Prevalence and causes of vision impairment and blindness in three ecological regions of Nepal

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Abstract

Background Vision impairment and blindness are significant public health issues worldwide. The study aims to explore is the prevalence and causes of moderate to severe vision impairment and blindness across three ecological regions of Nepal. Methods A comparative cross-sectional study was conducted in three districts covering all ecological regions of Nepal. Intensive training for health workers was provided to conduct door-to-door visits for vision acuity testing using Snellen chart and refer the abnormal cases for comprehensive ocular examination by technicians and ophthalmologists to diagnose and treat ocular morbidities. Collected data were analyzed using SPSS and Stata software. Results Altogether 5234 participants were enrolled in the study. The overall prevalence of moderate to severe vision impairment was 9.5% (4.7% in the Mountain district, 11.2% in the Hill district and 21.2% in the Tarai district), though the prevalence of MSVI was 1.5% in participants aged 15-49 years and 25.1% in those aged ≥50. The overall prevalence of blindness was 0.9%, and the prevalence of blindness in the 15-49 and ≥50 age groups was 0.2% and 2.3% respectively. Most cases of vision impairment and blindness (95.5%) were an avoidable cause, of which 93.7% were treatable and 1.8% were preventable. Overall, cataract was the leading cause of vision impairment and blindness (53.5%), followed by uncorrected refractive error (39.5%). Conclusion The prevalence of vision impairment and blindness varied significantly with age, ethnicity and locality. The correction of refractive error and cataract surgery would reduce nine in ten cases of moderate to severe vision impairment and blindness.

Background

Vision impairment including blindness is a major public health challenge, particularly in low- and middle-income settings [1]. More than 80% of individuals with vision impairment (VI) and blindness live in developing countries where resources are scarce. The prevalence of vision impairment varies in different locations and countries due to variations in accessibility, availability, affordability and acceptability of eye health services [2-4].

Previous studies have found that the prevalence of VI and blindness ranged from 10 to 35% across different age groups worldwide [5-7]. Prevalence of blindness is higher in females than males, which may be due to discrepancies in characteristics such as disease prevalence, utilisation of services and life expectancy [8-10]. The prevalence of vision impairment also varies across different age groups [11]. 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 [12, 13]. This study indicated the high magnitude of visual problems in Nepal.

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 vision impairment in the

rural community [14-16]. However, to date, there is a paucity of information available on the pattern of diseases across all ecological regions of Nepal due to limited resources and less focus on evidence-based planning and management in low- to middle-income settings. This study aims to investigate the prevalence and causes of moderate to severe vision impairment (MSVI) and blindness within these regions.

Methods

Study design

A comparative cross-sectional study was designed to understand the status of vision impairment and blindness in the study population in Nepal.

Study Areas

Nepal is divided into three ecological regions based on altitude and climatic conditions; namely the Mountain, Hill and Tarai (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 the Nepal, which include all the study areas. To explore the differences of ocular morbidity in different location, three districts, one from each ecological region were purposively selected for this study. The selected districts were Dolakha from the Mountain region, Dhading from the Hill region and Sarlahi from the Tarai region.

Sample size

As there was no pre-existing information on the prevalence of vision impairment and blindness by each ecological region in Nepal, a pilot study was conducted to determine the prevalence of MSVI and blindness from at least 100 participants in 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 Tarai region. Other studies also showed that the prevalence MSVI including blindness ranged from 7 to 25% in those aged 15 years and above [17-19].

The assumed prevalence of 14% with precision of 10% using 95% confidence interval and design effect of 2, the minimum required sample size was 4720 [20]. It was presumed that there was 15% non-response rate. After considering this presumed non-response rate, initially the survey was attempted to 5428 participants. Finally, we have identified 4.11% non-response rate and complete information available for 5234 subjects. Keeping in view having precise estimate the data was analyzed based on these 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.

Sampling procedure

Village Development Committees (VDCs) were chosen from each district using simple random sampling. The VDCs were eligible for selection if they had a population size >4,000 [13]. Based on the eligible criteria of the VDCs, and population probability proportion, one VDC was 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 ICD-10 classification system.[21] Individuals were excluded if they did not consent to participation in the study, were unable to communicate or were absent during the survey, even after repeated house visits.

Data collection

General, 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 a Snellen chart at six meters at a household level. Patients with vision impairment (presenting visual acuity less than 6/18) and other ocular abnormalities were asked to return and again 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. Other collected data were validated by public health personnel at a study site close to their village.

Ethical consideration

Ethical approval was granted by the Institutional Review Committee of the Tilganga Institute of Ophthalmology (IRC-TIO) and informed written consent was obtained from participants. A comparative cross-sectional study of 5,234 participants was conducted across three districts in Nepal.

Results

Altogether, 5234 participants had their visual acuity tested by enumerators during house-to-house visits. A total of 566 participants were found with vision impairment including blindness. Of these participants with VI, 24 participants (4.2%) were unable to participate in this second examination by ophthalmic professionals. Among non-respondents, 3.2% (5) were from Dolakha, 4.1% (8) from Dhading and 5.2% (11) from Sarlahi. These non-respondents were excluded for further analysis and interpretation. Of the total diagnosed vision impairment participants including blindness, only 542 participants with MSVI and blindness (95.8%) were included for analysis.

