

Population Prevalence, Pattern and Associated Factors for Retinal Diseases at High Altitude in Nepal

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Background: Retinal diseases are common at high altitudes due to a cascade of changes caused by hypoxia. The aim of this study is to assess the population prevalence, pattern and associated factors of retinal disorders at high altitude in Nepal.

Methodology: A cross-sectional study was conducted at three selected high-altitude districts (over 2500 meters) of Nepal. Subjects were at least 40 years old, and the target sample size was 309. A detailed history was taken. Visual acuity, blood sugar, blood pressure, and oxygen saturation were measured. Anterior and posterior ocular evaluations were conducted by retina specialists using slit lamp and indirect ophthalmoscopy.

Results: A total of 338 participants were recruited, with nearly equal numbers from the three districts with mean age of 57.0 (S.D 11.1) years. Two-thirds (63.9%) were females; 38.2% were illiterate, and 46.7% were farmers. Average blood oxygen saturation was 87.2% (S.D 4.1%). Systemic hypertension and diabetes mellitus were found in 58% and 11%, respectively. Retinal diseases were found in 176 (52.5%), with bilateral involvement in 157 (46.9%). The major retinal diseases were hypertensive retinopathy (32.2%), high-altitude retinopathy (10.4%), age-related macular degeneration (AMD) (8.1%), branch vein occlusion (BRVO) (2.1%), and diabetic retinopathy (DR) (1.8%). The multivariate analysis showed significant association of retinal diseases with age and hypertension. Best corrected visual acuity better than 6/18 was present in 96.7%.

Conclusion: Over half of the study participants had retinal diseases, with hypertensive retinopathy, AMD, and high-altitude retinopathy as the most common retinal problems. A significant association of retinal diseases was found with ageing, and hypertension. Access to eye care services and control of systemic hypertension along with patient education should be emphasized among people living at high-altitude.

Keywords: prevalence, pattern, risk factors, high-altitude retinopathy, Nepal

Introduction

Retinal disorders are the leading cause of blindness in Nepal.^{1,2} A study from Nepal reported a prevalence of retinal disorders in one or both eyes among 52% of the study participants age 60 years and above, which increased with ageing.² Retinal problems were found in 56.8% in a study conducted at high altitude in individuals 40 years and above among participants at an eye camp.³

Low level of oxygen and pressure of high altitude (HA) cause various physiological and psychological dysfunctions in the body leading to many systemic disorders. Total cholesterol and triglycerides were found to be elevated at high altitude mainly because of the residential settings and associated lifestyle practices.⁴ This could also be a reason for the high prevalence of retinal disorders at high altitude.⁴

Retinal problems are a major feature of high-altitude sickness (HAS). High-altitude retinopathy (HAR) is characterized by engorgement of retinal veins with occasional papilledema, cotton wool spots, vitreous haemorrhage, and retinal haemorrhages.⁵ The major pathogenic factor underlying HAR is thought to be hypoxia at high altitude, which leads to various changes in the retinal blood vessels.^{5,6}

Several studies and case series have reported retinal and neurological problems after HA exposure.^{7–15} Timely precautions and treatment could save from many HA-related ocular and systemic conditions.¹⁰ In Nepal, 15% of the land is highly mountainous. Almost 7% of the national population live in mountains, and many people live in the hilly districts at altitudes greater than 2500 meters.⁴ Due to difficult geographical terrain, transportation and eye care services are limited. As there are limited population-based studies on retinal problems, this study explores the prevalence, pattern, and associated factors for retinal diseases among populations residing at high altitudes in Nepal. These findings will help intervention programs to reduce blindness in remote regions.

Materials and Methods

Ethical approval was taken from Ethical Review Board of Nepal Health Research Council (NHRC) to conduct the study (Protocol Registration Number 199/2023; Reference number 3058). The study approval of NHRC was taken as per the rule of Government of Nepal. The study was conducted as per the declaration of Helsinki. The study design was a population-based, cross-sectional study conducted at high altitude in three districts of Nepal: the Manang, Mustang, and Solukhumbu districts. These districts were selected based on the availability of eye examination facilities at community eye centers and general hospitals. An altitude of over 2500 meter was taken as demarcation for high altitude where people generally experience adverse symptoms above this altitude.⁴ A list of municipalities and wards of the three study districts was prepared, and one municipality from each district was selected using simple random sampling. Based on the proportion of the population, wards were selected from each municipality. From these districts, the local study sites selected randomly were Chame Rural Municipality from Manang, Lo-Ghekar Damodarkunda Rural municipality from Upper Mustang and Khumbu Pasanglhamu rural municipality from Solukhumbu. In these areas, there are community eye centers with facilities for eye evaluations. Similarly, in Lukla Solukhumbu, there is an eye care facility with available ophthalmic equipment in a general hospital.

