Prevalence of Refractive Errors, Presbyopia and Unmet need of Spectacle Coverage in Sirajganj, Bangladesh: Rapid Assessment of Refractive Errors (RARE) Study

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Abstract

Purpose: To determine the prevalence of refractive error, presbyopia and spectacle coverage in Sirajganj district of Bangladesh.

Method: Rapid Assessment of Refractive Error (RARE) protocol was used to sample participants. A total of 3050 people within the age range of 15-49 years were enumerated and 3043 were available for examination.

Result: The prevalence of refractive error was 4.7% (95% CI: 4.69%-4.71%). Hyperopia(53.5%) followed by Myopia(38.7%) were highly prevalent types of refractive error among the study population. Refractive error was found to be statistically significant with age groups ($\chi^2_{(4)}$=127.889, p<0.001). While Myopia and astigmatism appeared to decrease, Hyperopia revealed to increase with age. Spectacle coverage for refractive error was 13.3%(95% CI 5.3-21.3%). The difference in spectacle coverage between male and female participants was not statistically significant (Chi Square test, p=0.098). The prevalence of Presbyopia was 30% (95% CI: 29.98-30.02%). Female had a significantly higher need for presbyopic correction than the male counterpart (χ^2=40.091, *P<.000).* The prevalence of Presbyopia demonstrated to increase with age and it was highly prevalent after the age of 35 years. It was estimated to be 54.3%(95% CI 53.84-54.76%) and 79.3% (95% CI 78.84-79.76%) for the age group of 36-42 and 43-49 years respectively. In spite of high prevalence, spectacle coverage for Presbyopic correction was very poor. It was estimated to be 3.3%(95% CI -0.6-6%).

Conclusion: This study provides valuable findings to plan effective and appropriate service delivery for refractive errors and Presbyopia which would contribute to achieve the goals of VISION 2020.

Introduction

Eliminating visual impairment due to uncorrected refractive error is one of the key strategies to achieve goals of VISION 2020[1]. Uncorrected refractive error affect people of both developed and developing countries regardless of age, gender and ethnicity. Recent global estimate suggests that 153 million people have visual impairment (< 6/18 in the better eye) due to uncorrected refractive errors which can be treated very easily[2].

Refractive errors can be defined as a state in which optical system of the non-accommodating eyes fail to bring parallel rays of light to focus on the retina. The length of the eyeball (longer or shorter), changes in the shape of the cornea, or aging of the lens can cause refractive errors. Myopia, Hyperopia, and Astigmatism are commonly known refractive errors.

Myopia or nearsightedness is a type of refractive error where close objects appear clearly, but distant objects appear blurry. Nearsightedness develops in eyes that focus images in front of the retina instead of on the retina, which results in blurred vision. Hyperopia- commonly known as farsightedness is the most common refractive error in which an image of a distant object becomes focused behind the retina, either because the eyeball axis is too short, or because the refractive power of the eye is too weak. Astigmatism is a condition in which an abnormal curvature of the cornea can cause two focal points to fall in two different locations - making objects up close and at a distance appear blurry. Astigmatisms may cause eye strain and may be combined with nearsightedness or farsightedness.

Another type of farsightedness is presbyopia, which is very common among people aged over 50 years. It is caused when the center of the eye lens hardens making it unable to accommodate near vision. In 2005, it has been estimated that 517 million people were without adequate correction for functional presbyopia[3].

Although prevention is not available for refractive error and presbyopia, they can be treated easily. Correction of refractive error and presbyopia often involves eye examination which is followed by the provision of spectacle, contact lenses or refractive error surgery. Scarcity of refraction services and spectacle provision along with low uptake rate of available services due to socio-economic barriers often impose negative consequences in person's educational and professional life[4].

Current data on magnitude of uncorrected refractive errors and spectacle coverage are essential to plan service delivery. Data can be obtained by various means like school screening programmes, community outreach services, needs assessment surveys, secondary data from hospitals and other service providers. But this information is not truly representative of the general population and depends on various factors like enrollment in schools, documentation, etc. Classical population-based epidemiological surveys can provide the vital information on the prevalence of refractive errors in the population. As surveys are often expensive and time consuming, the programme planners seek out methods to overcome these barriers of conventional survey method. Rapid Assessment of Refractive Error (RARE) is a method to obtain magnitude and spectacle coverage of refractive error in relatively quick and less expensive way.

