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Research Article

Prevalence Study of Visual Impairment and Blindness in Population of Mountainous Areas of Nepal

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Abstract

Introduction: A population based cross sectional study was carried out with the aim of identifying the prevalence of visual impairment and blindness of the population living in those high altitude and mountainous regions.

Material and Methods: A population based cluster random sampling method was used to select study population of 2,050 individuals. A total of 41 clusters were selected by using a probability proportion to size sampling procedure. From each cluster, 50 individuals were randomly selected. An Ophthalmic Assistant conducted the interview and performed the eye examinations of respondents.

Results: A total of 1,945 respondents (95% response rate) were participated in the study. The blindness prevalence (Presenting Visual Acuity (PVA) in better eye <6/60) was found 0.77% (95% confidence interval (CI) 0.2-1.3), moderate visual impairment (PVA<6/18 to 6/60) 4.06% (95% CI 2-6.1) and mild visual impairment (PVA<6/9-6/18) was 12.85% (95% CI 9.3-16.4). A total of 63.8% of female respondents, 61.7% of illiterate and 79.8% respondents of 50 year and over had visual impairment of less than 6/18 and worse. The principle causes of visual impairment and blindness were uncorrected refractive error (54.8%) and cataract (40%) respectively.

Conclusion: The elderly, female and illiterate peoples were observed to be as the major risk factors for blindness and visual impairment. The uncorrected refractive error and cataract were found to be the major contributing factors of visual impairment and blindness. By developing screening and educational programs focused on the risk factors will reduce visual impairment and blindness.

Keywords: Blindness; Mountainous; Prevalence; Visual Impairment

Introduction

Nepal is considered a least developed country in the world with a low economic growth rate of less than 4% [1]. The country announced a constitution in 2015 after more than 15 years of an unstable political environment. Our country suffered a very strong earthquake in April 2015 [2]. The natural disaster added a further challenge for health, including eye health. In Nepal's population of 28 million, over hundred thousand people are blind [3,4]. It is estimated that over 90% of the affected people reside in rural and remote areas, where often there is limited or no eye care service facilities [5]. Those, who are living in rural and remote areas of country, do not have adequate eye care services due to inaccessibility of such services. These factor may lead to visual impairment and blindness [6,7].

An increased emphasis has been put on the prevention and treatment of blindness and visual impairment around the world, but very little information is available on the prevalence of visual impairment and blindness and its causes in the highland population who live in the mountainous regions of Nepal, the Tibetan Plateau of China, Ladakh of India [8-11]. The high prevalence of blindness and visual impairment are found in high altitude areas such as Tibet in China and Karnali in Nepal where the prevalence of blindness was found to be 8.43% and 3.4% respectively [12,13].

Nepal is divided into three ecological regions i.e. Mountains, Hills and Terai (plain area). Out of 75 districts, Manang and Mustang Districts are known as the most remote and at the highest altitude of the inhabited mountainous districts in Nepal. Geographically both Districts fall between the altitudes of 1,000 to 8,100 meters above sea level and both of which are only accessible to their district Headquarters by road in the dry seasons and unpredictable air services. Furthermore, the social, economic and physical facilities are relatively sparse in both districts [3]. More than 95% of land is located at an altitude of above 3,000 meters above sea level [18,19]. An altitude of over 3,000 meters is well-known in medical literatures to cause biological effects on the human body. The atmospheric conditions in high mountainous regions are hypobaric with strong ultraviolet radiation and a high number of sunshine hours (average 3,400 hours per year) [20,21].

It is assessed that due to difficult geographical terrain, the population density is very low with limited access to eye health services, so people are prone to the risk of visual impairment and blindness in the mountainous areas of Nepal. To the best of our knowledge, no studies had been conducted in these two districts. Therefore, we conducted this study in Manang and Mustang which are known as high altitude mountainous districts. The main objective of the study was to find out the prevalence of visual impairment and blindness amongst the high altitude population of the mountainous regions of Nepal to enable the better future planning of eye health

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services.

