Original Article

Prevalence and Causes of Visual Impairment and Blindness in Three Ecological Regions of Nepal

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Abstract

Introduction: Visual impairment and blindness are significant public health issues worldwide. The objective of this study was to estimate the prevalence and causes of moderate to severe visual impairment (MSVI) and blindness in people aged 15 years and above across three ecological regions of Nepal.

Materials and methods: A comparative cross-sectional study was conducted in one district in each of the three ecological regions of Nepal. Number of participants from each region was distributed as per the prevalence findings of pilot study, with 2815 participants enrolled in Dolakha, 1509 in Dhading and 910 in Sarlahi. Intensive training was provided to health workers on how to conduct door-to-door enumeration, visual acuity testing and referral when indicated for comprehensive ocular examination by technicians and ophthalmologists to diagnose and treat ocular morbidities. Collected data were analyzed using standard software. For categorical data, frequency, percentage and 95% CI were calculated and statistical tests were done using Chi square/Fisher exact test.

Results: Altogether 5234 participants were enrolled in the study (participation rate 96.4%). The overall prevalence of MSVI was 9.5% (495). It was 4.7% (133) in the mountainous region, 11.2% (169) in the Hill and 21.2% (193) in the Tarai. In those aged 15-49 years, MSVI prevalence was 1.5% (52) and 25.1% (433) in ≥50 years. The overall prevalence of blindness was 0.9% (47). It was 0.2% (6) in 15-49 and 2.3% (41) in ≥50 age groups. More than 95% visual impairment and blindness were due

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to cataract and uncorrected refractive error. Cataract was the leading cause of visual impairment and blindness (290, 53.5%), followed by uncorrected refractive error.
Conclusion: The prevalence of visual impairment and blindness varied significantly with age, ethnicity and locality. The management of uncorrected refractive error and operable cataract would reduce nine in ten cases of moderate to severe visual impairment and blindness.

Key words: Epidemiology, Public health, Optic, Refraction, Visual.

Introduction

Visual impairment including blindness is a major public health challenge, particularly in low- and middle-income settings (Vos et al., 2016). More than 80% of individuals with visual impairment (VI) and blindness live in developing countries where resources are scarce. The prevalence of visual impairment varies between and within countries, largely due to variations in accessibility, availability, affordability and acceptability of eye health services (Bourne et al., 2017; Obrist et al., 2007; WHO, 2013a).

Previous studies have found that the prevalence of VI and blindness ranged from 10 to 35% across different age groups worldwide (Pascolini & Mariotti, 2012; Resnikoff et al., 2004). Prevalence of blindness is higher in females than males, which may be due to discrepancies in characteristics such as disease prevalence, utilization of services and life expectancy (Apex Body for Eye Health, 2011; Courtright, 2009). The Rapid Assessment of Avoidable Blindness (RAAB) survey conducted during 2008 to 2010 found that the prevalence of VI was 13.2% in the Bagmati and Janakpur zones of Nepal in those aged 50 years and above (Nepal Netra Jyoti Sangh, 2012; Pradhan et al., 2018).

Geographically, Nepal is a diverse country, with climate conditions ranging from tropical to frigid. Health problems, including ocular conditions, may differ across ecological regions due to dissimilar environmental characteristics, socioeconomic status and accessibility of eye health care. In order to achieve the targets of both the Vision 2020 goals, Global Action Plan (2014-2019) and the Sustainable Development Goals (SDGs) in Nepal, it is important to understand the burden of visual impairment in the rural community with independent and dependent population (Frick & Foster, 2003; Pizzarello, Abiose, Ffytche, & et al., 2004; WHO, 2013b). The correction of VI of younger people gives the potential to contribute to national economic growth, as many years of living with vision loss can be avoided. Therefore, reducing VI might be a good investment to improve the overall growth of Nepal. However, to date, there is a paucity of information available on the pattern of diseases across all ecological regions of Nepal. This study aims to investigate the prevalence and causes of moderate to severe visual impairment (MSVI) and blindness within these regions.

Materials and methods

Study design

A comparative cross-sectional study was designed to determine the prevalence and causes of visual impairment and blindness in one district from each of Nepal's three ecological regions.

