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Community Screening for Pseudoexfoliation Syndrome

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Acknowledgements

This research work would not have been possible without the valuable support from *Nepal Health Research Council*. *NHRC* and every member of its family have been very helpful and showed positive attitude towards this work, which had made this work successful. I on behalf of my team and the institute would like to thank *NHRC* for this remarkable support.

It would be incomplete if I do not pen down few lines of appreciation for my co-investigator *Professor Madan Prasad Upadhyay*. He has been a key person in generating this Study and he has been a source of constant inspiration. He was always there to help us in completing this survey and given his valuable time, constant feedback and suggestions during the period of report writing. We are very fortunate to have him with us as one of our investigators.

I would also like to thank *Prof. Shashank Koirala* for devoting his precious time in this survey work without which it would have been impossible to complete this work. I am highly obliged to him for his guidance and help.

I am also thankful to all of my *team members* who have accompanied me to the study areas and helped me to conduct this study despite of all the difficulties that they have faced during the field visit. My team members included *Dr Madhu Thapa, Dr Nor Tsering, Dr Kausalya Pradhan, Dr Sandra Wang Harris, Mr. Rabindra Ghising, Ms. Anju Shrestha, Mr. Suresh Sharma, Mr. Janardhan Dahal, Mr. Ravi Paudel and Mr. Rajesh Neupane*. It was a teamwork, which has made us, completed this study with out much of difficulty. I would also like to thank *Mr. Kevin Harris* who had accompanied us to Ghandruk and helped us in photography and imparted some technical help during the survey.

I would also like to thank *Mrs. Soma Thapa* who had helped us in developing the oracle program for entering and analyzing all the data collected from the field. I would also like to thank *Dr. Gulsan Shrestha, Mr. Prakash Paudel and Mr. Jyoti Khadka* for their valuable help and assistace.

Last but not the least, I would also like to thank the *administration and management unit of B.P.Koirala lions eye center* for supporting us in conducting this survey by providing all the required equipments and other technical help. This survey would have been impossible to conduct without this valuable support.

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1. Introduction




Pseudoexfoliation syndrome is an ocular condition characterized by a distinctive deposition of fibrillar material in the anterior segment of the eye.¹ Pseudoexfoliation syndrome is frequently associated with glaucoma.^{2,3,4} Exfoliation has been recognized as a cause of glaucoma for nearly a century by Lindberg. In 1917, Lindberg first showed the association of grayish flecks on pupillary border in 50% of his patients with chronic glaucoma.⁵ Wilson suggested the term "glaucoma senilis" to indicate that the exfoliation was a result of aging.⁶ Dvorack-Theobald suggested pseudoexfoliation of the lens capsule to differentiate it from the true exfoliation in glassblowers.⁷ Emphasis on this disease entity kept on changing till Sunde proposed the term "Exfoliation Syndrome"

Pseudoexfoliation syndrome is associated with glaucoma in all the population, although the prevalence varies considerably. Glaucoma occurs more commonly in eyes with pseudoexfoliation than in those without it. Henry et al found the 5 and 10 year cumulative probabilities of initially non-glaucomatous eyes with pseudoexfoliation developing glaucoma to be 5.3% +/- 1% and 15.4% +/- 2% respectively.⁸ Glaucomatous damage progresses more rapidly in patients with pseudoexfoliation than in those with just primary open angle glaucoma.^{9,10} This probably reflects the effects of higher IOP on optic nerve head but abnormalities of lamina cribrosa relating to elastic tissue cannot be ruled out.

Reported prevalence rates of pseudoexfoliation syndrome vary widely in different geographic locations.^{11,12,13,14} Reasons for such variations have been thought to be racial and ethnic composition of the population studied, patient selection and clinical criteria for the diagnosis. Although it was identified originally as a disease of Scandinavian descent, it is now being reported from different parts of the world.^{15,16,17} In Scandinavia, the highest rates in studies of persons over 60 years have been reported from Iceland, which accounted for 25% , from Finland about 20%.¹¹ The prevalence has been 0% among Eskimos¹² and 38% among Navaho Indians.¹² According to the hospital based data collected from 1993-2002 at B.P.K.Lions center for Ophthalmic Studies, total of 49 cases of pseudo-exfoliation syndrome were encountered during these years. The racial predominance by Gurungs was the most striking feature of this report. Following this observation, there arose the need to conduct a community based scientific survey among assumed potentially high-risk population. A study was therefore proposed to find out the prevalence of pseudo-exfoliation syndrome in different ethnic groups of Nepal.

