Awareness, Knowledge, and Practice on Retinal Diseases at High-altitude of Nepal

Raba Thapa,[1] Sanduk Ruit,[2] Manish Poudel,[3] Pratibha Neupane,[3] Pradeep Banjara,[3] Sushma Duwal,[4] Elena Gurung,[4] Geoffrey Craig Tabin[5]

[1]Department of Research and Vitreoretina, Tilganga Institute of Ophthalmology, Gaushala, Kathmandu, Nepal
[2]Department of Cataract and Cornea, Tilganga Institute of Ophthalmology, Gaushala, Kathmandu, Nepal
[3]Department of Research, Tilganga Institute of Ophthalmology, Gaushala, Kathmandu, Nepal
[4]Department of Vitroretina, Tilganga Institute of Ophthalmology, Gaushala, Kathmandu, Nepal
[5]Department of Cornea, Byers Eye Institute, Stanford University, Watson Court, Palo Alto, California, United States of America

ABSTRACT

Introduction: Retinal disorders are the major causes of visual impairment in Nepal. Limited access to eye care service in high altitude regions, along with low awareness and knowledge on the retinal diseases delays timely treatment and care.

Objective: To assess the awareness, knowledge, and practices on major retinal disorders at high-altitude in Nepal.

Methodology: An analytical cross-sectional study was carried out to assess the retinal disease prevalence at three high-altitude districts of Nepal namely Manang, Mustang, and Solukhumbu from 2023 May to 2023 July after ethical clearance. The sample size of 308 with the age 40 years and above were included with random sampling. Awareness, knowledge, and practice on major retinal disease on diabetic retinopathy (DR), age-related macular degeneration (AMD), hypertensive retinopathy (HR), and high-altitude retinopathy (HAR) were assessed. Facetoface interviews were conducted after obtaining informed written consent. Ethical approval was granted by the Nepal Health Research Council, and data were analysed using IBM SPSS v.20.

Result: A total of 338 study participants were enrolled. The mean age was 56.98±11.13 years with female preponderance (216, 63.9%). Three-fifth (61.8%) were literate. Awareness was found among 131 (38.76%) on diabetes mellitus affecting eye, 19 (5.6%) on AMD, 118 (34.9%) on hypertension affecting eye, and 273 (80.8%) on high-altitude affecting eye. However, only five (1.5%) were aware that high-altitude could affect retina and none were aware of its preventive measures. Eleven (33.3%) of people with diabetes had regular eye exams. One respondent had AMD, however he did not receive frequent eye examinations. Only eight (8.3%) of those with hypertension had undergone regular eye check-ups.

Conclusion: The awareness, knowledge, and practice on major retinal diseases including high-altitude retinopathy was low among the population of high-altitude in Nepal. Emphasis should be given on raising awareness activities besides enhancing the access to eye care services.

Key words: Awareness; high-altitude; knowledge; Nepal; practice; retinal diseases.

Financial Interest: Supported by Association for Research in Vision and Ophthalmology (ARVO) Foundation and Byers Eye Institute, Stanford University.

Conflict of Interest : A part of this research has been published. The data in this manuscript have not been published.

Received : 17.01.2025 Accepted : 04.06.2025

Corresponding Author
Dr. Raba Thapa MD, PhD
Professor, National Academy of Medical Sciences,
Head, Vitreoretina Unit and Chief, Research Department,
Tilganga Institute of Ophthalmology,
Gaushala, Kathmandu, Nepal.
E-mail: rabathapa@live.com

Access this article online
Website: www.nepjol.info/index.php/NEPJOPH
DOI: https://doi.org/10.3126/nepjoph.v17i34.68246

ISSN: 2072-6805, **E-ISSN:** 2091-0320

INTRODUCTION

Retinal diseases are public health problems as major causes of irreversible blindness especially in low-and-middle-income countries (Resnikoff et al., 2004). In Nepal, posterior-segment eye diseases, are second most common causes of blindness (Thapa et al., 2013; Thapa et al. 2020). Rise in retinal problems were found with ageing (Farsight, 2023; Thapa et al., 2020). Age-related macular degeneration (AMD), hypertensive retinopathy (HR), and retinal vein occlusion (RVO) are most common vitreoretinal disorders among low-and-high-altitude Nepali inhabitants (Rennie and Morrissey, 1975; Thapa et al., 2020). These retinal diseases cause low vision and blindness (Thapa et al., 2023; Thapa et al., 2018).