Study Areas

Nepal is divided into three ecological regions based on altitude and climatic conditions; namely the Mountain, Hill and Terai (plain) regions. The Tilganga Institute of Ophthalmology, a tertiary eye centre, and its branches have been providing eye care services,

mainly in the central development region of Nepal. The study was conducted from January to December 2011. To explore the differences of ocular morbidity in different locations, three districts, one from each ecological region were purposely selected for this study. The selected districts were Dolakha from the Mountain region, Dhading from the Hill region and Sarlahi from the Terai region.

Sample size

There was no pre-existing information on the prevalence of visual impairment and blindness in people aged 15 to 49 by each ecological region in Nepal, so we conducted a pilot study to determine the prevalence of MSVI and blindness from at least 100 participants from one Village Development Committee randomly selected from each region. The result of the pilot study showed that the prevalence of MSVI and blindness was 7% in the mountain region, 11% in the hill region and 22% in the Terai region.

Based on assumed prevalence of 14% in the population aged 15 years and above, with precision of 10% using 95% confidence interval and design effect of 2, we determined the minimum required sample size was 4720 (Naing, Winn, & Rusll, 2006). It was assumed that there would be a 15% non-response rate. After considering this assumed non-response rate, initially the survey was attempted to 5428 participants. The number of participants from each region was distributed as per the findings of pilot study, with 2815 participants enrolled in Dolakha, 1509 in Dhading and 910 in Sarlahi. The participants from each region were enrolled when desired sample size was reached.

Sampling procedure

Village Development Committees (VDCs) with a population size >4,000 (Nepal Netra Jyoti Sangh, 2012) were regarded as a cluster. Six clusters were selected using a simple random sampling method across the three districts. This resulted in one VDC selected in Sarlahi, two in Dhading and three in Dolakha.

Inclusion criteria

All residents were examined if they were aged 15 years and above, resided in the study areas and consented to the study during house-to-house surveys conducted by field assistants. Visual impairment and blindness was classified according to the International Classification of Disease -10 system.(WHO, 2006). The causes of visual impairment were classified into the following categories: avoidable (treatable and preventable), posterior segment diseases and others. Individuals were considered non-participants if they did not consent to participation in the study, were unable to communicate or were absent during the survey even after 2-3 repeated visits.

Training and orientation

Three days intensive skill based training was delivered to Community Medical Assistants on testing visual acuity; and detecting eye health abnormalities. The clinicians (ophthalmologist, ophthalmic technician) were oriented on the purpose of the research and the research protocol to maintain ethical standards in obtaining informed consent and delivering comprehensive eye examinations.

Data collection

General information including age, ethnicity etc, household, service utilization, financial and social information was collected through face-to-face interviews that were conducted during field administration in all districts. Visual acuity for distance (presenting visual acuity and best corrected visual acuity by pinhole) was tested by trained community medical assistants using E-Snellen chart at six meters distance. Participants with visual impairment (presenting visual acuity less than 6/18) and other ocular abnormalities were asked to return to the nearest place where feasible to

participants and their visual acuity was verified by ophthalmic technicians. An ophthalmologist performed a comprehensive eye examination, including diffuse torch light examination, slit lamp biomicroscopy, direct and indirect ophthalmoscopy with dilated pupils. Participants identified with visual impairment during the house to house screening were invited to attend a nearby facility for visual acuity to be confirmed and a comprehensive eye examination undertaken

Data Analysis

Data was entered in Microsoft Excel 2007 and cleaned. Statistical Package of Social Science V19 and Strata v10 were used for data analysis. Frequency, percentage and 95% CI were calculated. Chi square test / Fisher exact test was used for association for categorical data analysis. P-value <0.05 was considered as significant.

Ethical consideration

Ethical approval was granted by the Institutional Review Committee of the Tilganga Institute of Ophthalmology and informed written consent was obtained from participants.