2. Rationale



Like any other primary open angle glaucoma, glaucoma with pseudo-exfoliation syndrome too goes unnoticed until the late stage when one becomes completely blind. Knowing the fact that glaucoma produces irreversible blindness without any alarming symptoms, it would be logical to detect this disease in the community at the earliest so as to minimize and prevent the visual loss. One of the best ways to do so would be, to conduct a population based screening camps for high-risk groups. Even before we level a particular group as a high-risk population, we need to find out whether there is any racial predilection for this disease. To know the correct prevalence of pseudoexfoliation syndrome a scientific community based study is required to see the prevalence in different ethnic groups. If we could proclaim that this disease is more prevalent among certain racial population, the task of detecting this disease at earlier stage would be much easier.

Screening the population at large would not be feasible and thus it was proposed to carry out a survey on specific target groups. On the basis of hospital data, a hypothesis was generated whether Gurungs at higher risk of developing pseudoexfoliation syndrome than others. Therefore, a study was designed to screen the pockets of guring community against the control group of non-guring community.

3.Objectives

The main objective of this study was to estimate the prevalence of pseudoexfoliation syndrome in different ethnic community.

The specific objectives were:

- a) To screen the sampled population for the pseudo-exfoliation syndrome.
- b) To estimate the prevalence of pseudoexfoliation syndrome among gurgung population
- c) To estimate the prevalence of pseudoexfoliation among non-gurgung population
- d) To estimate the prevalence of glaucoma among both above population

4. Materials and Methods

4.1 Study design

This survey followed an analytical, cross-sectional design. Two different types of communities were screened for the presence or absence of pseudoexfoliation syndrome: 1) a community where majority belonged to Gurung population, the attribute which could have shown occurrence of pseudoexfoliation syndrome and 2) a control community where majority belonged to Brahmin and Chhetri (non-gurung).

4.2 Inclusion and Exclusion criteria

Inclusion:

- All individuals who were 30 years or above residing in study area

Exclusion

- Individuals from outside the study area
- Those who refused for the detail evaluation
- Individuals below 30 years of age
- Individuals who had corneal opacity obscuring the anterior segment view
- Individuals with any active ocular disease which made them unable to undergo full examination as per protocol

4.3 Description of the Survey area

The principal settlements of Gurungs are Western Nepal. Most of the villages are found at Lamjung, Kaski and Tanahu districts.¹⁸ Therefore a village of Ghandruk at Kaski district (case) and Khopasi of Kavre district (control) were taken *purposively* as the study areas.

Ghandruk lies in hilly area (1,974 meters) of western Nepal near Pokhara. The 1998 estimated population of Ghandruk is 5,793 with 1,232-households.¹⁹ Average household sizes are 4.7, and males are 1.4 times more than females. Over 30 years population covers 38% of the total and gurungs (67%) are dominant ethnic group in the village.

Likewise, Khopasi also lies in the hilly area of Kavre district near Bhaktapur. The 1998 census found that this village had not a single person belonging to Gurung community (reason for choosing this village as a control). This town (recently included under Panauti Nagarpalika) of Khopasi has a population of 3,591 with 704 households. Average household sizes are 5.1 and female population covers almost 52% of the total. About 34% of the total population is above 30 years of age.

4.4 Sampling

The formula used to calculate the sample size (for estimation of prevalence) is

$$n = 4pq/d^2 \text{ (Cochran)}^{20}$$

Where,

n= number of subjects needed

p= estimated proportion of attribute

d= acceptable error

q= 1-p

At 95% confidence level, if we assume p=0.6 (safe proportion as we do not know it exactly) and acceptable error=5%, the formula gives us

$$n = 350$$

Thus, we need to screen 350 individuals in each group who are 30 years or above.

For this, we need to screen:

n= 920 in Ghandruk (Study subjects=38% of total population)

n= 1,020 in Khopasi (Study subjects=34% of total population)

Looking at the population distribution of these areas, the following mentioned wards were taken:

Area	Wards in sample	Population in sample wards	No. of house
Ghandruk	Ward 1	1068	247**
Khopasi	Ward 13*	1033	238

Note: ** Household count have increased as compared to 1998 census

- * Initial plan was to take ward no. 2 & 3, but as there was change in ward numbering due to inclusion of khopasi into Panauti Nagarpalika, ward no 13 were taken into consideration.