In Nepal, about 15% land is mountainous. Engorgement experience and retinal vasculature tortuosity was reported above 2500 metres (Thapa et al., 2013). Numerous ocular and systemic sequelae associated with high-altitude (HA) are preventable with early detection, and treatment (Wiedman and Tabin, 1999). Retinal problems are reported after exposure to HA (Karki et al., 2019; Mashkovskiy et al., 2016; Izadi, 2017; Wiedman, 1975; Karaküçük et al., 2000; Houston,1976; Montgomery et al., 1989; Wiedman and Tabin, 1999; Thapa et al., 2013).

Nepal has high burden of type-2 diabetes (Gyawali et al., 2015; Wild, 2004). Diabetic retinopathy (DR) leading to blindness is increasing. Despite being most common retinal problem, study reported only 7.6% awareness on AMD, 11.5% on DR, and 13.8% on HR in semi-urban Nepal (Thapa et al., 2016; Thapa et al., 2022). Patients seek medical attention late because of insufficient awareness (Dandona et al., 2001). Raising awareness could promote regular eye examinations for early detection (Shrestha et al., 2018). Inadequate information exists on awareness, knowledge, and practice on high-altitude retinopathy (HAR) and major retinal diseases at high-altitude Nepal. Awareness and knowledge of HAR could help in prevention and early detection of disease by timely seeking services.

Hence, this study aimed to assess awareness, knowledge, and practice on major retinal disorders in high-altitude population.

METHODOLOGY

This analytical cross-sectional study was a part of population-based study on retinal diseases and associated factors at high-altitude of Nepal. The study was approved by the Ethical Review Board of Nepal Health Research Council (NHRC) (Protocol Registration Number 199/2023; Reference number 3058; dated: 10.05.2023). The informed consent was taken from the study participants before enrollment in the study. The study was conducted as per the declaration of Helsinki. Details of the study design, methods, and sampling have been mentioned in previous paper (Thapa et al., 2024). In brief, the three districts; Manang, Mustang, and Solukhumbu were selected purposively as they are representative of Nepal's mountain region. Data were collected from 2023 May to 2023 July. The total sample size for the study was calculated as 309 using the formula $n = Z^2P(1-p)/d^2$. It was calculated assuming retinal disease prevalence (P) as 56.8% at high-altitude (Thapa et al., 2013), 95% confidence level, and precision be 10% of prevalence rate. The

minimum sample size calculated for the study was 293. With assuming 5% non-response rate, the total sample size for the study was 309. The sample size was distributed with minimum of 103 for each district. Sampling method was conducted using a communitybased approach. Different areas of the selected districts were first selected through simple random sampling. Due to difficult terrain, a local field worker was hired and trained for the data collection. Within each selected area, households were visited sequentially by the hired filed worker, and eligible individuals were randomly selected and sent to the research clinic until the required sample size was reached. This approach ensured representativeness while maintaining feasibility in such a geographically challenging setting.

The study participants at the age 40 years and above were included in the study. Those participants unable to provide information were excluded. Detailed questionnaire was developed to assess the awareness, knowledge, and practice on major retinal diseases of DR, hypertensive retinopathy, AMD, and HAR. The questionnaires were based on previous studies and consultation with the experts.

The research officer, optometrist (BP) was involved in interview after receiving the training on interview and data collection process. Pretesting of study tool was done to refine the questionnaire for easy understanding by the study participants locally. Data collection was carried out through face-to-face interviews using a structured questionnaire on major retinal diseases; DR, hypertensive retinopathy, AMD and high-altitude retinopathy from each study participant. Data entry was done in Open Data Kit software. The entered data were exported to Microsoft Excel Sheet where cleaning and coding were done. The IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA) was used for the statistical data analysis. For the association of categorical data, Chi-square test was used and if the expected cell count was less than five, Fisher Exact test was used. The p-value less than 0.05 using two-tailed test was considered as statistically significant.

RESULT

Participants were enrolled from three districts having high-altitudes of Nepal namely Manang (109, 32.3%), Mustang (110, 32.5%), and Solukhumbu (119, 35.20%), with the total of 338 in number. The mean age ± standard deviation (SD) was 57±11.1 years. One-third (122, 36.1%) of total respondents were male, with similar gender distribution across the three districts. Literate comprised of 209 (61.8%), 158 (46.7%) of respondents were farmers, and 296 (87.6%) of them were Buddhists by religion. Thirty-three (9.8%) participants reported having diabetes mellitus, suggesting a statistically similar prevalence among these regions ($p = 0.19$). One hundred and thirty-one (38.76%) participants were aware that diabetes can affect eyes, which was statistically different among the districts ($p <0.001$). Manang exhibited the maximum level of awareness at 75 (68.8%), followed by Solukhumbu at 36 (30.3%) and Mustang at 20 (18.2%).

