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

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# Conflict of Interest

No conflict of Interest

# Outline of Presentation

- Background and objectives

- Methods

- Result

- Conclusion

- Acknowledgement

- References

# Background

- Retinal disorders are the second most common cause of visual impairment and blindness in Nepal [1,2]

- Prevalence of retinal disorders in Nepal: 52% ≥ age 60 years [2]

- Prevalence of retinal disorders at high altitude: 56.2% ≥ age 40 years at eye camp.[3]

# Background (contd.)

- High altitude (HA) related health problems: hypoxic and hypobaric conditions, associated lifestyle practices.[4,6-16]

- Retinal problems: high-altitude sickness (HAS), first described in 1969 [5]

- Avoidable ocular and systemic conditions: Awareness, timely precautions and treatment.[14]

# Background (contd.)

- Mountain: 15% of the land, 7% of the population, Nepal.

- Many hilly districts: altitude greater than 2500 meters [4]

- Difficult geographical terrain: limited access to transportation and primary eye care services

- Limited information on retinal disorders: high-altitude populations.

# Background..

- Study aimed to explores the population prevalence, pattern and associated factors for retinal disorders at high altitude in Nepal.

- Findings helpful in intervention programs: reduce blindness in remote regions.

# Objectives

**General Objective**

- To find the population prevalence, pattern and associated factors of retinal diseases at high altitudes of Nepal

# Objectives

**Specific Objectives**

•  To find the prevalence of retinal diseases at high

altitudes

• To find out the pattern of retinal diseases at high altitude

• To assess factors associated with retinal diseases at

high altitude

# Methodology

- Study design: population based, cross sectional study, **Duration:** May 2023 to Aug 2023.

- Study sites: Manang, Mustanng, Solukhumbu districts

- HA: usual residence at an altitude of over 2500 meter.[4]

- Existing primary eye care service: for detailed retinal evaluations.

# Methodology..

**Sample size:**

- Retinal problem prevalence (P) 56.8%, 95% confidence and 10% tolerable error, the minimum sample size for the study: 293.

- With 5% non-response rate: sample size (309)

# Methodology..

**Sampling Techniques**

- A list of municipalities and wards of the three study districts.

- Selection of one municipality from each district: using simple random sampling.

- Ward selection: random sampling based on the proportion of the population

# Methodology..

**Study sites (wards):**

- Chame Rural Municipality (Manang)

- Lo-Ghekar Damodarkunda Rural municipality (Upper Mustang)

- [Khumbu Pasanglhamu](#) rural municipality (Solukhumbu).

# Methodology..

**Inclusion Criteria:**

Subjects age 40 years and older residing in study sites

**Exclusion criteria:**

- Retinal evaluation was not possible: hazy media

- Unable to respond the history, examination, and investigation protocol

# Methodology (contd.)

**Consent:** Written informed consent

**Detailed history:** demographics, ocular, systemic disorder

**Examination of eye:** presenting and best corrected visual acuity (Snellen chart)

**Anterior segment evaluation:** slit lamp

**Fundus evaluation (mydriasis):** Indirect ophthalmoscopy (90 Diopter and 20 Diopter lens)

# Methodology (contd.)

- Retina evaluation: fellowship trained retina specialists

- Diabetic retinopathy (DR) and macular edema: Early Treatment Diabetic Retinopathy Study criteria.[18]

- AMD: International Age-related Maculopathy Epidemiological Study Group.[19]

- Hypertensive retinopathy: Modified Scheie Classification.[20]

# Methodology (contd.)

**Fundus photographs:** portable fundus camera (Nidek Versacam DS-20) under mydriasis

**General examination:**

- Blood pressure

- Height and weight

**Investigation:**

- Pulse oxymetry (Ross-Max)

- Blood sugar: random (venous blood)

# Methodology (contd.)

- Diagnostic criteria for diabetes mellitus: use of diabetic medications or a random blood sugar level of 200 mg/dl or greater.[1,2,17]

- Diagnostic criteria for hypertension: systolic BP ≥ 140 mmHg diastolic BP ≥ 90 mmHg, or antihypertensive medications.[1,2]

# Methodology..

**Ethical approval:**

- Ethical Review Board, Nepal Health Research Council (NHRC)

- Protocol Registration number: 199/2023

-  Reference number: 3058

# Methodology (contd.)

**Data analysis**

- Data collected: electronic software (Open Data kit) and transferred to MS Excel for cleaning and coding.

- Data analysis: Statistical Package for the Social Science (SPSS) V 20.

- Descriptive results: mean, percentage, tables, and figures, were prepared.

# Methodology (contd..)

**Data analysis**

- Categorical data: Chi Square or Fisher Exact tests
- For numerical data: Independent t test/Mann Whitney U test
- Statistically significant variables: multiple logistic regression to quantify the outcome.
- 95% Confidence interval (CI) of average oxygen level was also calculated.
- A *P*-value <0.05: statistical significant.