Results

Five thousand four hundred and twenty eight people were enumerated and 5234 enrolled (96.4%) and had their visual acuity tested by enumerators during house-to-house visits. A total of 566 participants were found with visual impairment (VI) including blindness. Of these participants with VI, 24 participants (4.2%) were unable to complete this second examination by ophthalmic professionals. Of these 24 participants, 3.2% (5) were from Dolakha, 4.1% (8) from Dhading and 5.2% (11) from Sarlahi. Results from these individuals were not analyzed further. Of the total diagnosed visual impairment participants including blindness, only 542 participants with MSVI and blindness (95.8%) were included for analysis.

I. Prevalence of visual impairment

Presenting visual acuity of participants

About 90% (4692) of all examined participants (5324) had a presenting visual acuity of 6/6-6/18 (no or mild visual impairment, NMVI), whereas the proportion of participants with a visual acuity of <6/18-3/60 (moderate to severe visual impairment, MSVI) and <3/60 (blindness) was 9.5% (495), and 0.9% (47) respectively (Table 1). The highest prevalence of moderate to severe visual impairment was found in Sarlahi (21.2%) followed by Dhading (11.2%) and Dolakha (4.7%). However, the highest prevalence of blindness was detected in Dhading district (1.2%), followed by Sarlahi (0.9%) and Dolakha (0.7%). The difference in rates of MSVI and blindness between the three ecological regions was statistically significant (p <0.0001).

Bilateral visual impairment by age and ethnicity

Approximately 98% of the participants aged 15 to 49 years had no or mild VI, compared to 72.6% in the age group of 50 and above. The prevalence of moderate to severe visual impairment was 25.1% in participants aged 50 years and above, and of these, 22.9% of participants were diagnosed with Moderate VI. More than 2% of participants were diagnosed with blindness, as opposed to 0.2% in the 15 to 49 age group. Over 90% of participants belonging to the Hill caste and Janajatis ethnicity groups had normal visual or mild visual impairment. Moderate VI was more prevalent in the Tarai/Madhesi caste (18%), followed by the Muslim group (16%). Rates of blindness was highest within the Muslim group (2.3%), followed by the Madhesi caste (1.3%) and the Dalit ethnicity group (1.2%) (Table 2).

II. Causes of visual impairment

Principal causes of bilateral visual impairment including blindness by location

The majority of visual impairment including

blindness (93.7%) were due to a treatable cause, such as uncorrected refractive error (URE), untreated cataract and uncorrected aphakia (Table 4). Approximately 2% of causes were preventable, namely those due to surgical complications, trachoma, phthisis and other corneal scars.

Treatable causes were highest in Dhading (95.7%), followed by Sarlahi (94.6%) and Dolakha (90.6%), while preventable causes of visual impairment were highest in Sarlahi (2.5%), followed by Dolakha (2.1%) and Dhading (0.5%). The potentially preventable causes of visual impairment including blindness were highest in Sarlahi (2.5%) and lowest in Dhading (0.5%). Thus, the proportion of visual impairment due to avoidable causes was 97%, 96% and 92% in Sarlahi, Dhading and Dolakha respectively.

Principal causes of bilateral visual impairment including blindness by age

The principal causes of bilateral visual impairment including blindness were different between the two age groups (Table 4). In the 15 to 49 age group, uncorrected refractive error was the leading cause of visual impairment (60.3%), followed by untreated cataract (20.7%). Both of these causes are correctable, thus the percentage of correctable VI in this age group is 81%. For the 50 years and over age group, untreated cataract was the leading cause of visual impairment (58.7%), followed by uncorrected refractive error (37%). Treatable causes of VI were higher in the 50 years and older age group (95.2%) compared to the under 50 age group (81.0%), however the prevalence of preventable VI was the same in both groups (1.7%). In total, 95.4% of all VI cases were avoidable.

Bilateral correctable visual impairment including blindness by age and location

The Visual impairment was low in participants below 50 years of age (1.7%), compared to participants aged 50 years and above (27.4%). However, the percentage of correctable visual impairment in the 15-49 years and ≥50 age groups were similar (55.2% and 56.2% respectively). The percentage of treatable visual impairment was highest in Dhading at 83%, followed by 60% in Dolakha and 28% in Sarlahi (Table 3).