RARE was implemented in Andhra Pradesh, India(in 2011) and Zoba Ma'ekel, Eritrea (in 2013) very successfully[4,5]. It has also been implemented in the current study in 2012. To know the extent of refractive error and spectacle coverage, Rapid Assessment of Refractive Error (RARE) study was implemented in Sirajganj district of Bangladesh.

Methods

A population based cross-sectional survey following the methodology of Rapid Assessment of Refractive Error (RARE) was used to obtain data.

Allowing for a required significance level of 5%, a worst acceptable result of 4%, a design effect of 1.5 for clusters of 61, and 10% non-response, the required sample size was estimated to be 3050 subjects. In total, 61 clusters of 50 people aged 15-49 years were required for this survey. A cluster random sampling was used to enumerate 3050 individuals from 61 clusters. The clusters were selected through probability-proportionate to size sampling, using updated data from the 2011 national census as the sampling frame. The total population of Sirajganj is about 3.1 million [5].

The study team consisted of four ophthalmologists, optometrist and two ophthalmic assistants. One cluster informer and a coordinator, two health assistants and one manager were part of the

team. The team was trained by an international expert on basic of RARE study, aims and objectives, methodology, challenges, measurement of VA, lens examination etc.

The survey team visited households door-to-door, accompanied by a village guide. If an eligible person was absent, the survey team returned to the household on the same day at least two times to examine the individual before leaving the area. If after repeated visits the subject could not be examined, information about his/her visual status was collected from relatives or neighbors. The contact details of the project ophthalmologists including the cell number were left with the neighbors and vice versa to minimize the non-responders.

Visual acuity (VA) was measured by an ophthalmic assistant with a LogMar chart. All measurements were taken in full daylight with available spectacle correction. If the VA was <6/18 in either eye then pinhole vision was also measured. Categories of visual impairment were defined as:

- Blindness - VA < 3/60, NPL, PL if < 3/60 in the better eye with available correction.
- Severe visual impairment - VA≥3/60 - <6/60 in the better eye with available correction.
- Low Vision - VA<6/18 and > 3/60 in the better eye with available correction.

People also screened for presbyopia prevalence and need of correction by optometrists using LogMar chart and advised glass accordingly. All participants were examined by an optometrist. The ophthalmologist examined referred severe visual impairment cases by optometrist.

Ethical consideration

Ethical approval for this study was obtained from the Institutional Review Board, Research, Evaluation, Advocacy and Development (READ) centre, Child Sight Foundation, Bangladesh. Informed consent was obtained from the subjects after explanation of the nature and possible consequences of the study. All people with other treatable conditions were referred for treatment.

Statistical analysis:

SPSS software was used for data entry and automatic standardized data analysis. The prevalence was calculated from descriptive statistical analysis in which standard error was taken into consideration. For categorical variable, χ^2 and Fisher exact test were used to analyze

propositions. Logistic regression analysis was also executed to see the contribution of age and sex on refractive errors and presbyopia.

Results

Basic Demographic Characteristics of Respondents

Among the enumerated study population of 3050 from 61 clusters, 3043 (99.8%) were available for ophthalmic examination. The median age of the participants was 32 years and the inter-quartile age range was 22-42 years. Whereas the highest proportion of people took part from 15-21 years age group, the lowest proportion was from 29-35 years. The percentage of female participants(54%) was proportionately higher compared to their male(46%) counterpart. Except the participants in the age range of 36-42 years, males and females did not differ significantly in terms of their average age.

Table-1: Basic demography of participants, rapid assessment of refractive error, Sirajganj, Bangladesh

	Participants	
	n	%
Age group (years)		
15-21	689	22.6
22-28	608	20.0
29-35	525	17.3
36-42	566	18.6
43-49	655	21.5
Sex		
Female	1642	54
Male	1401	46
Spectacle use		
Yes	2965	97.4
No	78	2.6
Total	3043	100.0

Refractive Error:

The prevalence of Refractive error was 4.7%, (95% CI: 4.69%-4.71%). Although the prevalence of refractive error was not found to be statistically significant it terms of sex, significant differences revealed among different age groups($\chi^2_{(4)}$=127.889, p<0.001).