Subjects age 40 years and older residing in Chame Rural Municipality from Manang, Lo-Ghekar Damodarkunda Rural municipality from Upper Mustang and Khumbu Pasanglhamu rural municipality from Solukhumbu were enrolled in the study. Assuming retinal problem prevalence (P) 56.8%, 95% confidence and 10% tolerable error, the sample size was 293. With assuming 5% non-response rate, the target sample for the study was 309, with a minimum sample of 103 for each district.

The exclusion criteria were participants whose retinal evaluation was not possible due to various causes such as media opacity or participants who were unable to comply with the history, examination, and investigation protocols of the study.

All study participants were from the geographical areas above 2500 meters. Informed written consent was taken before enrollment in the study. Demographic information, history of alcohol, smoking, systemic history, non-fasting blood sugar levels, height, weight, and blood pressure (BP) were measured using a questionnaire designed and finalized by the study team and experts. Body Mass Index (BMI) was calculated as weight in kilogram divided by height in meter square from the collected weight and height data.

In case of mountain climbers, details of average of height climbed and frequency in a year were recorded. Awareness of major eye diseases like DR, AMD, hypertensive retinopathy, and high-altitude retinal diseases was assessed.

Presenting and best corrected visual acuity was taken using a Snellen's chart. The anterior and posterior segments ocular evaluations were conducted using a slit lamp and an indirect ophthalmoscope both using 90 D lens and 20 D lens after mydriasis. Fundus photographs of each participant were captured using a portable fundus camera (Nidek Versacam DS-20) under mydriasis by a trained ophthalmic technician. Three fellowship trained retina specialists were involved for eye evaluation of all study participants at each site. The discussion was done to ensure accurate diagnosis whenever needed.

Diabetes mellitus was diagnosed if using oral hypoglycaemic agents or use of insulin or a random blood sugar level of 200 mg/dl or greater.^{1,2,16} Hypertension was diagnosed if participant has systolic BP 140 mmHg or more, or if diastolic BP 90 mmHg or more, or if they are using oral antihypertensive medicines.^{1,2} Early Treatment Diabetic Retinopathy

Study (ETDRS) criteria were used to diagnose various grades of diabetic retinopathy (DR) and macular edema.¹⁷ Classification of AMD as early and late AMD, further subdivided as wet and dry types, was based on the International Age-related Maculopathy (ARM) Epidemiological Study Group.¹⁸ Modified Scheie Classification was used to grade hypertensive retinopathy from grade 0 to grade 4.²⁰ Presence of any retinal disease in one eye or both eyes were considered to diagnose retinal disease in person. Oxygen saturation was assessed using pulse oximetry among all the study participants. The World Health Organization (WHO) (WHO) criteria were used for grading of blindness and low vision.^{1,2,19}

Data Analysis

Data collection was done using electronic software (Open Data kit) and transferred to Microsoft Excel for cleaning and coding. Statistical Package for the Social Science (SPSS) V²⁰ was used for statistical analysis. The mean, percentage, tables, and figures were prepared for descriptive analysis. For association of categorical data, Chi square test was used, and if the expected cell count was less than 5, Fisher's exact test was used. For the comparison of numerical data, independent *t* test was used. All the statistically significant variables found during bivariate analysis were used for multiple logistic regression using Enter method to quantify the outcome. Results were considered statistically significant if the *P*-value was less than 0.05. The data collected are stored in password-protected computer, ensuring the confidentiality of patients' data.

Results

Total 338 participants were enrolled from three districts. Among them, 109 (32.3%) were from Manang district, 110 (32.5%) were from Mustang district and 119 (35.2%) were from Solukhumbu district. The mean age of all participants was 57.0 years (S.D 11.1 years), whereas the mean age for Solukhumbu was 58.3 years (S.D 11.5 years), Mustang 58.6 years (S.D 10.0 years), and Manang 54.0 years (SD 11.2 years).

The average oxygen saturation level among participants was 87.2% (S.D 4.1%), range 72% to 96%. The mean highest saturation oxygen level was in the Solukhumbu district (87.9%), while it was the lowest in the Mustang district (85.2%).