Material and Methods

It was population based cross sectional study. The cluster random sampling method was applied to select the study populations from all age groups of two mountainous Districts (Manang and Mustang) in Nepal. The sample size was calculated by applying an estimated blindness prevalence of 2.6% (reference blindness prevalence of Gandaki stud) [22] in the sample size calculation formulae (Sample size, $n = z^2 * (p*q) / d^2$ Where, Z = Standard Normal Variant =2 for 95% confidence, P = prevalence rate, d= absolute error and design effect 2). By applying the reference prevalence of 2.6% in formulae, Sample size (n) = 4*(0.026*0.974)/0.01*0.01 = 1,013. The required sample size was calculated 1013. The design effect of 2 was used to select the most representative study population. After applying the design effect of 2 in the required sample size, the sample size was 2026 (sample size =1013*2 = 2026). According to Rapid Assessment of Avoidable Blindness (RAAB)'s recommendation, the proposed sample population was 50 individuals in each cluster. Thus, total sample population was taken 2,050 and the required cluster number was 41 (required cluster number (k) = 2026/50 = 41). The required Sampling Interval (SI) was 425 which was calculated by dividing total population of study districts by cluster number (SI=17,410/41=424.63=425). The study population was selected by applying the Probability Proportion to Size (PPS) sampling procedure.

Thus, 2,050 study populations (was 12% of the total population of two districts) and 41 clusters were selected from two districts. The Ward of Village Development Committee was taken as a cluster. In each cluster, the population was divided into segments of 425 people (425 was sampling interval). One segment was randomly selected from each cluster and 50 individuals were randomly selected as subject populations from the selected segment.

A semi-structured questionnaire and clinical performa for eye examination were used to collect data. The questionnaire and clinical performa that was used in earlier Rapid Assessment of Avoidable Blindness (RAAB) surveys was considered for this study. Those questionnaires and clinical performa was slightly modified and developed in the English language, but the questionnaire was translated into Nepalese language and tested again in a pilot test. The data collection was carried out from August to October in 2015. After completion of training of enumerator on data collection and data entry procedure, a pilot study was conducted in non-sampled population in one of study district.

During household survey by using the questionnaire, a trained Senior Ophthalmic Assistant conducted face to face interviews with the respondents of 18 year and over and with the guardians or parents of children less than 18 years. In the case of insufficient numbers of respondents in a study cluster, the required numbers of respondents were taken from adjoining clusters. After the interview, the respondents were invited to have an eye examination at a central point in the Village. The temporary eye clinic was set up at one of respondent's house, a school building or a health post whichever was available. A trained eye health worker measured presenting and best corrected (pinhole) visual acuity of respondents of age of 5 years and older by using a standard Snellen vision chart at 6 meters distance. Children of 5 years and under, who could not take part in Snellen vision chart were tested by using a flash light and recorded as "Follows Light" (FL) or "does Not Follows Light" (NFL). A trained Senior Ophthalmic Assistant performed the eye examinations, including those of the anterior segment of the eyes of each respondent, by using flash light and portable slit lamp (Shin Nippon XL-1). The posterior segment of eyes was examined by using a direct ophthalmoscope (Heine) without and with dilation if necessary. Furthermore, the eye which didn't improve to 6/12 with pinhole, except those with a cornea or an obvious cataract (defined as a lens opacity preventing view of the fundus), were dilated and evaluated for detailed evaluation of the posterior segment by using a direct ophthalmoscope. The suspected patient with posterior segment and other cases were referred to and examined by an Ophthalmologist based on a clinical examination history from an Ophthalmic Assistant at the District Headquarters during a surgical eye camp period. All eye examinations were carried out based on the study protocol.

In this study, four vision categories were used. They were defined as followings: a) normal vision: Presenting Visual Acuity (PVA) better than 6/12 in both eyes, b) mild visual impairment: PVA less than 6/9 to 6/18 in better eye, c) moderate visual impairment: PVA less than 6/18 to 6/60 in better eye, d) blindness: PVA less than 6/60 in better eye.

The collected quantitative data was entered into the developed online Google data base software. The data analysis was performed by using SPSS software version16.5 (SPSS Inc. Chicago, USA). P-value was calculated by using chi-square and fisher's exact test. It was considered that p values <0.05 to denote statistical significance.

Out of 152 children of 5 years and below, 105 children, whose visual acuity could not be recorded with the Snellen vision chart, were excluded from the study. Because of the low number of respondents in the blindness and moderate visual impairment area age and sex adjusted analysis was not performed. Further, p value calculation was performed in the normal and visual impairment group.

The ethical approval of the study was permitted by the Institutional Review Committee of Tilganga Institute of Ophthalmology. The respondents, with the age of 18 years and older, had given written consent prior to the interview and eye examination, whilst with the children of less than 18 years old, were taken from their parents or guardian whoever was present.