Among those who were aware, 77 (58.8%) reported diabetes mellitus impair vision, which was statistically different among the districts ($p <0.001$). Solukhumbu showed the maximum level of knowledge among 30 (83.3%), followed

by Mustang in 15 (75%), and Manang in 32 (42.7%) participants. Similarly, 42 (12.4%) study participants had knowledge that diabetic patients have to visits eye specialist, which was statistically different among the districts (p = 0.006). Manang showed the maximum level of knowledge at 20 (18.3%), followed by Solukhumbu at 17 (14.3%) % and Mustang at five (4.5%).

Among those who were aware that diabetes affects eyes (n = 131), only 26 (19.8%) were aware that blindness from diabetes can be prevented, which is significantly different among districts (p = 0.005). Very few participants 15 (4.4%) were aware on DR, which was also significantly different among districts (p = 0.037).

The level of understanding regarding diabetic retinopathy was marginally inconsistent. There was no significant difference among the districts, and 73.3% of respondents correctly defined DR (p = 0.297). Furthermore, 14 (93.3%) respondents had knowledge on DR is a cause of blindness, with no statistically significant difference between districts (p = 1.00). Six (40%) participants were aware that DR can be treated, which was statistically similar across the three districts (p = 0.748).

One-third (33.3%) participants checked up their eyes for DR, which was statistically similar across the districts (p = 0.133). Among the participants who checked up their eyes, only two (18.2%) immediately checked up their eyes after diabetes diagnosis, which was statistically similar across all districts (p = 0.717) (Table 1).

Awareness of AMD was found in 19 (5.6%) in overall participants, which was statistically different across districts. In Manang, 15 (13.8%) were aware of AMD followed by Solukhumbu with three (2.5%) and Mustang with one (0.9%). Among the aware respondents, all participants had knowledge on smoking aggravates AMD in all districts. Similarly, 18 (94.7%) had knowledge on sunlight aggravates AMD, 19 (100%) participants had knowledge on green vegetables, fruits, and seafood protects AMD, and 18 (94.7%) had knowledge on AMD progression can be slow down by using certain vitamins. All these are statistically similar across the districts.

Furthermore, among the AMD aware participants, five (26.3%) had knowledge on AMD can cause blindness if not treated properly, which was statistically similar across all districts (p = 0.39). Only one respondent (6.7%) from Manang had a family history of AMD, was diagnosed and taking medication for AMD, but no frequent eye exam (Table 2).

Table 1: Awareness, knowledge, and practice on diabetes and diabetic retinopathy among the study participants, n (%).

Variables	Category	Address				p-value
		Manang	Mustang	Solukhumbu	Total	
Having diabetes	Yes	10 (9.2)	7 (6.4)	16 (13.4)	33 (9.8)	0.19
	No	99 (90.8)	103 (93.6)	103 (86.6)	305 (90.2)	
Knowledge of diabetes related questions						
Diabetes affecting eyes	Yes	75 (68.8)	20 (18.2)	36 (30.3)	131 (38.8)	<0.001
	No	34 (31.2)	90 (81.8)	83 (69.7)	207 (61.2)	
Diabetes impair vision	Yes	32 (42.7)	15 (75)	30 (83.3)	77 (58.8)	<0.001
	No	43 (57.3)	5 (25)	6 (16.7)	54 (41.2)	
Need for diabetics to visit an eye specialist	Yes	20 (18.3)	5 (4.5)	17 (14.3)	42 (12.4)	0.006
	No	89 (81.7)	105 (95.5)	102 (85.7)	296 (87.6)	
Practice related questions						
Frequency of eye check-ups for diabetics	1 month interval	-	2 (40)	-	2 (4.8)	
	12 months interval	-	-	2 (11.8)	2 (4.8)	
	3 months interval	4 (20)	-	2 (11.8)	6 (14.3)	
	6 months interval	9 (45)	1 (20)	10 (58.8)	20 (47.6)	
	As per doctors' discretion	3 (15)	-	1 (5.9)	4 (9.5)	
	Do not know	4 (20)	2 (40)	2 (11.8)	8 (19)	
	Total	20 (100)	5 (100)	17 (100)	42 (100)	
Awareness of diabetes related questions						
Awareness of preventable blindness from diabetes	Yes	8 (10.7)	5 (25)	13 (36.1)	26 (19.8)	0.005
	No	67 (89.3)	15 (75)	23 (63.9)	105 (80.2)	
Awareness of diabetic retinopathy	Yes	5 (4.6)	1 (0.9)	9 (7.6)	15 (4.4)	0.037
	No	104 (95.4)	109 (99.1)	110 (92.4)	323 (95.6)	
Knowledge of diabetes retinopathy related questions						
What is diabetic retinopathy?	Correct Answer	5 (100)	1 (100)	5 (55.6)	11 (73.3)	0.297
	Incorrect Answer	-	-	4 (44.4)	4 (26.7)	
Diabetic retinopathy causes blindness	Yes	5 (100)	1 (100)	8 (88.9)	14 (93.3)	1.00
	No	-	-	1 (11.1)	1 (6.7)	
Awareness of diabetes retinopathy related questions						
Awareness of treatments for diabetic retinopathy	Yes	2 (40)	1 (100)	3 (33.3)	6 (40)	0.748
	No	3 (60)	-	6 (66.7)	9 (60)	
Practice of diabetic retinopathy related questions						
Eye check-up for diabetic retinopathy	Yes	1 (10)	2 (28.6)	8 (50)	11 (33.3)	0.133
	No	9 (90)	5 (71.4)	8 (50)	22 (66.7)	
First eye check-up for diabetic retinopathy	Immediately after diagnosis of diabetes	-	-	2 (25)	2 (18.2)	0.717
	Within one year	-	2 (100)	3 (37.5)	5 (45.5)	
	Others	1 (100)	-	3 (37.5)	4 (36.4)	