# Photographs

# Photographs
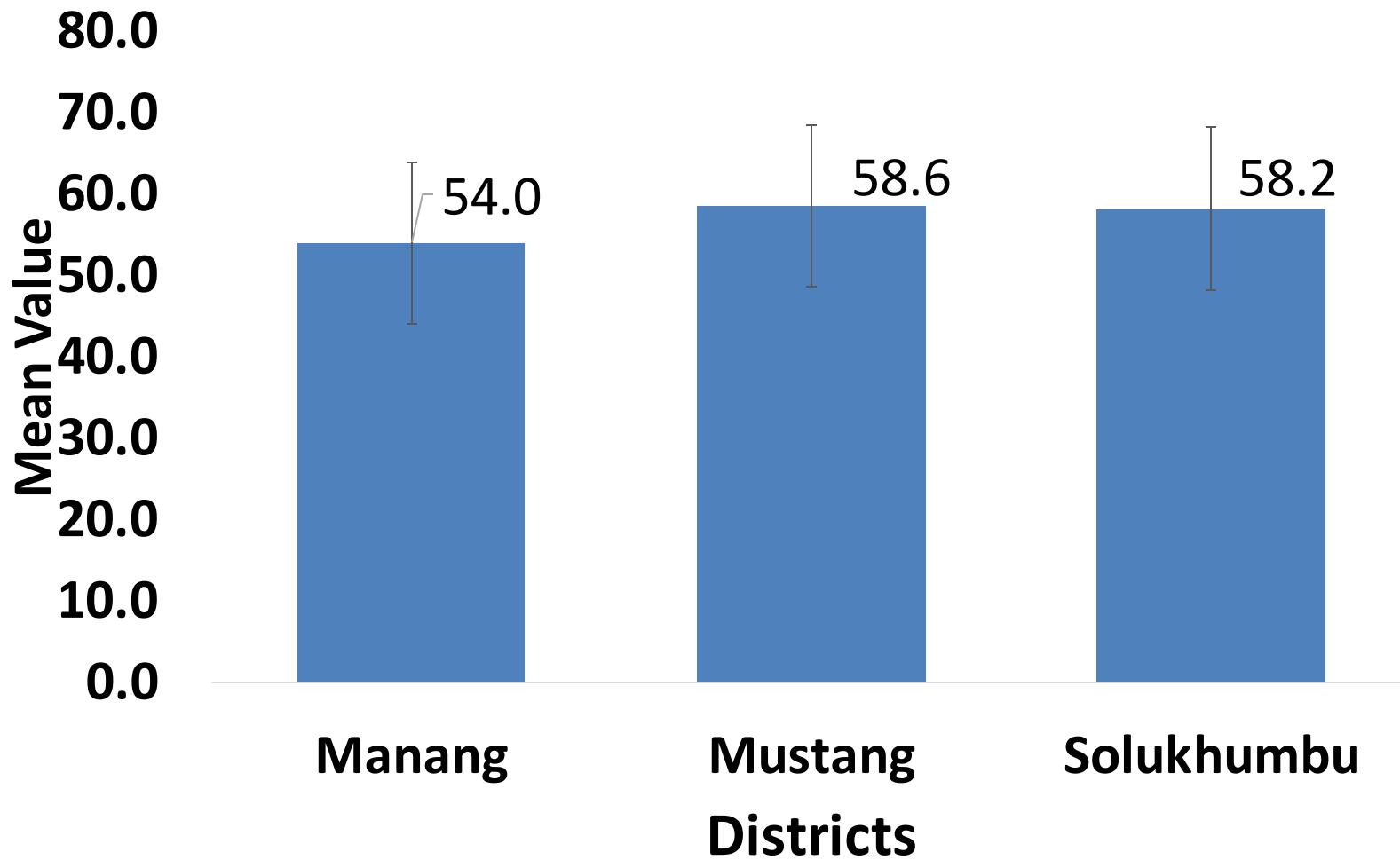
# Photographs
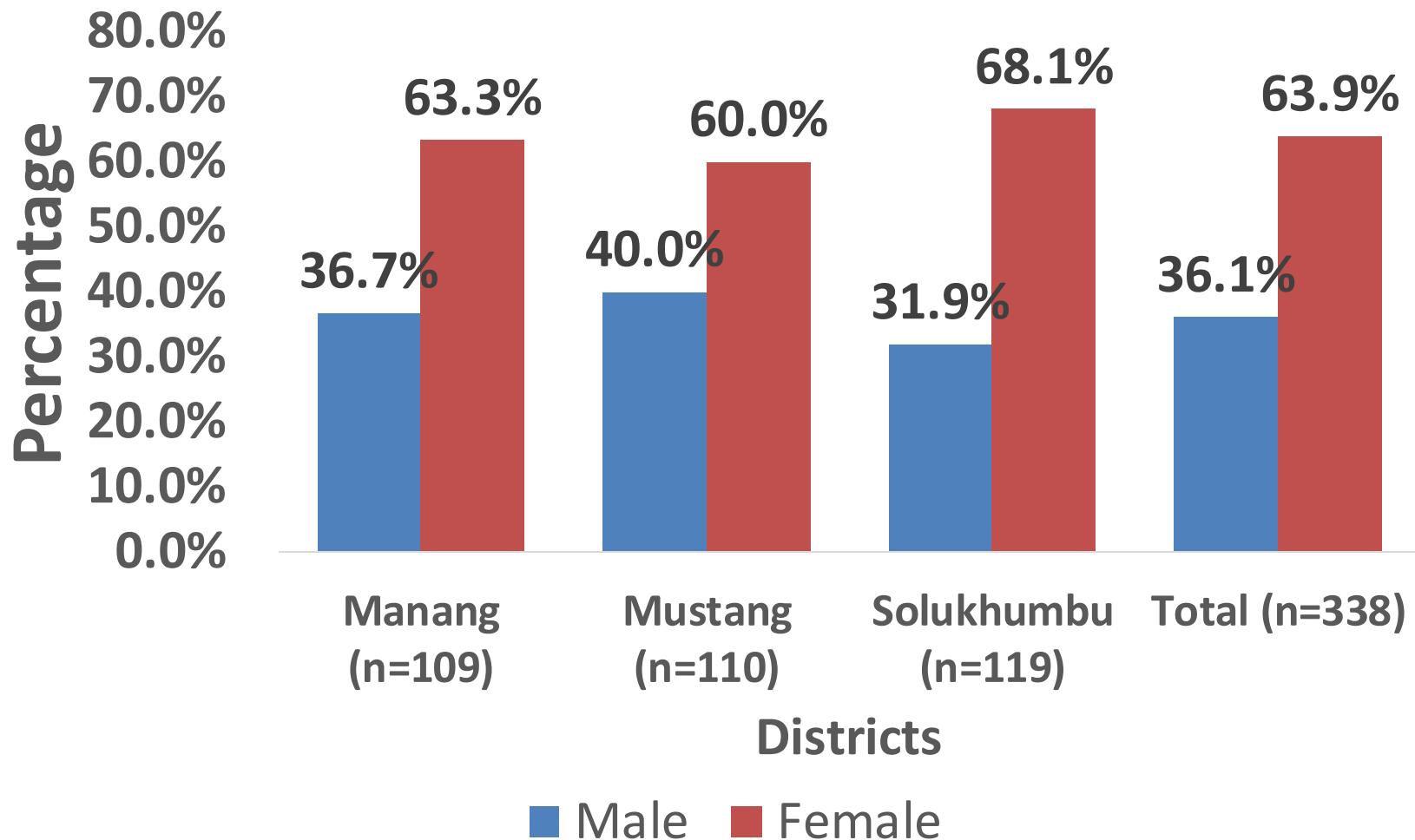
# Results

- Total study participants: 338

- Manang: 109 (32.3%)

- Mustang: 110 (32.5%)

- Solukhumbu: 119 (35.2%)