4.5 Description of Survey team

The survey team included an Ophthalmologist, two Ophthalmology residents, two Optometrists, one ophthalmic technician, one ophthalmic photographer and a field administrator along with three local enumerators in each study area.

Ophthalmologist and residents in Ophthalmology helped in evaluating all the sample cases for the presence or absence of clinical signs of Pseudo-exfoliation. Optometrist helped the team by taking detail history and external examination of the eyes. Ophthalmic technician helped to record the visual acuity of all the individuals and also helped on the floor for the smooth running of the examination procedure. Field

administrator helped the team by doing proper registration for every person coming for screening and also cross checking the list of those who failed to turn up for the examination so that they can be called back again. The enumerators did the household survey to get the household and sample population data. They had also played a major role in convincing people for detail eye examination.

Pre-survey Trial

Pre-survey trial on measurement of IOP was done to minimize the error during the survey. The gold standard to measure IOP would have been by Goldman applanation tonometer but due to technical reason, the Perkins's tonometer was used to measure IOP. The average error between Goldman and Perkins's tonometer was calculated prior to their use in the field for survey. Thirty cases from the general clinic in the Hospital were subjected to both above tonometry by a single observer. The average difference was calculated to be 1.93 mmHg between two with SD of 1.03. Perkins's tonometer measured the IOP less by 1.93 mm Hg than Goldman.

4.6 Survey Procedure

The survey took place at two levels, one being a household survey to accumulate household data. The second was the detail clinical survey that was focused on clinical signs to look out for Pseudo-exfoliation syndrome in the targeted population.

Household Survey

Ward no. 1 from Ghandruk and ward no. 13 from Khopasi districts were chosen for the survey. Household survey was performed in every house from the targeted area. In Ghandruk 247 households were surveyed and similarly 238 households were covered in Khopasi.

Enumerators were chosen from the same district and the ophthalmic technician/assistant there upon trained them to enumerate household data and fill up the referral forms. All those individuals 30 years and above were referred to the screening station the following day, so that household forms could be studied by the screening team a day prior to examination. Those who failed to report to the screening camp were traced next day for the examination in order to cover maximum population. Every individual were given separate referral slip by the enumerators to be produced at the screening camp.

Clinical survey (Eye Evaluation)

The examination of the eye took place at various stations where different levels of ophthalmic manpower were stationed to perform different procedures.

Station One

Every individual was first registered and counter checked with the household forms by the field administrator. Available visual acuity was taken with the help of snellen E chart at the distance of 6 meters in the bright natural daylight. Pinhole vision was taken for all those who had vision less than 6/6. These were performed by the ophthalmic assistant/technician.

Station Two

In this station, an optometrist took the detail history as per pre-designed Performa. They were also subjected to torch light evaluation and pupillary reactions, which were noted down in the Performa.

Station Three

Ophthalmology resident performed a detail anterior segment evaluation with the help of table stand Slit lamp biomicroscope (Clement Clarke 904) specially to look for any evidence of exfoliative material in the iris and pupillary margin. Also, the depth of the anterior chamber was evaluated by van herrick's method.

Station Four

Ophthalmology residents measured the intra-ocular pressure with the help of Perkin's tonometer, Kowa HA-2 (three times in each eye) after instilling the topical anesthesia (4% Xylocaine).

Station Five

The subjects were then directed to the last station where consultant ophthalmologist performed the gonioscopy on those who were suspected to have the evidence of exfoliation, all cases of glaucomas and suspected cases of primary angle closure. A drop of dilating medication, a combination of Tropicamide 1% and Phenylephrine 10% was instilled in all the eyes unless it was contraindicated. After full pupillary dilatation, consultant ophthalmologist again performed the slit lamp bio-microscopy with Topcon SL 7 F to look for the evidence of exfoliation in the lens and also

evaluated cup and disc ratio with the help of 90 D binocular examination. Anterior segment photo documentation was done with the help of anterior segment camera PENTAX K-1000 in all those cases, which had evidence of exfoliation.