Table 2: Awareness, knowledge, and practice on age-related macular degeneration among the study participants, n (%).

Variables	Category	Address				p-value
		Manang	Mustang	Solukhumbu	Total	
Awareness of AMD related questions						
Awareness of AMD	Yes	15 (13.8)	1 (0.9)	3 (2.5)	19 (5.6)	<0.001
	No	94 (86.2)	109 (99.1)	116 (97.5)	319 (94.4)	
Knowledge of AMD related questions						
Smoking aggravating AMD	Yes	15 (100)	1 (100)	3 (100)	19 (100)	-
	No	-	-	-	-	
Sunlight aggravating AMD	Yes	14 (93.3)	1 (100)	3 (100)	18 (94.7)	1.000
	No	1 (6.7)	-	-	1 (5.3)	
Green vegetables, fruits, and seafood protecting against AMD	Yes	15 (100)	1 (100)	3 (100)	19 (100)	-
	No	-	-	-	-	
Use of certain vitamins slowing AMD progression	Yes	14 (93.3)	1 (100)	3 (100)	18 (94.7)	1.000
	No	1 (6.7)	-	-	1 (5.3)	
Knowledge of AMD treatment	Yes	6 (40)	-	-	6 (31.6)	0.668
	No	9 (60)	1 (100)	3 (100)	13 (68.4)	
AMD causing blindness	Yes	3 (20)	-	2 (66.7)	5 (26.3)	0.39
	No	12 (80)	1 (100)	1 (33.3)	14 (73.7)	
Family members having AMD	Yes	1 (6.7)	-	-	1 (5.3)	1.000
	No	14 (93.3)	1 (100)	3 (100)	18 (94.7)	
AMD practice related questions						
Having AMD	Yes	1 (6.7)	-	-	1 (5.3)	1.00
	No	14 (93.3)	1 (100)	3 (100)	18 (94.7)	
If yes, Regular eye check-ups	Yes	-	-	-	-	-
	No	1 (100)	-	-	1 (100)	
If AMD, Being on medication	Yes	1 (100)	-	-	1 (100)	-
	No	-	-	-	-	

Among the study participants, 96 (28.4%) had known hypertension, with equal proportions in Manang and Solukhumbu (36.7% and 36.1%, respectively). It is statistically lower in Mustang at 13 (11.8%), p <0.001. Similarly, 118 (34.9%) had knowledge of hypertension affect the eyes, which is statistically different among the districts (p <0.001). The highest knowledge was at Manang with 57 (52.3%) followed by Solukhumbu with 38 (31.9%) and Mustang with 23 (20.9%). Among those aware of hypertension affect eye, 63 (90%) reported hypertension affect vision, which was statistically similar across the districts (p = 0.313). Additionally, 42 (73.7%) reported hypertension causes blindness, which was statistically different across the districts (p = 0.002). The highest knowledge was at Solukhumbu with 17 (100%) followed by Mustang with 10 (76.9%) and Manang with 15 (55.6%) respectively.

Furthermore, 50 (14.8%) had a family history of hypertension, which was statistically similar across the districts (p = 0.109). Among the hypertensive patients, only eight (8.3%) go to

regular eye check-up, which was statistically similar across the districts (p = 0.078).

