	27 (1.2%)	0.7 (0.3, 1.6)	0.45	1.4 (0.6, 3.0)	0.33
Senior secondary and above (*n*=2011)	12 (0.6%)	0.3 (0.2, 0.8)	0.01	0.9 (0.4, 2.3)	0.98

VI: Visual impairment; CI: Confidence interval. *Out of 5117 participants, 91 with bilateral visual impairment have been excluded for unilateral visual impairment

errors, contributing to visual impairment came out to be 1.48%, and 0.7% for unilateral visual impairment. It is heartening to note that this estimate is lower than what is reported in other settings in this age group – Mozambique (2.6%), south India (5.8%), Eritrea (6.4%), and Tanzania (7.5%).[7,12,18,19] The differences in the study might be attributed to variations in geographic location, sample size, study methodology, timing, availability, and utilization of eye care services. It is seen that the prevalence of visual impairment is on decline with increasing time trends.[7] Extrapolating our prevalence estimates for rural population within Jhajjar district, there were 6,822 visually impaired adults in the age group of 15–49 years. In addition, there were 3,790 unilaterally visually impaired adults. Altogether, there were 8,330 visually impaired adults with uncorrected refractive errors. These are high numbers and can easily be treated by provision of refractive services, including uptake of spectacles.

Age segregated analysis in our study pointed out maximum visual impairment to be present in the age group of 40–49 years as reflected in multivariate analysis. Increasing age has been a consistent associated factor in many visual impairment surveys.[12,14-16] We also found education as a significant associated factor with inverse relationship, consistent with other studies. Visual needs are more for literate adults and visual problems get attended early in these.[20-22]

The impact of visual impairment due to uncorrected refractive errors in younger age groups is enormous in terms of the number of years spent in visual impairment and resulting economic and productivity losses. In the Indian state

Table 5: Causes of visual impairment (bilateral and unilateral): Distribution by age and gender

Cause	Visual impairment number	Uncorrected refractive error, *n* (%)	Cataract, *n* (%)	Others, *n* (%)
Bilateral total	91	76 (83.5)	05 (5.5)	10 (10.9)
Age group (years)				
15-29	28	26 (92.8)	01 (3.6)	01 (3.6)
30-39	16	14 (87.5)	00	02 (12.5)
40-49	47	36 (76.6)	04 (8.5)	07 (14.9)
Gender				
Men	34	27 (79.4)	01 (2.9)	06 (17.7)
Women	57	49 (86.0)	04 (7.0)	04 (7.0)
Unilateral total	53	44 (83.0)	02 (3.8)	07 (13.2)
Age group (years)				
15-29	14	10 (71.4)	00	04 (28.6)
30-39	13	12 (92.3)	00	01 (7.7)
40-49	26	22 (84.6)	02 (7.7)	02 (7.7)
Gender				
Men	26	24 (92.3)	00	02 (7.7)
Women	27	20 (74.1)	02 (7.4)	05 (18.5)

Figures in parenthesis represent row-wise percentages out of total for that category

of Andhra Pradesh, among the individuals, who were blind, the total number of blind person-years suffered over their lifetime by those blind due to refractive errors was estimated to be about twice that suffered by those due to cataract.[23] It is imperative that refractive care services be augmented within rural areas so as to mitigate burden and resulting impact of visual impairment for younger age groups.

Our study merits a mention of few strengths. First, we achieved a high response rate (94%). Second, it was a population-based study in the productive age group, which is not accorded focus in traditional visual impairment surveys. Finally, we have reported levels of mild visual impairment and unilateral visual impairment, which is often not mentioned in studies. This has increasingly being given attention now.[1] Our study had few limitations also. Details of other causes of visual impairment especially posterior segment diseases were not examined. Though this would not affect overall prevalence of visual impairment. Also, our study population being rural, the findings would not be generalizable to urban settings. The study would have been further strengthened if we would have estimated false-positive and false-negative rate of the initial vision screening at household level. However, we are reassured that the workers were well trained in recording vision and were cross-checked satisfactorily in 10% of participants.

Conclusion

To conclude, we found prevalence of visual impairment in the rural population of Jhajjar district within the age group of 15–49 years as 1.8%. Uncorrected refractive errors were most common cause of visual impairment. Increasing age and lower educational status were found to be associated with visual impairment. Our prevalence estimate generated would serve as benchmark for monitoring progress in future the effect of eye care services, especially correction of refractive errors, for this population.

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Conflicts of interest

There are no conflicts of interest.

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