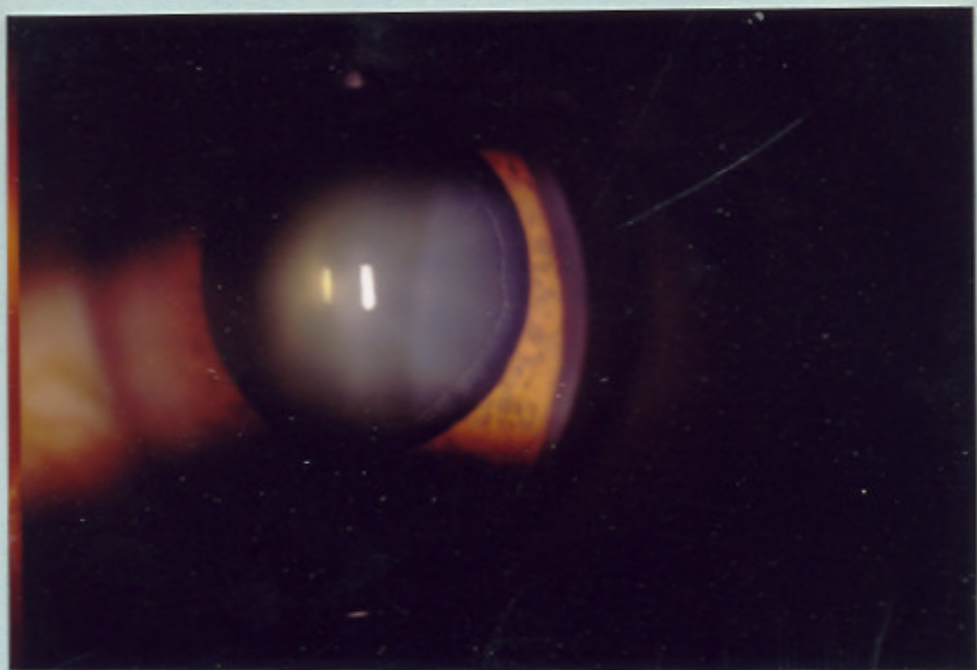
Subjects having glaucoma and suspected glaucoma were referred to the base hospital for automated perimetry. Cases found to have frank glaucoma were given medical treatment and referred to base hospital for proper follow up. Similarly, all those who had cataract or other ocular disorders were also referred to base hospital for further management.

Diagnosis Criteria

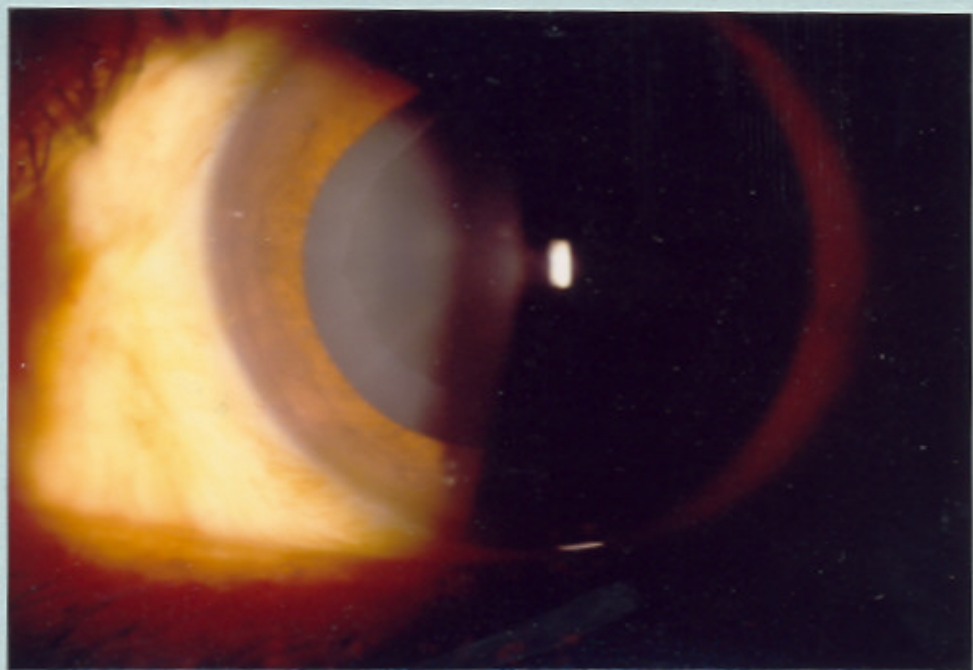
Pseudo-exfoliation Syndrome was diagnosed only after evaluating the eye thoroughly with fully dilated pupil. Presence of exfoliative material on the pupillary border was the first tool to suspect the disease. After dilating the pupils, the presence of exfoliation changes over the anterior surface of the lens capsule was the determining sign for the diagnosis. Therefore, the diagnosis was made completely on the basis of presence or absence of anterior capsular changes either typical granular stage with three different zones or atypical with granular changes without three distinct zones. (See picture 1 & 2)