- Mean age of participants:  57.0 years&S.D.11.1 years
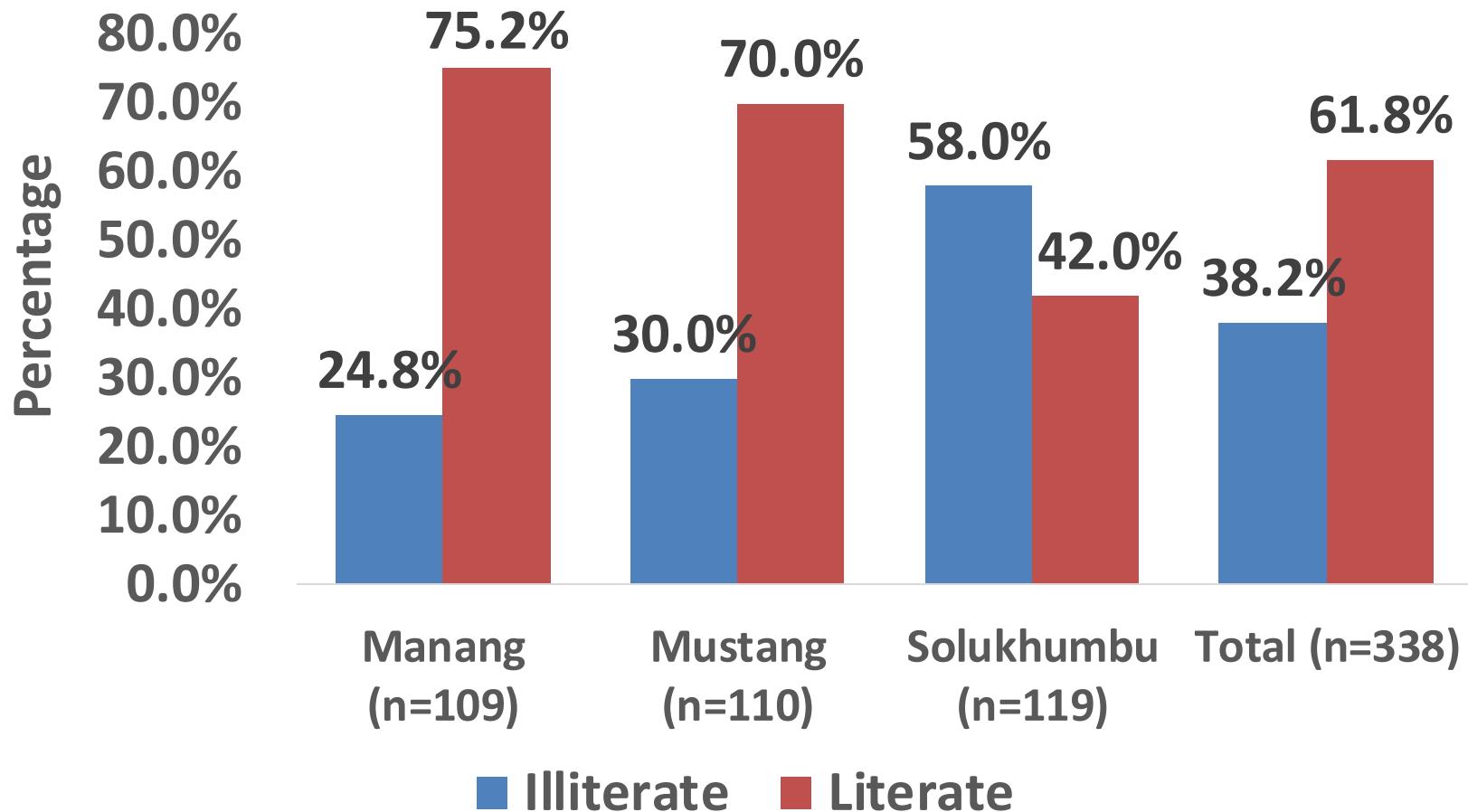
**Result:** Age (SD) Distribution

# Result: Gender Distribution

# **Results:** Literacy Status



Chart showing literacy status percentages by region. Y-axis: Percentage (0.0% to 80.0%). Legend: Illiterate (blue), Literate (red).

- Manang (n=109): Illiterate 24.8%, Literate 75.2%
- Mustang (n=110): Illiterate 30.0%, Literate 70.0%
- Solukhumbu (n=119): Illiterate 58.0%, Literate 42.0%
- Total (n=338): Illiterate 38.2%, Literate 61.8%

# Results: Demographic characteristics

| Category | Manang, n(%) | Mustang, n(%) | Solukhumbu, n(%) | Total, n(%) |
|---|---|---|---|---|
| **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) |
| Others | 2(1.8) | 1(2) | 5(4.2) | 8(2.4) |
| **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) |
| Others | 3(2.8) | 0 (0) | 5(4.2) | 8(2.4) |
| Total | 109(100) | 110(109) | 119(100) | 338(100) |

# Result: PaO2(%) (Minimum value) in study sites

| Districts | Mean (SD) | 95% CI |
|-----------|-----------|--------|
| *Manang* | 88.56 (4.22) | 87.76 - 89.36 |
| *Mustang* | 85.25 (3.66) | 84.55 - 85.94 |
| *Solukhumbu* | 87.87 (3.73) | 87.2 - 88.55 |
| *Total* | 87.24 (4.11) | 86.8 - 87.68 |