Table 1: Prevalence of bilateral moderate to severe visual impairment and blindness

Vision category	All	Dolakha	Dhading	Sarlahi
	n (%, 95% CI)	**n (%, 95% CI)**	**n (%, 95% CI)**	**n (%, 95% CI)**
NMVI	4692 (89.6, 88.8 - 90.5)	2662 (94.6, 93.7 - 95.3)	1322 (87.6, 85.9 - 89.3)	708 (77.8, 74.8 - 80.5)
MSVI	495 (9.5, 8.7 - 10.3)	133 (4.7, 4.0 - 5.5)	169 (11.2, 9.6 -12.9)	193 (21.2, 18.7 -24.0)
Blindness	47(0.9, 0.6 - 1.2)	20 (0.7, 0.4 - 1.1)	18(1.2, 0.7 - 1.7)	9 (1.0, 0.4 - 1.8)
Total	**5234 (100.0)**	**2815 (100.0)**	**1509 (100.0)**	**910 (100.0)**

Note: $\chi^2 = 229.57$, $p < 0.001$. NMVI = 6/6 - 6/18, MSVI = <6/18 - 3/60, Blind = <3/60

Table 2: Types of bilateral visual impairment and blindness by age and ethnicity

Variables		Total	NMVI	MSVI	Blind	χ^2	p- value
			n (%)	n (%)	n (%)		
Age (years)	15-49	3470	3412 (98.3)	52 (1.5)	6 (0.2)	836.48	0.000
	≥50	1764	1280 (72.6)	443 (25.1)	41 (2.3)		
	Total	5234	4692 (89.6)	495 (9.5)	47 (0.9)		
Ethnicity	Hill caste	2408	2235 (92.8)	156 (6.4)	17 (0.7)	157.04	0.000
	Tarai/ Madhesi	537	408 (76)	122 (22.7)	7 (1.3)		
	Dalit	515	462 (89.7)	47 (9.1)	6 (1.2)		
	Janajatis	1643	1484 (90.3)	145 (8.8)	14 (0.9)		
	Muslim	131	103 (78.6)	25 (19.1)	3 (2.3)		
	Total	5234	4692 (89.6)	495 (9.5)	47 (0.9)		

Note: NMVI = 6/6 - 6/18, MSVI = <6/18 - 3/60, Blind = <3/60

Table 3: Principal causes of bilateral visual impairment including blindness by location

Diseases	Location			Age (Years)		All n (%)
	Dolakha n (%)	Dhading n (%)	Sarlahi n (%)	15-49 n (%)	50 and older n (%)	
Uncorrected Refractive Error	62 (40.5)	109 (58.3)	43 (21.3)	35 (60.3)	179 (37.0)	214 (39.5)
Cataract, untreated	76 (49.7)	70 (37.4)	144 (71.3)	12 (20.7)	278 (57.4)	290 (53.5)
Aphakia, uncorrected	0 (0.0)	0 (0.0)	4 (2.0)	0 (0.0)	4 (0.8)	4 (0.7)
Surgical complications	1 (0.7)	0 (0.0)	1 (0.5)	0 (0.0)	2 (0.4)	2 (0.4)
Trachoma	0 (0.0)	0 (0.0)	3 (1.5)	1 (1.7)	2 (0.4)	3 (0.6)
Phthisis	1 (0.7)	0 (0.0)	0 (0.0)	0 (0)	1 (0.2)	1 (0.2)
Other corneal scar	1 (0.7)	1 (0.5)	1 (0.5)	0 (0)	3 (0.6)	3 (0.6)
Glaucoma	3 (2.0)	1 (0.5)	4 (2.0)	5 (8.6)	3 (0.6)	8 (1.5)
Diabetic retinopathy	0 (0.0)	0 (0.0)	1 (0.5)	0 (0)	1 (0.2)	1 (0.2)
ARMD	2 (1.3)	1 (0.5)	0 (0.0)	0 (0)	3 (0.6)	3 (0.6)
Other posterior segment/CNS	6 (3.9)	2 (1.1)	1 (0.5)	3 (5.2)	6 (1.2)	9 (1.7)
Others	1 (0.7)	3 (1.6)	0 (0.0)	0 (0.0)	0 (0.0)	4 (0.7)
Total	153 (100)	187 (100)	202 (100)	58 (100)	484 (100)	542 (100)