Glaucoma was diagnosed only when two out of three features to suspect glaucoma were present in an individual. Large suspicious cup disc ratio either associated with higher IOP (>22 mmHg) or definitive field defect was labeled as Glaucoma. Presence of open or closed angle was determined by performing gonioscopy on every individual suspected to have glaucoma of any reason.

Picture. 1



Deposition of Exfoliative material over the lens



Picture. 2

Minimizing inter-observer variation

To minimize the inter-observer bias, a single examiner had performed each clinical procedure in this study at both the study places.

Post survey care

All the people who required medical therapy were treated there and then with various medications and who required different investigations were referred to base hospitals for the same. All those needing surgical intervention were brought to the base hospital for the surgery and laser therapy.

Data Analysis

All the data were fed into the computer and data analysis was done with the help of the Oracle 9 i and front end developer 2000.

Results

Report on Ghandruk survey (A Study area)

Total of 1044 population from 247 households were considered for survey and out of which 398 individuals were found to have fulfilled the criteria for the inclusion in this study.

Only 333 out of 398 individuals turned up for the clinical evaluation, covering almost 84% of the sampled population. To cover this 84% of the sampled population, repeated visits were made at the household levels by the enumerators. Out of 65 people who did not attend the screening clinic, 52 were out of village and 13 could not attend due to inability to leave their houses.

AGE AND GENDER DISTRIBUTION OF TOTAL POPULATION

Among 333-sampled population, 186 were females accounting for 55.9% out of total and rest were males. Majority belonged to the age group under 70 years and only 11.7% of them were above 70 years. The mean age of male population examined was 48.62 with SD of 15.402. Similarly, mean age of female population examined was 49.21 with SD of 16.061.

TABLE 1
AGE AND GENDER DISTRIBUTION

Age group	Males	Females	Total	Percentage
30-50	79	79	158	47.5%
51-70	43	93	136	40.8%
>70	25	14	39	11.7%
Total	147(44.1%)	186(55.9%)	333	100%

ETHNICITY OF SAMPLED POPULATION DISTRIBUTION

Majority of sampled population belonged to a particular ethnic group " Gurung" accounting for 82.58% of total (reason for this place to be chosen as the study area) followed by Baishya accounting for 13.52%. Very few of other races were seen.

TABLE 2
ETHNIC DISTRIBUTION

Ethnicity	Number	Percentage
Gurungs	275	82.58%
Baishya	45	13.52%
Chhetri	7	2.10%
Brahmin	4	1.20%
Magar	2	0.60%

OCCUPATIONAL DISTRIBUTION OF TOTAL POPULATION

Majority were farmers accounting for 63.06% (210) of total population followed by housewives (52) equating 15.16% and retired army men (36) accounting for 10.81%.

TABLE 3

OCCUPATIONAL DISTRIBUTION

Occupation	Number	Percentage
Farmers	210	63.06%
Housewives	52	15.62%
Retired army men	36	10.81%
Business men	24	7.21%
Service holder	11	3.30%

DIAGNOSIS OF THE OCULAR CONDITIONS MADE DURING THE CLINICAL EXAMINATION

Out of total population examined, 226 of them had no clinical evidence of ocular diseases and were labeled as Normal cases. Thirty-four of them were found to have Pseudo-exfoliation syndrome with or without glaucoma that accounted for 10.21% of total sampled population. Out of 34 cases 10 of them had associated glaucoma. Eleven of others had independent glaucoma accounting for 3.30% out of total. Therefore, glaucoma was seen in total of 21 individuals (6.31%). Apart from them, 19 (5.71%) individuals were suspected to have primary open angle glaucoma (POAG) and 12 (3.60%) primary angle closure suspect. Primary angle closure suspects (PAC Suspect) were diagnosed on the basis of gonioscopy finding showing occludable

angles. All the cases of POAG suspect were subjected to Automated perimetry and those of PAC suspect were referred for YAG peripheral iridotomy.