Twelve (28.6%) study participants were aware of hypertensive retinopathy, which was high in Solukhumbu with eight (47.1%) followed by Manang with four (26.7%). No one reported awareness of hypertensive retinopathy in Mustang. Only 13 (3.8%) of the study participants were aware of blindness due to hypertensive retinopathy, which was nine (7.6%) in Solukhumbu and four (3.7%) in Manang. No one reported it from Mustang (p = 0.006). No one had regular medication for hypertensive retinopathy in all districts (Table 3).

Table 3: Awareness, knowledge, and practice on hypertension and hypertensive retinopathy among the study participants, n (%).

Variables	Category	Manang	Mustang	Solukhumbu	Total	p-value
Having hypertension	Yes	40 (36.7)	13 (11.8)	43 (36.1)	96 (28.4)	<0.001
	No	69 (63.3)	97 (88.2)	76 (63.9)	242 (71.6)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
Knowledge of hypertension related questions						
Hypertension affect eyes	Yes	57 (52.3)	23 (20.9)	38 (31.9)	118 (34.9)	<0.001
	No	52 (47.7)	87 (79.1)	81 (68.1)	220 (65.1)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
Hypertension affect eyesight	Yes	27 (96.4)	13 (86.7)	23 (85.2)	63 (90)	0.313
	No	1 (3.6)	2 (13.3)	4 (14.8)	7 (10)	
	Total	28 (100)	15 (100)	27 (100)	70 (100)	
Hypertension causes blindness	Yes	15 (55.6)	10 (76.9)	17 (100)	42 (73.7)	0.002
	No	12 (44.4)	3 (23.1)	-	15 (26.3)	
	Total	27 (100)	13 (100)	17 (100)	57 (100)	
Practice of hypertension related question						
Family member have hypertension	Yes	20 (18.3)	10 (9.1)	20 (16.8)	50 (14.8)	0.109
	No	89 (81.7)	100 (90.9)	99 (83.2)	288 (85.2)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
If having hypertension, go for regular eye checkup?	Yes	6 (15)	1 (7.7)	1 (2.3)	8 (8.3)	0.078
	No	34 (85)	12 (92.3)	42 (97.7)	88 (91.7)	
	Total	40 (100)	13 (100)	43 (100)	96 (100)	
Aware of hypertensive Retinopathy related questions						
Aware of hypertensive retinopathy	Yes	4 (26.7)	-	8 (47.1)	12 (28.6)	0.023
	No	11 (73.3)	10 (100)	9 (52.9)	30 (71.4)	
	Total	15 (100)	10 (100)	17 (100)	42 (100)	
Aware of HTN retinopathy cause blindness	Yes	4 (3.7)	-	9 (7.6)	13 (3.8)	0.006
	No	105 (96.3)	110 (100)	110 (92.4)	325 (96.2)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
Practice of hypertensive retinopathy related question						
If hypertensive retinopathy, being on medication	Yes	-	-	-	-	-
	No	40 (100)	13 (100)	43 (100)	96 (100)	
	Total	40 (100)	13 (100)	43 (100)	96 (100)	

Majority of study participants 273 (80.8%) were aware on impact of high-altitude on eyes, which was statistically different among the districts (p = 0.004). It was higher in Solukhumbu with 104 (87.4%) and lower in Manang with 77 (70.6%). Very few, five (1.5%) study participants had knowledge on high-altitude affect retina, which was statistically similar in three districts (p = 0.534).

Almost 60% of the respondents had knowledge on high-altitude can cause vision problems while only 31 (9.2%) had knowledge on high-altitude can cause blindness. Both were statistically different across the districts, p <0.001. Moreover, 229 (67.8%) respondents were aware of different ways to prevent high-altitude-related eye problems, with the highest proportion from Solukhumbu 91 (76.5%) and lowest from Manang 63 (57.8%), p = 0.001. Furthermore, 107 (31.7%) had ever diagnosed with eye problem due to high-altitude, which was statistically different across the districts (p = 0.002). It was higher in Solukhumbu with 49 (41.2%) and lower in Manang with 21 (19.3%).

Furthermore, none reported awareness about prevention of high-altitude-related retina problems or awareness of treatment procedures if they had experienced high-altitude-related retina problems (Table 4).

Table 4: Awareness, knowledge and practice on high-altitude retinal disease among the study participants, n (%).