# Results: Visual Acuity Status

- Presenting visual acuity (better eye): 6/6 to 6/18 : **89.1%**

- Best corrected visual acuity (better eye):   6/6 to 6/18: **96.7%**

- BCVA : **3.9%** had low vision, blindness: **no**

- Presenting VA: **4.2%** low vision; Blind: **0.9%**
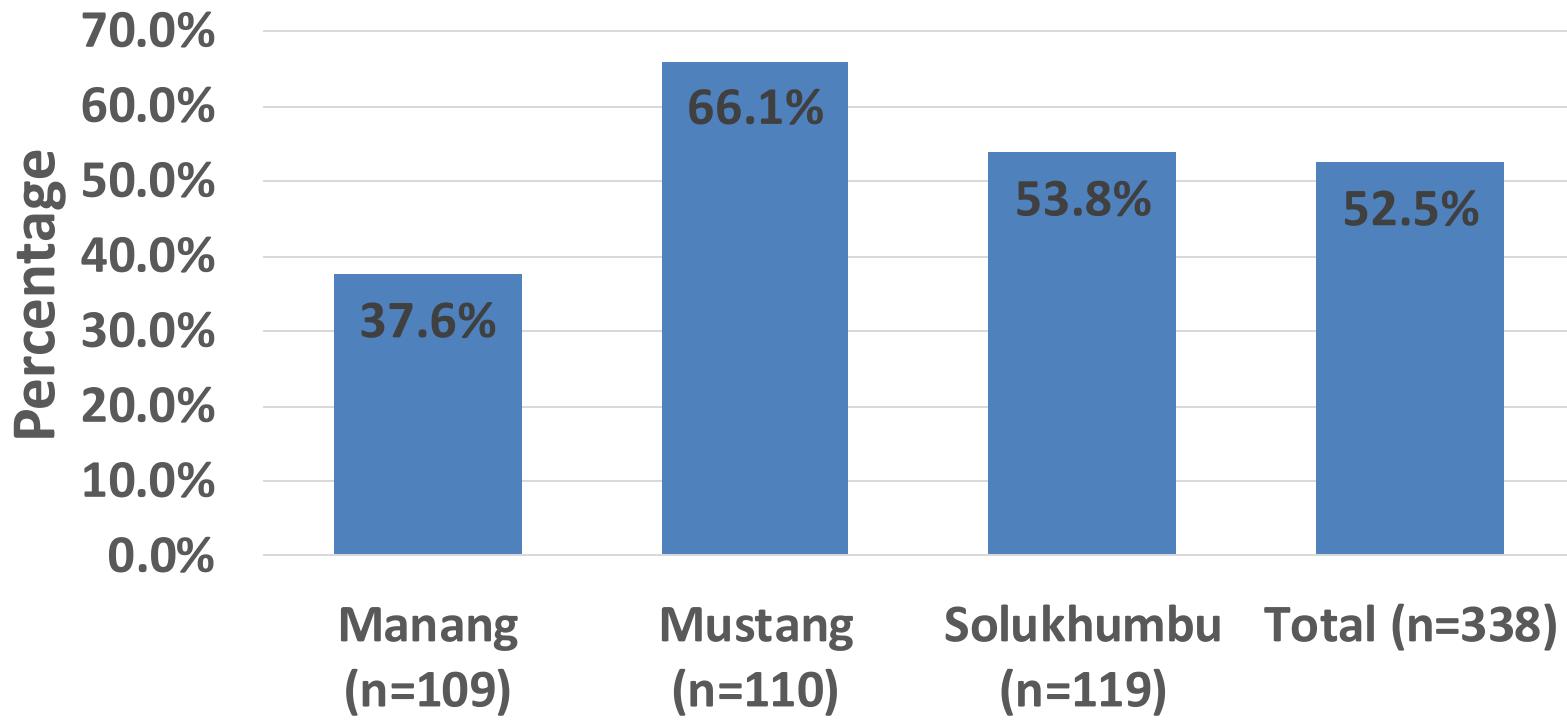
# Result: Prevalence of systemic hypertension (HTN)

| HTN | Manang | Mustang | Solukhumbu | Total |
|---|---|---|---|---|
| | n(%) | n(%) | n(%) | n(%) |
| Known | 40(36.7) | 18(16.4) | 43(36.1) | 101(29.9) |
| New | 20(18.3) | 32(29.1) | 43(36.1) | 95(28.1) |
| No | 49(45.0) | 60(54.5) | 33(27.7) | 142(42.0) |
| Total | 109(100) | 110(100) | 119(100) | 338(100) |

# Result: Prevalence of systemic diabetes mellitus (DM)

| DM | Manang n(%) | Mustang n(%) | Solukhumbu n(%) | Total n(%) |
|---|---|---|---|---|
| Known | 10(9.2) | 7(6.4) | 11(9.2) | 28(8.3) |
| New | 0 | 0 | 9(7.6) | 9(2.7) |
| No | 99(90.8) | 103(93.6) | 99(83.2) | 301(89.1) |
| Total | 109(100) | 110(100) | 119(100) | 338(100) |