Table-2. Prevalence of Refractive error and presbyopia in different age and sex groups, and the overall prevalence in examined population

	Refractive error (95% CI)	**Presbyopia (95% CI)**
Age group		
15-21	0.9(0.89-0.91)	0.3(0.16-0.76)
22-28	2.6 (2.59-2.61)	1.5(1.04-1,96)
29-35	1.7(1.69-1.71)	15.1(14.64-15.56)
36-42	5.3(5.28-5.32)	54.3(53.84-54.76)
43-49	12.4(12.38-12.43)	79.3(78.84-79.76)
Sex		
Male	4.2(4.06-4.22)	22.4(22.37-22.43)
Female	5.2(5.10-5.26)	35.0(34.97-35.03)
overall	*4.7(4.69-4.71)*	*30.0(29.98-30.02)*

Myopia and Hyperopia have been seemed as common types of refractive error. Hyperopia was highly prevalent after 35 years. Among 53.5% people with hyperopia, only 3.5% examined from people aged 35 years and younger (Table-3).

Table-3. Percentages of Myopia, Hyperopia, and Astigmatism in Age and Sex groups

	Myopia	**Hyperopia**	**Astigmatism**
	if <_0.5	if >_+2.0	if >_+_1.75
Age group			
15-21	3.5	0	0.7
22-28	9.9	0	1.4
29-35	1.4	3.5	1.4
36-42	7.0	12.0	2.1
43-49	16.9	38.0	2.1
Sex			
Male	20.4	16.9	3.5
Female	18.3	36.6	4.2
Total	*38.7*	*53.5*	*7.7*

Logistic regression analysis has also been calculated to see the contribution of sex and age on different types of refractive errors. Significant association with all types of refractive errors has been demonstrated only in case of age. Myopia and Hyperopia were significantly associated at $p< 0.001$ level and Astigmatism at $p<0.05$ level.

Table-4 showed the coefficients (B), their standard errors, and odds ratio (Exp (B). Exp(B)=1.097 implies that the likelihood of occurring refractive error (versus not occurring) increased 1.097 times with one unit increase of age while other factors remain fixed.

Table-4: Summary of Logistic Regression Analysis of demographic factors (age & Sex) explaining association with Refractive Error and Presbyopia

	Predictors					
	Sex			**Age**		
Variables	**B**	**S.E.**	**Exp(B)**	**B**	**S.E.**	**Exp(B)**
Refractive Error	.079	.178	1.083	.093**	.010	1.097
Miopia	-.726	.382	.484	-.082**	.022	.921
Hyperopia	.711	.394	2.036	.122**	.027	1.129
Astigmatism	.290	.707	1.336	-.069*	.032	.933
Presbyopia	.462**	.116	1.587	.236**	.009	1.266
df	*1*					

***** p<.001, * p<.05***

While the likelihood of occurring (versus not occurring) Myopia and Astigmatism decreased respectively .921 and .993 times with one unit increase of age, it was increased 1.129 times in case of Hyperopia.

Table-5: Spectacle coverage for Refractive error

	Refractive error			
	Met need, n	Unmet need, n	Total need, n	Spectacle coverage % (95% CI)
Male	11	47	58	19.0 (3.4-31.6)
Female	8	77	85	9.4(-0.9-19.7)
Total	19	124	143	13.3(5.3-21.3)

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Spectacle coverage for refractive error was estimated at 13.3%(95% CI 5.3-21.3%). Spectacle coverage for male was 19.0 (95% CI 3.4-31.6) and for female was 9.4%(95% CI -0.9-19.7). Although the spectacle coverage was higher in males than females, the difference was not statistically significant(Chi Square test, p=0.098).

Presbyopia:

30% (95% CI 30.01-30.05%) of the examined population demonstrated the need for presbyopic correction which showed to have a significant linkage with sex and age(Table-2 &4).

Table-6: Need for Presbyopic Correction according to the distribution of sex.

Need for Presbyopic correction	Male	Female	Total
	N (%)	N (%)	N (%)
Yes	314 (11.2%)	573 (18.8%)	914 (30%)
No	1060 (34.8%)	1069 (35.1%)	2129 (70%)
Total	1401 (46.0%)	1642 (54.0%)	3043 (100%)

***P<.000**

Females (18.8%) showed significantly higher needs for presbyopic correction relative to their male (11.2%) counterparts (χ^2=40.091, *P<.000;* Table-6). They had 1.266 (odds ratio 1.266) times higher need for presbyopic correction than males in the examined population(Table-4).