Variables	Category	Address				p-value
		Manang	Mustang	Solukhumbu	Total	
High-altitude knowledge related questions						
High-altitude affect eye	Yes	77 (70.6)	92 (83.6)	104 (87.4)	273 (80.8)	0.004
	No	32 (29.4)	18 (16.4)	15 (12.6)	65 (19.2)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
High attitude affect retina	Yes	1 (0.9)	3 (2.7)	1 (0.8)	5 (1.5)	0.534
	No	108 (99.1)	107 (97.3)	118 (99.2)	333 (98.5)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
High-altitude exposure causes vision problems	Yes	49 (45)	57 (51.8)	89 (74.8)	195 (57.7)	<0.001
	No	60 (55)	53 (48.2)	30 (25.2)	143 (42.3)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
High-altitude exposure causes blindness	Yes	9 (8.3)	2 (1.8)	20 (16.8)	31 (9.2)	<0.001
	No	100 (91.7)	108 (98.2)	99 (83.2)	307 (90.8)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
know the ways of preventing high-altitude related eye problem	Yes	63 (57.8)	75 (68.2)	91 (76.5)	229 (67.8)	0.011
	No	46 (42.2)	35 (31.8)	28 (23.5)	109 (32.2)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
know the ways of preventing high-altitude related retina problem	Yes	-	-	-	-	-
	No	109 (100)	110 (100)	119 (100)	338 (100)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	
Ever diagnosis with high-altitude eye problem	Yes	21 (19.3)	37 (33.6)	49 (41.2)	107 (31.7)	0.002
	No	88 (80.7)	73 (66.4)	70 (58.8)	231 (68.3)	
	Total	109 (100)	110 (100)	119 (100)	338 (100)	

DISCUSSION

In this study, the average age of study participants was 56.9±11.1 years. Females constituted two-thirds of the respondents. Findings of this study were comparable with other studies conducted at high-altitude region, by Rennie and Morrissey, 1975 with the mean age of 56.7 years and Thapa et al., 2013 with mean age of 56.7±11.15 years. Females were higher in these studies as well. Overall, one-third (33%) of the study participants were found to be illiterate, with the highest number observed in the Solukhumbu district. This number is lower than the previous study, where illiteracy was reported at 80.2% (Thapa et al., 2013). Nearly half of the study participants were farmer, a trend consistent with a previous study conducted at high-altitudes (51.9% by Thapa et al., 2013). Majority (85.6%) of respondents were Buddhists by religion. The predominant ethnic group in high-altitude areas was particularly the Sherpa community, who adhere to Buddhism (Rennie and Morrissey, 1975; Thapa et al., 2013).

In this series, one-third of the study participants were aware of diabetes affecting eye. However, the awareness on DR (4.4%) was low. The awareness on DR was relatively lower compared to the study carried out in a semi-urban region (Thapa et al.., 2015. Higher rates of illiteracy and limited access to eye care service could be the reason for this disparity of awareness on DR. In this series, one-third were aware of need of regular eye check-up for DR however, only 18.2% provided history of doing eye check-up for DR immediately after the diagnosis of diabetes. A study from semi-urban area (Thapa et al., 2015) reported need of regular eye check up by people with diabetes in only 10.1%. The findings on awareness were better in the current series. This could be because of the former study was conducted a decades before this study and also among the elderly at the age 60 years and above. The awareness might have increased with time. However, both studies highlight the necessity of focused educational activities to address this gap in knowledge and emphasize the significance of regular eye examinations for patients with diabetes.

This study showed that only 5.6% participants were aware of AMD which was aligned with another population-based study conducted in Nepal, only 7.6% of respondents were aware (Thapa et al. 2015). According to AMD Alliance International Global Report 2005, less than one in ten respondents in Spain, the Netherlands, Hong Kong, Italy, and Japan were aware. Similarly, the awareness in UK (16%), South Africa and Germany (14%), France (13%), Ireland (11%), and Switzerland (10%) were better with the highest awareness level of 30%, 25%, and 21% of participants respectively from developed countries the United States of America (USA), Canada, and Australia (Awareness of Age-related Macular Degeneration and Associated Risk Factors AMD Global Report, 2005). Thus, it seems that the awareness of AMD is universally low as in this study except for developed countries, which have better awareness compared to developing countries. In this series, among those who were aware of AMD, over 94% reported the awareness of smoking and sunlight exposure as an aggravating factor and increased consumption of fruits and vegetables as a protective factor for AMD. However, only 31.6% were aware of AMD treatment. In contrast to current study findings, only 7.5% and 7.4% of study participants were

aware of aggravating and preventive factors in previous population-based study conducted in low land population. (Thapa et al., 2015). The difference could be because of education level of the study participants. The lower rates of awareness on AMD and its treatment highlights the importance of enhancing AMD awareness in the community.