Table 4: Bilateral correctable visual impairment and blindness by age and location

Age group (years)	Location						All	
	Dolakha		Dhading		Sarlahi			
	Total PVIB, n	CVIB, n (%)	Total PVIB, n	CVIB, n (%)	Total PVIB, n	CVIB, n (%)	Total PVIB, n	CVIB, n (%)
15 - 49	7	1 (14.3)	28	22 (78.6)	23	9 (39.1)	58	32 (55.2)
≥50	146	91 (62.3)	159	133 (83.6)	179	48 (26.8)	484	272 (56.2)
Total	**153**	**92 (60.1)**	**187**	**155 (82.9)**	**202**	**57 (28.2)**	**542**	**304 (56.1)**

Note= PVIB- Presenting Visual Impairment and blindness, CVIB- Correctable Visual Impairment and blindness

Discussion

We found that the prevalence of visual impairment was 1.7% in the 15-49 age group and 27.4% in those aged 50 years and above. We found the prevalence estimate in the study among those 50 years and above (25.1%) was higher than the national estimate of 17.1% from the RAAB survey between 2008 and 2010 (Nepal Netra Jyoti Sangh, 2012). Few studies have been conducted in the young population aged 15 to 49 years, but our findings of prevalence of visual impairment are similar to estimates from a Northern Indian population (Malhotra, Vashist, Gupta, et al., 2018).

Geographically, Nepal is divided into three ecological regions, each having its own unique culture and climate. To date, there have been a paucity of eye health studies conducted over these different regions. This study explored the prevalence of MSVI and blindness in all regions and found that there were vast differences across the locations. The prevalence of visual impairment and blindness was found to be one in twenty participants in Dolakha (Mountain) district, one in eight in Dhading (Hill) district and one in five in Sarlahi (Tarai) district. It indicated that the overall prevalence of visual impairment was lowest in Dolakha and highest in Sarlahi which is comparable as mountain and plain areas with previous study conducted in others parts of the Nepal (Gurung, Pandey, Shrestha, Gurung, & Ruit, 2017), Northern India (Malhotra, Vashist, Gupta, et al., 2018; Malhotra, Vashist, Kalaivani, et al., 2018) and Tibetan autonomous areas of China (Zhao et al., 2010).

Based on presenting visual acuity, 542 cases of MSVI and blindness were found during the survey (153 from Dolakha, 187 from Dhading and 202 from Sarlahi). After correction via pinhole, it was found that 56% of uncorrected refractive error was not visual impaired. This demonstrates that more than half of the visual impaired participants found in this study can be treated by correction of refractive error. This can be achieved by using simple procedures at the community level with low investment and does not necessitate patients needing to attend and receive treatment at well-equipped clinics or hospitals. Those findings are similar to previous studies conducted in Karnali zone of Nepal.

Cataract was the leading cause of MSVI and blindness followed by uncorrected refractive error. In total, about ninety five percent of all VI cases were due to avoidable causes by cataract operation and correction of refractive error. Uncorrected refractive error was the leading cause of visual impairment in the 15 to 49 age group, whereas cataracts were the leading

cause in the 50 years and over age group (Dulal & Sapkota, 2012; Nepal Netra Jyoti Sangh, 2012).

This study has a number of limitations. Small VDCs were excluded from the sample frame which limits generalizability of the findings. In addition, although differences were found in the different geographical areas, the findings may not be generalized beyond the study districts within each region. There were also strengths. For example, the team returned more than once to provide a range of opportunities for participants to attend the comprehensive examination, which meant participation rates were high.

Conclusion

The prevalence of MSVI and blindness was found in one in ten participants across the three regions. In terms of ocular conditions, cataracts and its sequelae and uncorrected refractive error were the main causes of moderate to severe visual impairment and blindness, though the prevalence of these conditions differed from region to region. The correction of refractive error and cataract surgery would eliminate nine in ten cases of visual impairment including blindness. The findings of the study can be used to set priorities of the eye care services across the three ecological regions in Nepal.

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