Results

A total of 1,945 respondents (95% response rate) were included in the study of visual impairment and blindness. Male to female ratio was 1:1.39 in the study population. Total of 21% of respondents were from the less than 18 years age group, 45% of respondents from 18 to 49 years and rest were from 50 years and over age group. The mean age was 37.96 years (range: minimum 0.10 to maximum 92 years and Standard Deviation (SD) 21.85). Over 26% respondents were illiterate.

A total of 0.77% (95% Confidence Interval (CI) -0.2-1.3) respondents were blind in both eyes (in presenting visual acuity less than 6/60 in better eye), moderate visual impairment (PVA<6/18 to 6/60 in better eye) was 4.06% (95% CI 2-6.1) and mild visual

Table 1: Prevalence of Visual Impairment and Blindness: presenting visual acuity (PVA) in study population (n, %, CI).

PVA	< 6/9 - 6/18	< 6/18 - 6/60	<6/60
Prevalence in person	250,12.8% (9.3-16.4)	79,4.06% (2 -6.1)	15,0.77% (-0.2-1.7)
Prevalence in eye	552,14.2% (11.8-16.6)	210,5.4% (3.9-6.9)	85,2.19% (1.2-3.2)
Gender			
Male	108,43.2% (38-48.4)	29,36.7% (31.6-41.8)	5,33.3% (28.4-38.3)
Female	142,56.8% (51.6-62)	50,63.3% (58.2-68.4)	10,66.7% (61.7-71.6)
Age group			
< 18 year	12,4.8% (2.5-7.1)	5,6.3% (3.8-8.9)	0(0)
18 to 49 year	42,6.8% (12.8-20.8)	14,17.7% (13.7-21.8)	0(0)
50 year& over	196,78.4% (74.1-82.7)	60,75.9% (71.4-80.5)	15(100)
Literacy			
Illiterate	130,52.2% (46.9-57.5)	46,58.2% (53-63.4)	12,80% (75.8-84.2)
Literate	119,47.8% (42.5-53.1)	33,41.8% (36.6-47)	3,20% (15.8-24.2)

*Number of respondent, % confidence interval.

Table 2: Prevalence of visual impairment and blindness: pinhole visual acuity (PHVA) in better eye in study population.

VA/sex	Male (n, %, CI)	Female (n, %,CI)	Total (n,%, CI)
<6/9 - 6/18	30,35.7% (22.8-48.6)	54, 64.3% (51.4-77.2)	84,4.3% (2.2-6.5)
< 6/18- 6/60	10,41.7% (27.4-55.9)	14,58.3% (44.1-72.6)	24,1.2% (-2-4.4)
<6/60	5,38.5% (25.6-51.3)	8,61.54% (48.7-74.4)	13,0.67% (-1.5-2.8)
Total	45,37.2% (23.4-51)	76,62.81% (49-76.6)	121,6.2%

impairment (PVA<6/9-6/18 in better eye) was 12.85% (95% CI 9.3-16.4) in study population (Table 1). Total blind eyes were 2.19% (CI 95%, 1.2-3.2), moderate visually impaired eyes 5.40% (95% CI, 3.9-6.9) and mild visually impaired eyes 14.19% (95% CI, 11.8-16.6) in study population (Table 1). Almost double of female respondents 66.7% (95% CI 61.5-71.8) were found to be blind and 63.3% (95% CI, 58.2-68.4) had moderate visual impairment as compared to their male counterpart. The mild visual impairment 56.8% (95% CI, 51.6-62) was also observed higher in the female population than male.

With best corrected (pinhole) prevalence of blindness, moderate and mild visual impairment in better eye were found as 0.67% (95% CI -1.5-2.8), 1.2% (95% CI -2-4.4) and 4.3% (95% CI 2.2-6.5) in study population respectively. Visual impairment and blindness were observed in two thirds of female respondents (Table 2).