Three study participants were excluded from the retinal disease analysis because retinal evaluation was not possible in one eye due to hazy media, and fellow eye was normal. One eye of each three cases had thick posterior capsular opacification with corneal scar, mature cataract, and mature cataract with corneal scar, respectively.

Demographic Characteristics

Among the total study participants, 216 (63.9%) were females. This trend of female predominance was similar in all three districts. Three-fifth of the study participants (60%) were between 40 and 60 years of age. Patients 70+ years comprised 16.6%. A total of 129 participants (38.2%) were illiterate, which was highest in Solukhumbu (58%). A total of 158 (46.7%) were farmers, followed by business people 69 (20.4%). By religion, the majority 296 (87.6%) were Buddhists (Table 1).

Prevalence of Retinal Diseases, Systemic Hypertension, and Diabetes Mellitus in Three Study Sites

Among the study participants, retinal diseases were present in 176 (52.5%). The highest prevalence of retinal diseases was found in Mustang district 72 (66.1%), followed by Solukhumbu district 63 (53.8%) and Manang district 41 (37.6%). Bilateral involvement of retinal diseases was found in 157 (46.9%) and unilateral involvement in 19 (5.7%).

Among the total study participants, systemic hypertension was found in 58.0%, out of which over one-fifth of total (28.1%) were newly diagnosed during the study. The highest proportions were found in Solukhumbu and lowest in Mustang.

A total of 37 (11.0%) of study participants were diagnosed with diabetes mellitus. Among these, 9 (2.7%) were newly diagnosed during the study. The mean blood sugar level was 100.2 mg/dl (S.D 30.8) (Table 2).

Table 1 Demographic Characteristics of Study Population

Description		Manang	Mustang	Solukhumbu	Total
		n(%)	n(%)	n(%)	n(%)
Gender	Male	40(36.7)	44(40)	38(31.9)	122(36.1)
	Female	69(63.3)	66(60)	81(68.1)	216(63.9)
Age Group (Years)	40–49	42(38.5)	23(20.9)	28(23.5)	93(27.5)
	50–59	36(33.0)	34(30.9)	40(33.6)	110(32.5)
	60–69	17(15.6)	34(30.9)	28(23.5)	79(23.4)
	70–79	10(9.2)	18(16.4)	16(13.4)	44(13.0)
	80–89	4(3.7)	1(0.9)	7(5.9)	12(3.6)
Education	Illiterate	27(24.8)	33(30.0)	69(58.0)	129(38.2)
	Informal Education	37(33.9)	57(51.8)	18(15.1)	112(33.1)
	Literate	45(41.3)	20(18.2)	32(26.9)	97(28.7)
Occupation	Agriculture	31(28.4)	81(31)	46(38.7)	158(46.7)
	Housewife/Household work	24(22.0)	19(24)	18(15.1)	61(18.0)
	Business	33(30.3)	2(33)	34(28.6)	69(20.4)
	Service	19(17.4)	7(19)	16(13.4)	42(12.4)
	Labor	2(1.8)	1(2)	3(2.5)	6(1.8)
	Others specify	0(0.0)	0(0)	2(1.7)	2(0.6)
Religion	Hinduism	25(22.9)	1(25)	8(6.7)	34(10.1)
	Buddhism	81(74.3)	109(81)	106(89.1)	296(87.6)
	Christianity	3(2.8)	0(3)	3(2.5)	6(1.8)
	Kirat	0	0(0)	2(1.7)	2(0.6)
	Total	109(100)	110(109)	119(100)	338(100)

Abbreviation: n=number.

Pattern of Retinal Diseases

Among the various retinal diseases, hypertensive retinopathy was highest at 32.2%, followed by high altitude retinopathy at 10.7%, AMD at 8.1% and retinal vein occlusion at (2.1%) (Table 3).

Classification of Hypertensive Retinopathy, Diabetic Retinopathy, and AMD

Among the cases of hypertensive retinopathy, four-fifth eyes (81.9%) were having grade one and 2.8% were having grade three hypertensive retinopathy. Nearly one-third of eyes had mild non-proliferative diabetic retinopathy (NPDR), and proliferative DR with macular edema comprised one-tenth of the eyes. Wet AMD comprised 8.7% of eyes, and geographic atrophy was found in 2.4%. Majority were having mild and intermediate dry AMD (97.5%) among the eyes having dry AMD (Table 4).