# Results: Prevalence of retinal disease
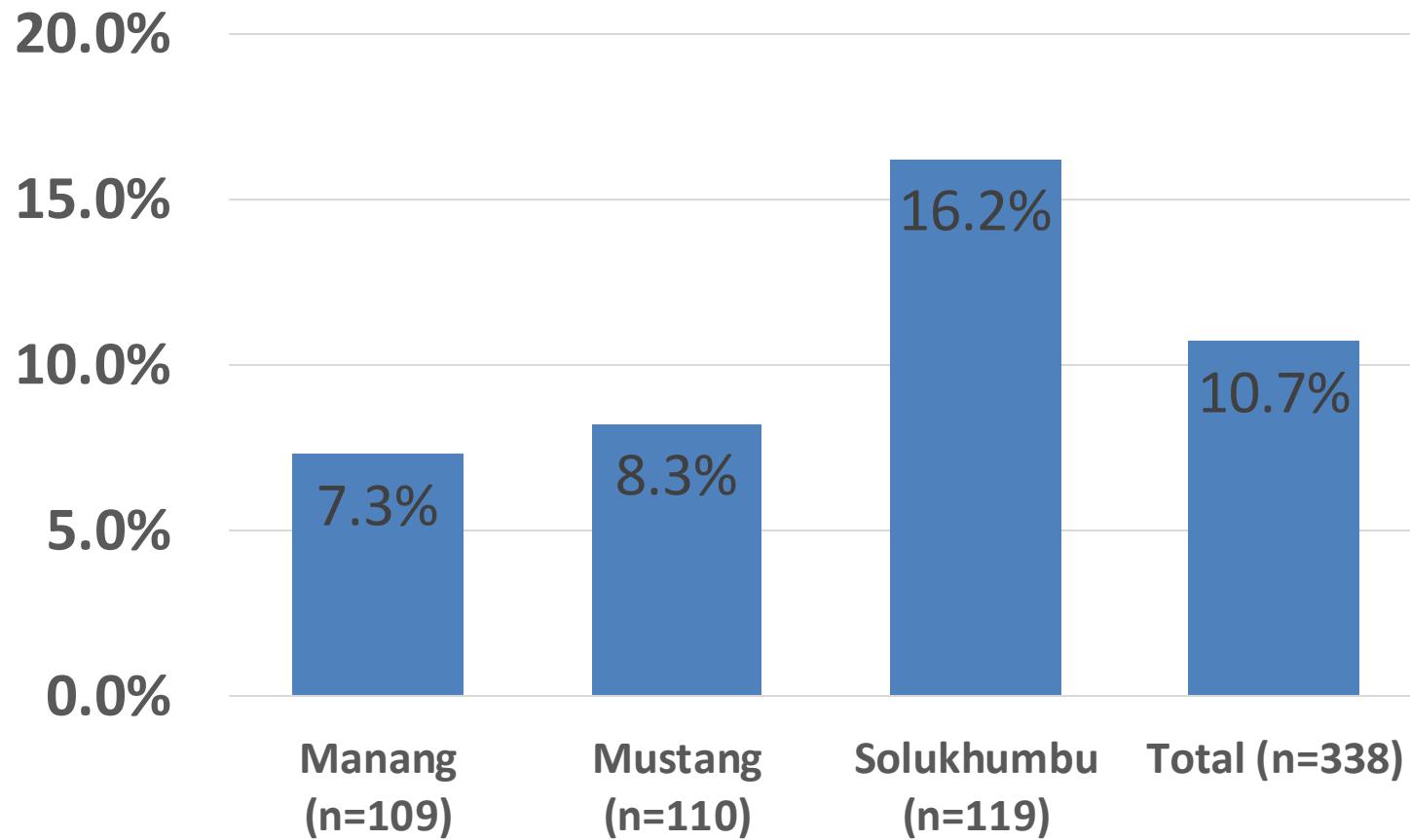
# Result: Laterality of retinal disease