In this study, 34.9% were aware of hypertension affecting eyes. Among these, 90% reported hypertension affect eyesight and 73.7% reported it can lead to blindness. A total of 28.6% were aware of hypertensive retinopathy. However, only 3.8% were aware on blindness due to hypertensive retinopathy. A population-based study conducted in Nepal at semi-urban area among subjects with hypertension reported that awareness of hypertension's effects on the eyes, retina and vision was found in 13.84%, 8.4%, and 11.98% respectively (Thapa et al. 2022). Higher awareness level in this study could be due to age difference of study participants. The findings of the study reflects that awareness level is in increasing trend. Among the hypertensive subjects, only 8.3% reported regular eye check-up. This emphasised the need of more awareness programs in the study sites.

The current study showed over four-fifth (80.8%) of the participants were aware on high-altitude affecting eye. While comparing district-wise data findings were almost similar with slightly lower in the Manang district. However, only 1.5% were aware that high-altitude could affect retina. Despite of nearly one-third of study participants had experience of high-altitude eye problem, only 9.2% were aware of its blinding complications. Likewise, 67.8% respondents reported that they knew the ways of preventing high-altitude related eye problem. It seems that as compared to other retinal problems, majority of the participants residing in high-altitude were aware about effect of high-altitude in eye and preventing ways for high-altitude related eye problem. There are no other literatures regarding the awareness on high-altitude eye problems.

With the limited literatures in these fields, this study findings could be the baseline for further studies and intervention activities in reducing visual impairment at high-altitude in Nepal.

The limitation of the study is that the study was a part of population prevalence of retinal disease at high-altitude in Nepal. So, the sample may not represent the entire awareness, knowledge and practice on major retinal diseases of the high-altitude region. Further studies are recommended for the wider assessment of awareness, knowledge and practice at high-altitude.

CONCLUSION

The awareness and knowledge on retinal diseases were low along with suboptimal practices on diabetic retinopathy, hypertensive retinopathy, AMD and high-altitude retinopathy among the population of high-altitude in Nepal. Emphasis should be given in enhancing awareness and knowledge on these important blinding diseases among the high-altitude population also having limited access to transportation due to difficult geographical terrain, and eye health care facilities to reduce the low vision and blindness in high-altitude part of the country.

ACKNOWLEDGEMENTS

The investigators would like to acknowledge Association for Research in Vision and Ophthalmology (ARVO) Foundation for providing the financial support to conduct the study as a part of Collaborative Research Fellowship Award to Dr. Raba Thapa MD, PhD. The investigators would also like to acknowledge Byers Eye Institute, Stanford University, California, USA for the support of this study as a part of the mentorship program for the Collaborative Research Fellowship Award by Prof Dr. Geoffrey Craig Tabin MD.

REFERENCES

AwarenessofAge-relatedMacularDegenerationandAssociatedRiskFactorsAMDGlobalReport2005.(n.d.).Availableat: https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=a88de79d39266c31be9faf5ced217b303d3acf6e [Accessed 7 Jun. 2024]

Dandona, R., Dandona, L., John, R.K., McCarty, C.A. and Rao, G.N (2001). Awareness of eye diseases in an urban population in southern India. *Bulletin of the World Health Organization*, *79*(2), pp.96-102. PMID: 11242828

Farsight. (2023). *Highlights of the Nepal Census 2021 | The Farsight Nepal*. [online] Available at: https://farsightnepal.com/news/137.

Gyawali, B., Sharma, R., Neupane, D., Mishra, S.R., van Teijlingen, E. and Kallestrup, P., (2015) . Prevalence of type 2 diabetes in Nepal: A systematic review and meta-analysis from 2000 to 2014. *Global Health Action*, *8*(1), p.29088. PMID: 26613684

Houston, C.S. (1976). High-altitude illness: disease with protean manifestations. *Journal of American Medical Association*, *236*(19), pp.2193-2195.

Izadi, M., Pourazizi, M. and Alemzadeh-Ansari, M.H. (2017). Ocular problems in high-altitude traveling: a review with focus on management. *International Journal of Travel Medicine and Global Health*, *5*(2), pp.41-45.

Karaküçük, S. and Mirza, G.E. (2000). Ophthalmological effects of high-altitude. *Ophthalmic research*, *32*(1), pp.30-40. PMID: 10657753

Karki, P., Sijapati, M.J., Pandey, M. and Khadka, N. (2019). Ocular presentations in high-altitude sickness: experience of our centre. *Nepalese Medical Journal*, *2*(1), pp.141-144.