Factors Associated with Retinal Diseases Among the Study Participants (Univariate Analysis)

Among the various factors in univariate analysis, there was significant association of retinal diseases with increase in ageing ($p<0.001$), smoking use ($p=0.047$), alcohol consumption ($p<0.001$), presence of systemic hypertension

Table 2 Prevalence of Retinal Diseases, Hypertension and Diabetes Mellitus Among Study Population at Three Study Sites

Variables	Manang	Mustang	Solukhumbu	Total
	n(%)	n(%)	n(%)	n(%)
Retinal diseases (Person)				
Present	41(37.6)	72(66.1)	63(53.8)	176(52.5)
Unilateral	8(19.5)	2(2.8)	9(14.2)	19(10.8)
Bilateral	33(80.5)	70(97.2)	54(85.8)	157(89.2)
Hypertension (HTN)				
Known HTN	40(36.7)	18(16.4)	43(36.1)	101(29.9)
New HTN	20(18.3)	32(29.1)	43(36.1)	95(28.1)
No HTN	49(45.0)	60(54.5)	33(27.7)	142(42.0)
Total	109(100)	110(100)	119(100)	338(100)
Diabetes mellitus (DM)				
Known DM	10(9.2)	7(6.4)	11(9.2)	28(8.3)
New DM	0	0	9(7.6)	9(2.7)
No DM	99(90.8)	103(93.6)	99(83.2)	301(89.1)
Total	109(100)	110(100)	119(100)	338(100)
Blood sugar level				
Mean (SD), [95% CI]	97.7(25.4), [93.2 to 102.7]	95.21(20.0), [91.5 to 99.1]	107.24(41.3), [100.6 to 114.4]	100.2(30.8), [97.1 to 103.2]

Abbreviations: HTN: Hypertension, DM: Diabetic Mellitus, SD: Standard Deviation, CI: Confidence Interval, n=Number.

Table 3 Pattern of Various Retinal Diseases Among the Study Population

Disease	Yes, n(%) (Person, n=335)	Yes, n(%) (Eyes, n=671)
HTN Retinopathy	108 (32.2)	216 (32.2)
High Altitude Retinopathy	36 (10.7)	72 (10.7)
Age Related Macular Degeneration	27 (8.1)	46 (6.9)
Diabetic Retinopathy	6 (1.8)	10 (1.5)
Branch retinal vein occlusion	7 (2.1)	7 (1.0)
Retinal Tear	3 (0.9)	3 (0.4)
Foveal Atrophy	3 (0.9)	2 (0.3)
Central serous retinopathy	2 (0.6)	3 (0.4)
Lattice Degeneration	2 (0.6)	2 (0.3)
Macular dystrophy	2 (0.6)	4 (0.6)
Macular Scar	2 (0.6)	2 (0.3)
Retinitis Pigmentosa	2 (0.6)	4 (0.6)

(Continued)

Table 3 (Continued).

Disease	Yes, n(%) (Person, n=335)	Yes, n(%) (Eyes, n=671)
Chorioretinal Scarring	1 (0.3)	2 (0.3)
Epiretinal membrane	1 (0.3)	2 (0.3)
Lamellar Macular Hole	1 (0.3)	2 (0.3)
Macular Hole	1 (0.3)	2 (0.3)
Optic Atrophy with Macular Scar	1 (0.3)	2 (0.3)
Post Traumatic Macular scar	1 (0.3)	1 (0.1)

Abbreviations: n=Number, HTN: Hypertension, DM: Diabetic Mellitus, RPE=Retinal pigment epithelium.

Table 4 Classification of Hypertensive Retinopathy, Diabetic Retinopathy, and AMD (Eyes)

Hypertensive Retinopathy classification	n (%) (Eyes)
Grade 1	177 (81.9)
Grade 2	33 (15.3)
Grade 3	6 (2.8)
Total	216 (100)
Diabetic Retinopathy classification	
Mild Non proliferative Diabetic Retinopathy	7 (70.0)
Moderate Non proliferative Diabetic Retinopathy	1 (10.0)
Severe Non proliferative Diabetic Retinopathy	1 (10.0)
Proliferative Diabetic Retinopathy with DME	1 (10.0)
Total	10 (100)
AMD classification	
Dry	42 (91.3)
Wet	4 (8.7)
Total	46 (100)
DRY Age Related Macular Degeneration Type	
Advanced	1 (2.4)
Intermediate	6 (14.2)
Mild	35 (83.3)
Total	42 (100)

Abbreviation: AMD=Age related macular degeneration, n=number.