| Description | | Manang | Mustang | Solukhumbu | Total |
|---|---|---|---|---|---|
| | | n(%) | n(%) | n(%) | n (%) |
| Retinal diseases (Person) | Yes | 41(37.6) | 72(66.1) | 63(53.8) | 176(52.5) |
| Laterality | Unilateral | 8(7.3) | 2(1.8) | 9(7.7) | 19(5.7) |
| | Bilateral | 33(30.3) | 70(64.2) | 54(46.2) | 157(46.9) |
| | Total | 109(100) | 109(100) | 117(100) | 335(100) |
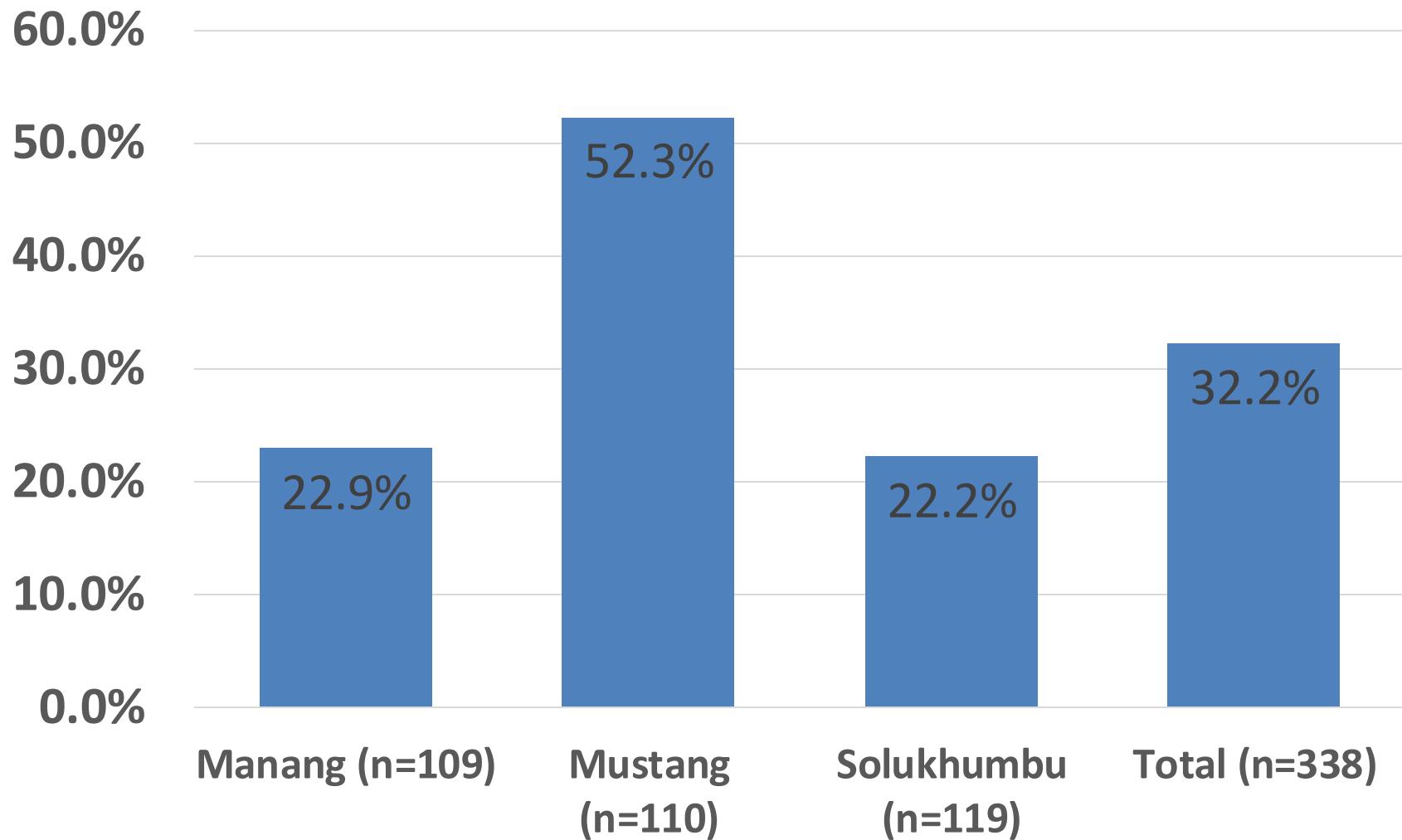
# Result: Pattern of retinal diseases

| | | Manang | Mustang | Solukhumbu | Total |
|---|---|---|---|---|---|
| Hypertensive Retinopathy | Yes | 25(22.9) | 57(52.3) | 26(22.2) | 108(32.2) |
| High Altitude Retinopathy( Person) | Yes | 8(7.3) | 9(8.3) | 19(16.2) | 36(10.7) |
| AMD(Person) | Yes | 6(5.5) | 4(3.7) | 17(14.5) | 27(8.1) |
| Diabetic Retinopathy (Person) | Yes | 5(4.6) | 0 | 1(0.9) | 6(1.8) |
| Others Retinal Disease (Person) | Yes | 10(9.2) | 9(8.3) | 10(8.5) | 29(8.7) |

# Results: Prevalence of HAR

# Results: Prevalence of HTN Retinopathy

# Result: Pattern of retinal disease (others) (n=19)

| Retinal Disease (Bilateral) | n (%) |
|---|---|
| Optic Atrophy with Macular Scar | 1 (0.3%) |
| HTN Retinopathy, Lamellar Macular Hole | 1 (0.3%) |
| Lattice Degeneration | 1 (0.3%) |
| Central serous retinopathy | 1 (0.3%) |
| Congenital retinal disorders (macular dystrophy) | 2 (0.6%) |
| Retinitis Pigmentosa | 2 (0.6%) |
| Chorioretinal Scarring | 1 (0.3%) |
| Epiretinal membrane | 1 (0.3%) |

# Result: Pattern of retinal disease (Others)

| Retinal Disease (Unilateral) | n (%) |
|---|---|
| Central serous retinopathy | 1 (0.3%) |
| HTN Retinopathy, foveal Atrophy | 2 (0.6%) |
| Retinal Tear | 3 (0.9%) |
| HTN Retinopathy, Moderate NPDR, Macular Scar | 1 (0.3%) |
| Post Traumatic Maculopathy | 1 (0.3%) |
| Branch retinal vein occlusion | 5 (1.5%) |
| Macular Scar | 1 (0.3%) |