I. Prevalence of vision impairment

Prevalence of presenting visual acuity of participants

About 90% of participants had a presenting visual acuity of 6/6-6/18 (no or mild vision impairment, NMVI), whereas the percentage of participants with a visual acuity of <6/18-3/60 (moderate to severe vision impairment, MSVI) and <3/60 (blindness) were 9.5%, and 0.9% respectively (Table 1). The highest prevalence of moderate to severe vision impairment was found in Sarlahi (21.2%) followed by Dhading (11.2%) and Dolakha (4.7%). Similarly, the highest prevalence of blindness was detected in the 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 = 0.000).

Table 1: Prevalence of bilateral moderate to severe vision 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 = 0.000. *NMVI = 6/6 - 6/18, MSVI = <6/18 - 3/60, Blind = <3/60*

Bilateral vision 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 vision 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 vision or mild vision 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).

Bilateral treatable VI by age and location

The case load of vision 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 vision impairment in the <50 years and ≥50 age groups were similar (55.2% and 56.2% respectively). The percentage of treatable vision impairment was highest in Dhading at 83%, followed by 60% in Dolakha and 28% in Sarlahi (Table 3).

II. Causes of vision impairment

Principal causes of bilateral vision impairment including blindness by location

The causes of vision impairment were classified into the following categories: avoidable (treatable and preventable), potentially preventable, posterior segment diseases and others. The majority of vision impairment including blindness cases (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 vision impairment were highest in Sarlahi (2.5%), followed by Dolakha (2.1%) and Dhading (0.5%). The potentially preventable causes of vision impairment including blindness were highest in Sarlahi (2.5%) and lowest in Dhading (0.5%). Thus, the prevalence of total avoidable vision impairment and blindness in Sarlahi, Dhading and Dolakha was 97%, 96% and 92% respectively.

Principal causes of bilateral vision impairment including blindness by age

The principal causes of bilateral vision 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 vision 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 vision 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.

Discussion

This study found that the prevalence of vision impairment was 1.7% the 15-49 age group and 27.4% in the 50 years and above. In latter age group, the percentage of participants with MSVI and blindness were 25.1% and 2.3% respectively. The prevalence found in this study is higher than the 2012 RAAB survey, which found that the prevalence of vision impairment in the 50 and above age group was 17.1% nationwide [13]. As a low prevalence of visual impairment, the few study was conducted in the young population aged 15 to 49 years. The findings is similar with Northen Indian population [22].

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 it there were vast differences in all 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) distrcit. It indicated that the overall prevalence of visual impairment was lowest in Dolakha and highest in Sarlahi which is comparable with previous study conducted in others parts of the Nepal [19], Northern India [22, 23] and Tibetan autonomous areas of china [24].

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% (304) of uncorrected refractive error was NVI. This demonstrates that more than 50% of vision impairment cases 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. Interestingly, over 83% of vision impairment cases in Dhading were correctable by pinhole, whilst the percentage of correctable vision impairment in Dolakha and Sarlahi was 60% and 28% respectively [25].

Overall, cataract was the leading cause of MSVI and blindness (53.5%), followed by uncorrected refractive error (39.5%). In total, 95.4% 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 vision impairment in the 15 to 49 age group, whereas cataracts were the leading cause in the 50 years and over age group [13, 26].

Although differences were found in the different geographical areas, the findings of this study may not be generalized other than the study districts. In order to generalize findings of such study for entire country, it is recommended to conduct further study with sufficient large sample size.

Conclusion

In conclusion, the prevalence of MSVI and blindness was found one in ten participants. In terms of ocular conditions, cataracts and its sequelae and refractive error were the main causes of moderate to severe vision impairment and blindness, though the prevalence of these conditions differed from region to region. The correction of refractive error and cataract surgery would reduce nine in ten cases of vision impairment including blindness.

Abbreviations

ICD: International Classification of Diseases; MSVI: Moderate to Severe Vision Impairment; RAAB: Rapid Assessment of Avoidable Blindness; SDG: Sustainable Development Goals; VDC: Village Development Committees; VI: Vision Impairment.

Declarations

· **Ethics approval and consent to participate:** Ethical approval was granted by the Institutional Review Committee of the Tilganga Institute of Ophthalmology (IRC-TIO). Informed written consent was obtained from adult participants and consent of child (age below 18 years) was obtained from parent or guardian.

· **Consent for publication:** Not Applicable

· **Availability of data and material:** The datasets analysed during the current study are not publicly available due data confidentiality but are available from the corresponding author on reasonable request.

· **Competing interests:** No conflict of interest
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· **Authors' contributions:** MKS planned and conducted the study, analysed the data, and drafted and revised the paper. SS analysed the data, and drafted and revised the paper. BL conducted the study and revised the paper. MP cleaned and analysed the data, and revised the paper. SK, BP and MS planned the study and revised the paper.

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Tables 2-4

Due to technical limitations, Table(s) 2-4 are only available as a download in the supplemental files section.

Supplementary Files

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