Logistic regression analysis revealed that the need for presbyopic correction increased 1.266 times with increase age of one year(Table-4). However, a large number of sample (62%) over 35 years showed a need for presbyopic correction(Table-7). Among all examined people with presbyopia (916), 95% (869) were obtained from over 35 years age(Table-7 &8). The prevalence of presbyopia for 36-42 years and 43-49 years were estimated to be 54.3%(95% CI 53.84-54.76%) and 79.3% (95% CI 78.84-79.76%) respectively(Table-2).

Table-7: Need for Presbyopic Correction after age of 35 years.

Need for presbyopic correction	Number	Percent
Yes	869	62%
No	533	38%

Use of spectacle among the study population was very low. Only 2.6% of the study population were using glasses due to refractive error (0.6%), presbyopia (1%) and some other eye difficulties.

Spectacle coverage for presbyopia was very poor. It was estimated to be 3.3%(95% CI -0.6-6%); Although female showed significantly higher need for presbyopic correction, spectacle coverage was relatively fewer for females (2.6%; 95% CI 0.7-5.9%) than for males (4.7%; 95% CI 0.1-9.3%) for males. However this difference was not statistically significant (Chi Square test p=0.092).

Table-8: Spectacle coverage for Presbyopia

	Presbyopia			
	Met need, n	Unmet need, n	Total need, n	Spectacle coverage % (95% CI)
Male	16	325	341	4.7(0.1-9.3)
Female	15	560	573	2.6(0.7-5.9)
Total	31	885	914	3.3(-0.6-6)

Discussion

To achieve the goal of vision 2020, refractive error has been considered as one of the priority eye diseases in Bangladesh National Eye Care Plan. It is important to know the situation and magnitude of refractive error to design district based and overall service delivery system in an effective way. Different methodologies have been developed to know the magnitude of refractive error considering different age groups. Key Informant Method(KIM) has been used to identify cataract and refractive errors among children aged 0-18 years [6]. Rapid Assessment of Avoidable Blindness(RAAB) was another methodology used for people with 50 years and over to detect cataract and refractive error [7]. And for people with the age group of 15-49 years, a quick and cost-effective methodology, Rapid Assessment of Refractive Error (RARE) was developed for determining refractive error. Since both KIM and RAAB was carried thus excluded those age groups and the present study was targeted for 15-49 years using RARE methodology.

The prevalence of Refractive error was 4.7%, (95% CI: 4.69%-4.71%). This suggested that estimated people with refractive error ranged from 83,743 to 84,100. This huge range of physically and economically active people need immediate services to be more functional in their daily activities. Similar RARE study in Andhra Pradesh, India, Zoba Ma'ekel, Eritea, Uganda and Tanzania revealed with the prevalence of refractive error 2.7% (95% CI, 2.1-3.2% in the better eye), 6.4% (95% CI, 5.6-7.7%), 8.6% (95% CI, 7.7-9.6%), and 10.4% (95% CI, 9.4-11.4%) respectively[4, 8].

Hyperopia was revealed as a highly prevalent refractive error, especially after the age of 35 years. This corroborated with findings revealed from a study in Bangladesh where older subjects (40-49 years) were found to have significantly more hyperopia compared to the subjects at younger age group(30-39 years) [9]. One of the studies in Norway also reported the prevalence of hyperopia increased with age from 13.2% (20-25 years) to 17.4% (40-45 years) [10].

The prevalence of presbyopia was 30% (95% CI 30.01-30.05%). It resembles with the prevalence rate(32%; 95% CI 30.3-35.7%) in Zoba Ma'ekel [4]. However, people aged over 35 years had demonstrated higher need for presbyopic correction. Within this age group 62% of all examined people and 95% of all presbyopic people detected to have presbyopia. Similarly, in

Andhra Pradesh presbyopia was present in 63.7% (95% CI 60.8-66.6%) subjects aged over 35 years[8].

Spectacle coverage for refractive error and presbyopia was very poor which was 13.3% (95% CI 5.3-21.3%) and 3.3%(95% CI -0.6-6) respectively. In case of refractive error, spectacle coverage was more than double in Andhra Pradesh (29%) and higher in Zoba Ma'ekel(22.2%)[4,8]. Similarly spectacle coverage for presbyopia was almost tripled in Zoba Ma'ekel (9.9%) and was much more higher in Andhra Pradesh (19%)[4,8]. These differences reflect a strong need for service availability and service uptake. Although the study provided valuable findings, factors influencing uptake of services for refractive error and presbyopia need to be investigated to plan effective service deliver approach.

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