In blindness and visual impairment, age is observed as a major risk factor. The older age respondents bear a higher burden of blindness and visual impairment than younger aged respondents. All the blind respondents were from the age group of 50 year and over. With visual impairment, in the less than 6/9 to 6/18 category, 4.8% (95% CI 2.5-7.1) respondents were from the age group of 18 years and younger, 16.8% (95% CI, 12.8- 20.8) from the age group of between 18 and 49 years and 78.4% (95% CI 74.1-82.7) were of the age group of 50 years and over. Similarly, in the less than 6/18 to 6/60 category, 6.3% (95% CI 3.8-8.9) respondents were from the age group of 18 years and younger, 17.7% (95% CI, 13.7- 21.8) from the age group of

Table 3: Gender, age group and literacy distribution in normal and visually impaired person in study population (PVA 6/6 to6/9, <6/9 to 6/18 & <6/18).

Particular	PVA	6/6 to 6/9 (n, %)	<6/9 to 6/18 (n, %)	< 6/18 (n, %)	P Value
Gender	Male	665,41.5%	108,43.2%	34,36.2%	>0.05
	Female	936,58.5%	142,56.8%	60,63.8%	
Literacy	Illiterate	307,19.7%	130,52.2%	58,61.7%	<0.001
	Literate	1251,80.3%	119,47.8%	36,38.3%	
Age group (in Years)	<18	309,19.3%	12,4.8%	5,5.3%	<0.001
	18 to 49	868,54.2%	42,16.8%	14,14.9%	
	50 and above	424,26.5%	196,78.4%	75,79.8%	

Table 4: Principal causes of ocular morbidity and visual impairment in study population (better eye PVA 6/6 to 6/9, <6/9-6/60 and <6/60).

Principle cause	6/6 to 6/9	<6/9 to 6/60	<6/60 to pl	Total (n, %)*	p value
Refractive error	587(84.2%)	179(54.6%)	2(13.3%)	768(73.8%)	<0.001
Cataract, Untreated	23(3.3%)	94(28.7%)	6(40.0%)	123(11.8%)	<0.001
Aphakia, untreated	0(0%)	0(0%)	1(6.7%)	1(0.1%)	
Pseudophakia	18(2.6%)	34(10.4%)	2(13.3%)	54(5.2%)	<0.001
Surgical complications	1(0.1%)	0(0%)	0(0%)	1(0.1%)	
Inflammation/Inf. (Conj/ lid)#	47(6.7%)	1(0.3%)	1(6.7%)	49(4.7%)	<0.001
Pterygium	10(1.4%)	5(1.5%)	1(6.7%)	16(1.5%)	<0.05
Corneal scar	1(0.1%)	3(0.9%)	0(0%)	4(0.4%)	>0.05
Globe abnormality	2(0.3%)	0(0%)	0(0%)	2(0.2%)	
Strabismus	2(0.3%)	1(0.3%)	0(0%)	3(0.3%)	>0.05
Glaucoma	2(0.3%)	1(0.3%)	0(0%)	3(0.3%)	>0.05
Posterior segment disorder	0(0%)	8(2.4%)	2(13.3%)	10(1%)	>0.05
Others	4(0.6%)	2(0.6%)	0(0%)	6(0.6%)	>0.05
Total	697(67%)	328(31.5%)	15(1.4%)	1,040	

*Number of respondent and %, # Inf- infection, Conj- conjunctiva.

18 to 49 years and 75.9% (95% CI 71.4 - 80.5) were of the age group of 50 years and over. Additionally, blindness was found to be four times higher in the illiterate respondents with 80%, (95% CI 75.8-84.2) than their counterpart literate respondents (Table 1).

Table 3 shows the gender, literacy and age group distributions in normal vision and visual impaired population in the study population. In gender, about two thirds (63.8%) of female respondents had presented vision less that 6/18 and worse. A total of 61.7% of illiterate and 38.3% of literate respondent had presented with vision less that 6/18 and worse. The association between literacy and visual impairment were found to be statistically significant (p<0.001). Similarly, 79.8% of the respondent of the age group of 50 year and over were from the visually impaired group of less than 6/18 and worse. The association between age group and visual impairment was found to be statistically significant (p<0.001) (Table 3).

The overall principle causes of visual impairment in presenting visual acuity in better eye, the Uncorrected Refractive Error (URE), untreated cataract and pterygium were found as 73.8%, 11.8% and 1.5% respectively. The URE (54.6%) was the leading cause of visual impairment followed by cataract (28.7%), pseudophakia (10.4%),

posterior segment disorder (2.4%) and pterygium (1.5%) in the study population. Cataract (40.0%) was the leading cause of blindness followed by uncorrected pseudophakia (26.7%), refractive error (13.3%) and posterior segment disorder (13.3%), untreated aphakia (6.7% and pterygium 6.7%. There was a strong association of principal causes with vision (p value <0.001). Similarly, the refractive error and cataract showed a strong statistical significance with vision (p value ≤0.001) (Table 4).