Montgomery, A.B., Mills, J. and Luce, J.M. (1989). Incidence of acute mountain sickness at intermediate altitude. *Journal of American Medical Association*, *261*(5), pp.732-734. PMID: 2911169

Mashkovskiy E, Szawarski P, Ryzhkov P, Goslar T, Mrak I (2016). Fulminant high-altitude blindness. Journal of Travel Medicine. 2016 Nov;23(6):taw057. PMID: 27601532

Morris, D.S., Somner, J., Donald, M.J., McCormick, I.J., Bourne, R.R., Huang, S.S., Aspinall, P. and Dhillon, B (2007). The eye at altitude. In *Hypoxia and Exercise* (pp. 249-270). Springer US. PMID: 17089894

Rennie, D. and Morrissey, J. (1975). Retinal changes in Himalayan climbers. *Archives of ophthalmology*, *93*(6), pp.395-400.

Resnikoff, S., Pascolini, D., Etya'Ale, D., Kocur, I., Pararajasegaram, R., Pokharel, G.P. and Mariotti, S.P.(2004). Global data on visual impairment in the year 2002. *Bulletin of the world health organization*, *82*(11), pp.844-851. Rapid Assessment of Avoidable Blindness Survey. The epidemiology of blindness in Nepal. *Nepal Netra Jyoti Sangh*. 2012;1–72.

Shrestha, G.S., Sigdel, R., Shrestha, J.B., Sharma, A.K., Shrestha, R., Mishra, S.K. and Joshi, S.N. (2018). Awareness of eye health and diseases among the population of the hilly region of Nepal. *Journal of ophthalmic & vision research*, *13*(4), p.461. PMID: 30479718

Thapa R, Khanal S, Tan HS, Thapa SS, van Rens GHMB (2020). Prevalence, pattern and risk factors of retinal diseases among an elderly population in Nepal: The Bhaktapur Retina Study. *Clinical Ophthalmology* 14:2109-2118. PMCID:PMC: 7399464. PMID:32801619

Thapa, R., Bajimaya, S., Paudyal, G., Khanal, S., Tan, S., Thapa, S.S. and van Rens, G (2015). Population awareness of diabetic eye disease and age related macular degeneration in Nepal: the Bhaktapur Retina Study. *BMC ophthalmology*, *15*, pp.1-8. doi: 10.1186/s12886-015-0175-z

Thapa R, Bajimaya S, Paudyal G, Khanal S, Tan S, Thapa SS, van Rens GHMB (2018) Prevalence and causes of low vision and blindness in an elderly population in Nepal: The Bhaktapur Retina Study. *BMC Ophthalmology* 13;18 (1):42. PMID: 29439666.

Thapa R, Khanal S, Tan HS, Thapa SS, van Rens GH (2022). Prevalence, associated factors and awareness of hypertensive retinopathy among an elderly population with hypertension in Nepal: the Bhaktapur retina study. Nepalese journal of ophthalmology. 23;14(1):49-58. doi: 10.3126/nepjoph.v14i1.35401.

Thapa, R., Poudyal, G., Crandall, A.S. and Tabin, G (2013). Vitreoretinal disorders at high-altitude in Nepal. *Nepalese Journal of Ophthalmology: a Biannual Peer-reviewed Academic Journal of the Nepal Ophthalmic Society:* Nepalese journal of ophthalmology. *5*(1), pp.57-62.

Thapa, R., Poudyal, G., Maharjan, N. and Bernstein, P.S. (2012). Demographics and awareness of diabetic retinopathy among diabetic patients attending the vitreoretinal service at a tertiary eye care center in Nepal. *Nepalese Journal of Ophthalmology: A Biannual Peer-reviewed Academic Journal of the Nepal Ophthalmic Society:* Nepalese journal of ophthalmology. *4*(1), pp.10-16.

Thapa R, Ruit S, Poudel MP, Neupane P, Banjara P, Duwal S, Gurung E, Tabin G (2024). Population Prevalence, Pattern and Associated Factors for Retinal Diseases at High Altitude in Nepal. Clinical Ophthalmology. Dec 31:2555-65. PMID: 39257593

Thapa, S.S., Thapa, R., Paudyal, I., Khanal, S., Aujla, J., Paudyal, G. and Rens, G.V (2013). Prevalence and pattern of vitreoretinal diseases in Nepal: the Bhaktapur glaucoma study. *BMC ophthalmology*, *13*, pp.1-8.

Wiedman, M. (1975). High-altitude retinal hemorrhage. *Archives of Ophthalmology*, *93*(6), pp.401-403.

Wiedman, M. and Tabin, G.C. (1999). High-altitude retinopathy and altitude illness. *Ophthalmology*, *106*(10), pp.1924-1927.

Wild, S., Roglic, G., Green, A., Sicree, R. and King, H. (2004). Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. *Diabetes care*, *27*(5), pp.1047-1053. PMID: 15111519