# Result: Pattern of retinal disease (others)

| Retinal Disease (Unilateral) | n (%) |
|---|---|
| Macular Scar | 1 (0.3%) |
| HTN Retinopathy, Macular Hole | 1 (0.3%) |
| RPE Atrophy | 1 (0.3%) |
| HTN Retinopathy, Lattice Degeneration | 1 (0.3%) |
| HTN Retinopathy, Intermediate Dry AMD, Old branch retinal vein occlusion | 1 (0.3%) |
| HTN Retinopathy, Dry Mild AMD, Old branch retinal vein occlusion | 1 (0.3%) |

# Results: Pattern of other ocular morbidities (anterior segment)

No ocular problems: 76 (11.2%)

Anterior Segment eye diseases:

• Pingecula: 420 eye (62.1%)

• Cataract: 197 (29.1%)

• Refractive error: 175 (25.9%),

• Pterygium:  63(9.3%),

• Pseudophakia with capsular opacification: 57 (8.4%)

# Result: Factors with Retinal Diseases (bivariate)

| Variable | Category | Total |
|----------|----------|:-----:|
| *Age Group* | *<60, 60 and Above* | <0.001 |
| *Gender* | *Male, Female* | 0.055 |
| *Religion* | *Buddhism, Others (Hindu, Kirat)* | 0.332 |

# Result: Factors with Retinal Diseases (bivariate)

| Variable | Category | Total |
|---|---|---|
| *Education* | *Illiterate, Informal Education, Literate* | 0.084 |
| *Smoking History* | *Non-smoker, Present smoker, Past smoker* | 0.047 |
| *Alcohol consumption* | *Yes, No* | <0.001 |

# Result: Factors with Retinal Diseases (bivariate)

| Variable | Category | Total |
|---|---|---|
| *Systemic hypertension* | *Known HTN, New HTN, No HTN* | <0.001 |
| *Diabetes mellitus* | *Known DM, New DM, No DM* | 0.383 |
| *Best Corrected Visual Acuity Category* | *6/6 to 6/18, <6/18 to 6/60, <6/60 to 3/60* | 0.293 |
| *PaO2:(in%) (Lowest value) category* | *<90, 90 and above* | 0.004 |
| *Trekking* | *Yes, No* | 0.151 |
| *Blood Sugar* | *Mean (SD)* | 0.997 |

# Result: Multiple logistic regressions

| | p value | OR (95% CI |
|---|---|---|
| Age Group (>60 compared with <60) | 0.003 | 2.19(1.3 to 3.1) |
| **Occupation: (Others)** | **Reference** | |
| Occupation: Agriculture | 0.212 | 1.43(0.82 to 2.51) |
| Occupation: Business | 0.517 | 0.79(0.4 to 1.6) |
| **Smoking History (Past Smoker)** | **Reference** | |
| Smoking History(Non Smoker) | 0.334 | 0.72(0.38 to 1.39) |
| Smoking History( Present Smoker) | 0.938 | 1.04(0.4 to 2.69) |

# Result: Multiple logistic regressions

| | p value | OR (95% CI |
|---|---|---|
| Alcohol consumption(Yes compared with No) | 0.382 | 1.26(0.75 to 2.12) |
| **HTN (No)** | Reference | |
| HTN( Known) | 0.000 | 5.31(2.86 to 9.86) |
| HTN(New) | 0.045 | 1.8(1.01 to 3.18) |
| Constant | 0.034 | 0.42(0 to 0) |
| SPO2 <90>90% | 0.113 | 1.54 (0.9 to 2.64) |

# Results: Awareness of major retinal diseases

- Diabetic retinopathy awareness:  15 (4.4%),.
- AMD awareness:  19 (5.6%)
- Hypertensive retinopathy awareness: 10 (23.8%)
-  Awareness of high-altitude retinopathy: 10.7%

# Fundus photographs

# Conclusion

- Over half of the study participants had some form of retinal diseases in one or both eyes.

- Most common retinal disorder were hypertensive retinopathy, high altitude retinopathy and AMD.

- Retinal diseases had significant association with age, and systemic hypertension.

# Conclusion..

- Awareness of major retinal disease was very low, despite of high prevalence of blinding disease among the population.

# Takeaway message

- There is high prevalence of blinding retinal disease among study population.

- Majority of retinal diseases are avoidable on timely precaution.

- Enhancement of access to eye care services and awareness on major blinding retinal diseases need to be emphasized among population at high altitude in Nepal.

# Acknowledgement

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-  Mentorship: Byers Eye Institute, Stanford University, California, USA

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# Thank you