Discussion

In this study, the response rate was 95%. More female respondents participated in the study population. The study showed that 0.77% of the populations were blind persons and 2.19% were with blind eyes. The prevalence of blindness is similar to Bhaktapur study 2010 [24] and Nepal National Survey 1981 [5]. The prevalence was found to be higher than in the Nepal National blindness study 2012 [25]. However, it is not comparable with the findings of blindness prevalence in the Tibet Eye Care Assessment 2003 [26], Gandaki study 2003 [22] and Karnali study 2012 [13] as the prevalence in these studies were observed being higher than in this study findings. This study observed the prevalence of blindness only in the age group of 50 years and over. Similarly, this study reported a low prevalence of blindness in eyes than in the Tibet study 2013 [12], but it was higher than the Nepal National blindness survey 1981 [5],

Furthermore, in this study, the mild and moderate visual impairment were found to be 12.8% and 4.1% respectively. Though it was found to be lower than studies conducted in Gandaki 2003 [22], the Nepal National Blindness survey 2012 [25], the Lhasa Tibet 2013 [12] and the Tibet Eye Care Assessment 2003 [26], the number of affected people in the whole population was still considered to be high. The prevalence of blindness in the female population was found to be almost double than that of their male counterpart. Similar results were found in the studies conducted in Karnali 2012 [13], the Nepal National survey 1981 [5] and the Tibet Eye Care assessment 2003 [26].

Similarly, prevalence of visual impairment and blindness were found to be higher in the older age group, illiterate and female population. Additionally, the blindness and visual impairment were found four times higher in the illiterate population than in its counterpart literate population in this study.

In the overall principal causes of ocular morbidity, the Uncorrected Refractive Error (URE) (74.8%) was the leading cause followed by untreated cataract (12%) and pterygium (1.6 %). Furthermore, the URE (54.8 %) was the leading cause of visual impairment followed by cataract (28%) in the visually impaired population. The prevalence of URE is higher than studies conducted in western Nepal 2010 [20] and Karnali 2012 [21]. Looking at the prevalence of blindness, cataract (40%) was found as the leading cause of blindness followed by pseudophakia (26.7%), refractive error (13.3%) and posterior segment disorders (13.3%), untreated aphakia (6.7%) and pterygium (6.7%). Though it is not comparable due to an age group difference of the study population, for the information, cataract blindness was found lower than in the studies of Karnali 2012, the Nepal national blindness survey 1981 [5], and 2012 [22], Gandaki 2002 [18], Lhasa Tibet 2013 [23] and the Tibet Eye Care Assessment 2003 [24]. Pseudophakia and aphakia were observed as the leading cause of low vision in the study conducted in a tertiary center of western Nepal 2014 [25] and the third most common cause of low vision in Nepal Mid-Term Review of VISION 2020, 2011[4].

Based on the study finding, among 17,400 people, estimated 134 people were blind and 3,049 people were with visual impairment. Among visually impaired population 1,269 people were male and 1,779 were female. Four hundred and eighty one children and 1,184 adults were suffered from refractive error. Cataract alone accounted for over 54 blind individuals and for over 875 people with visual impairment. About 2,540 individual with visual impairment needed spectacles to correct their vision. Furthermore, a large proportion of visual impairment (85%) and blindness (80%) were due to avoidable causes.

Conclusion

In conclusion, the study urges that blindness and visual impairment are major public health problem in the mountainous regions of Nepal. The uncorrected refractive error, cataract, uncorrected aphakia and pterygium were found to be the major contributing factors of visual impairment and blindness. Female, older age group and illiterate people are in high risk of blindness and visual impairment. This study finding reveals that by providing simple refraction and spectacle services, the blindness and visual impairment could be reduced, by one forth and three times respectively. The study also claims that the blindness could be reduced by three fold through education and a creation of awareness of eye health services and making service accessible and available.

However, this study can't remain without limitations; it has brought the most important findings on the eye health situation in the population of the mountainous regions that could be useful for eye care providers, researcher and stakeholders within district of the country and the similar geographic and social groups of other parts of world, in the alleviation of visual impairment and blindness.

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