($p < 0.001$), and low partial pressure of oxygen ($p = 0.004$). However, there was no significant association with education, gender, religion, diabetes mellitus, visual acuity, or with a history of trekking or blood sugar levels (Table 5).

Multiple logistic regressions were carried out to quantify the retinal diseases with statistically significant variables. Age group and hypertension were found to be statistically significant variables in multiple logistic regressions. Age 60 years and above had a 2.19-fold increase in risk of having retinal diseases as compared to those less than 60 years of age. Patients having a known history of hypertension had 5.4-fold increased risk, and new hypertension had 1.8-fold increased risk of retinal disease (Table 6).

Table 5 Factors Associated with Retinal Diseases Among the Study Participants (Univariate Analysis)

Variable	Category	Retinal Disease		P-value
		No, n(%)	Yes, n(%)	
Age Group (Years)	<60	117(57.6)	86(42.4)	<0.001
	60 and Above	42(31.8)	90(68.2)	
	Total	159(47.5)	176(52.5)	
Gender	Male	49(40.5)	72(59.5)	0.055
	Female	110(51.4)	104(48.6)	
Education	Illiterate	53(42.1)	73(57.9)	0.084
	Informal Education	51(45.5)	61(54.5)	
	Literate	55(56.7)	42(43.3)	
Religion	Buddhism	142(48.5)	151(51.5)	0.332
	Others (Hindu, Kirat)	17(40.5)	25(59.5)	
Smoking History	Non-smoker	123(51.5)	116(48.5)	0.047
	Present smoker	14(43.6)	18(56.4)	
	Past smoker	22(34.4)	42(65.6)	
Alcohol consumption	Yes	68(38.9)	107(61.1)	<0.001
	No	91(56.9)	69(43.1)	
Systemic hypertension	Known HTN	26(26.0)	74(74.0)	<0.001
	New HTN	45(47.9)	49(52.1)	
	No HTN	88(62.4)	53(37.6)	
Diabetes mellitus	Known DM	10(35.7)	18(64.3)	0.383
	New DM	5(55.6)	4(44.4)	
	No DM	144(48.3)	154(51.7)	
Best Corrected Visual acuity (Better eye)	6/6 to 6/18	156(48.1)	168(51.9)	0.293
	<6/18 to 6/60	3 (37.5)	5 (62.5)	
	<6/60 to 3/60	0 (0)	3 (100)	
PaO ₂ : (in %) (Minimum value)	<90	97 (42.2)	133 (57.8)	0.004
	90 and above	62 (59)	43 (41)	

(Continued)

Table 5 (Continued).

Variable	Category	Retinal Disease		P-value
		No, n(%)	Yes, n(%)	
Trekking	Yes	51 (53.7)	44 (46.3)	0.151
	No	108 (45)	132 (55)	
Body Mass Index	Underweight (Less than 18.5)	9 (52.9)	8 (47.1)	0.424
	Healthy (18.5–24.9)	71 (44.4)	89 (55.6)	
	Overweight (25.0–29.9)	54 (47)	61 (53)	
	Obesity (30 and above)	25 (58.1)	18 (41.9)	
Blood sugar level	Mean(SD)	100.3 (34.2)	100.3 (27.7)	0.997

Abbreviations: HTN: Hypertension, DM: Diabetic Mellitus, PaO₂: Partial Pressure of Oxygen in Arterial Blood, SD=Standard Deviation.

Table 6 Factors Associated with Retinal Diseases in Multivariate Analysis

Variable	P-value	OR	95% C.I	
			Lower	Upper
Age Group (>60 compared with <60 years)	0.003	2.19	1.300	3.750
Occupation: (Others)	Reference			
Occupation: Agriculture	0.284	1.36	0.770	2.400
Occupation: Business	0.636	0.840	0.420	1.710
Smoking History (Past smoker)	Reference			
Smoking History(Non-smoker)	0.320	0.720	0.370	1.380
Smoking History(Present smoker)	0.905	1.060	0.410	2.750
Alcohol consumption(Yes compared with No)	0.447	1.220	0.730	2.070
HTN (No)	Reference			
HTN(Known)	0.000	5.390	2.900	10.020
HTN(New)	0.036	1.850	1.400	3.300
Minimum PaO ₂ : (<90 compared with 90 and above)	0.113	1.540	0.900	2.640
Constant	0.011	0.322		

Abbreviations: HTN: Hypertension, PaO₂: Partial Pressure of Oxygen in Arterial Blood.

Visual Status Among the Study Participants

A presenting visual acuity and best corrected visual acuity of 6/6 to 6/18 in the better eye among the study participants were found in 89.1% and 96.7%, respectively. The visual acuity status was almost similar in all three districts. As per the WHO criteria, none of the cases were blind and 3.9% had low vision.

Discussion

Posterior segment problems are an important cause of visual impairment in Nepal.^{1,2,19} High altitude retinopathy is specific to people residing in high altitude regions or climbing high mountains.^{3,6–9}

Over half (52.5%) of study participants were diagnosed with retinal disease. The highest prevalence was in Mustang (66.1%), then Solukhumbu (53.8%), then Manang (37.6%). About 47% of participants had bilateral retinal disease and 5.7% had unilateral disease. Retinal diseases in this study were consistent with other high altitude studies of retinal disease in Nepal, despite the fact that this study was not conducted on a population presenting to an eye camp, which would be expected to contain a greater proportion of individuals with retinal pathology. This emphasizes the need for regular eye check-ups in these geographically remote areas. The Mustang site was the highest altitude site and also had the highest prevalence of retinal disease (66%). An increase in altitude could be the possible cause for high prevalence of retinal diseases.⁶

The retinal disease prevalence was quite higher as compared to the population-based study conducted in low land population in the same age group.^{1,2}

There were more participants diagnosed with hypertension (58%) in our study compared to the prior high-altitude study in Nepal (28%).³ This could be due to uncontrolled blood pressure and longer duration of hypertension at high altitude. This could be the reason for more hypertensive retinopathy cases in our study.

High altitude retinopathy was found in 10.4% of study participants in our series, but all participants were found to have dilated and tortuous vessels. In a previous study, dilated and tortuous vessels were found in 25.9% of study participants, due to hypoxia. In our series, the average SpO₂ among study participants was 87.2% (S.D 4.1%), with a range of 72% to 96%. About 68.8% of patients had a SpO₂ less than 90%. The low SpO₂ in the majority of the study participants could be the reason for the high number of cases of high altitude retinopathy. Dilated and tortuous vessels have been reported as high altitude retinopathy in other studies.^{3,12}

Among the hypertensive retinopathy, grade one hypertensive retinopathy was found in highest number, consistent with other studies.²¹ The predominant dry mild AMD and NPDR were also consistent with other studies from low land and previous study conducted at high altitude.^{2,3}

In our study, age and systemic hypertension were significantly associated with retinal disease. This is consistent with other studies of retinal disease, including those conducted at both high altitude and low land populations.^{1-3,22,23}

The best-corrected visual acuity of the vast majority of patients was very good despite the high prevalence of retinal diseases at high-altitude. Not a single participant met the WHO criteria for blindness. This suggests that refractive error services like provision of spectacles could adequately address most cases of decreased vision in this population to improve the quality of life. Regular check-ups, especially for older individuals and those with diagnosis of hypertension and diabetes, are important.^{2,22}

The limitation of our study is that, although the study population was all enrolled from sites over 2500 meters, all three sites were not at the exact same elevation. This could affect the prevalence of retinal diseases in three different districts.

Conclusion

Over half of the study participants had some form of retinal diseases. Hypertensive retinopathy was the most common disorder followed by AMD, then high altitude retinopathy. Retinal diseases were significantly associated with age and systemic hypertension. The findings emphasize the need for enhanced access to eye care services, good control of hypertension and education on major blinding retinal diseases at high altitude in Nepal.

Abbreviations

HA High Altitude; HAS, High-Altitude Sickness; HAR, High-Altitude Retinopathy; DR, Diabetic Retinopathy; ETDRS, Early Treatment Diabetic Retinopathy Study; AMD, Age-Related Macular Degeneration; DM, Diabetes Mellitus; RVO, Retinal Vein Occlusion; BRVO, Branch Retinal Vein Occlusion.

Data Sharing Statement

Data related to the study are all provided in the manuscript. The corresponding author will be responsible for sharing further details as needed.

Ethics Approval and Informed Consent

Study was conducted after the approval of the study by the Ethical Review Board of Nepal Health Research Council (NHRC) (Registration Number 199/2023; Reference number 3058). The study approval of NHRC was taken as per the rule of Government of Nepal. The study was conducted as per the declaration of Helsinki.

Written informed consent was obtained from the study participants after detailed information about the study before enrollment.

Consent for Publication

There is consent for publication from all the investigators.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that none of them had any competing interests in the study.

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