TABLE 4

PATTERN OF DIAGNOSIS MADE DURING THE SURVEY

Diagnosis	Number
Normal eyes	226
Pseudo-exfoliation syndrome	34
Primary open angle glaucoma	6
Primary angle closure glaucoma	5
POAG suspects	19
PAC suspects	12
Plateau iris	3
Ocular hypertension	3
Cataracts	18
Others	15

NOTE: Above represents the number of diagnosis made, one person could have more than one diagnosis

TABLE 5

RELATION BETWEEN PSEUDO-EXFOLIATION AND GLAUCOMA

Pseudoexfoliation	Number	Percentage
With glaucoma	10	29.4%
Without glaucoma	22	64.7%
With glaucoma suspect	2	5.9%

AGE AND GENDER DISTRIBUTION AMONG PSEUDO-EXFOLIATION CASES

Pseudoexfoliation was seen predominantly in males than females accounting for 64.7% out of total. This disease affected all the age groups considered in the study. The youngest individual affected by this disease was 34 years old.

TABLE 6

AGE AND GENDER DISTRIBUTION AMONG PSEUDO-EXFOLIATION SYNDROME CASES

Age in Years	Male	Female	Total (%)
30-50	5	6	11 (32.35)
51-70	10	5	15 (44.12)
>70	7	1	8 (23.53)
Total	22 (64.7%)	12 (35.3%)	34 (100)

TABLE 7

PREVALENCE OF PSEUDOEXFOLIATION IN RELATION TO AGE

Age	Pseudoexfoliation	Total individuals	Percentage
30-50	11	158	6.96%
51-70	15	136	11.03%
>70	8	39	20.51%

LATERALITY OF PSEUDOEXFOLIATION SYNDROME

There was no significant difference seen in regard to laterality as almost equal number of them had suffered of either unilateral or bilateral syndrome. Since 18 of them had bilateral affection, total number of eyes having Pseudo-exfoliation equated to be 52.

TABLE 8

LATERALITY OF PSEUDO-EXFOLIATION SYNDROME

Laterality	Number	Percentage
Unilateral	16	47.1%
Bilateral	18	52.9%

ETHNICITY AMONG THE CASES OF PSEUDOEXFOLIATION SYNDROMES

Out of 34 cases having pseudo-exfoliation, 33 of them belonged to a single ethnic group 'The Gurungs' and only one of them was a Brahmin. It meant that almost 97% of the affected population was Gurung.

TABLE 9
ETHNICITY AMONG PSEUDO-EXFOLIATION CASES

Ethnicity	Number	Percentage
Gurungs	33	97.1%
Brahmins	1	2.9%

Report on Khopasi Survey (Control Area)

Total of 1030 population from 238 households were surveyed and 370 individuals were found to have fulfilled all the criteria for the inclusion in the study. Out of 370 individuals who were referred to the screening camp, only 362 of them had turned up for the examination. Eight people who did fail to attend the screening camp were traced out but despite of re-counseling, due to some or other reasons, they were lost for examination.

AGE AND GENDER DISTRIBUTION OF TOTAL SAMPLED POPULATION

ETHNICITY DISTRIBUTION

Like in Ghandruk, females showed slight more preponderance over males as there were 200 females accounting for 55.2% out of total. Similar to Ghandruk population, majority were under 70 years of age accounting for 90% out of total. Populations over 70 years were only 10% of total. The mean age among males were 48.20 with SD of 13.30 and the mean age among females were 46.50 with SD of 16.24.

TABLE 10

AGE AND GENDER DISTRIBUTION

OCCUPATIONAL DISTRIBUTION AMONG SAMPLED POPULATION

Age group	Males	Females	Total	Percentage
30-50	83	118	201	55.5%
51-70	60	65	125	34.5%
>70	19	7	36	10.0%
Total	162(44.8%)	200(55.2%)	362	100%

OCCUPATION

ETHNICITY DISTRIBUTION OF SAMPLED POPULATION

Majority were Chhetris and Brahmins followed by Tamangs and Newars. The most striking feature in this community was that, there was not even a single Gurung residing in Khopas

Occupation	Number	Percentage
Teacher	5	1.4%
Tailoring	3	0.8%
No work	4	1.1%

ETHNICITY DISTRIBUTION

Ethnic group	Number	Percentage
Chhetri	111	30.7%
Brahmin	102	28.2%
Tamang	69	19.1%
Newar	64	17.6%
Baishya	16	4.4%

TABLE 11

DIAGNOSIS OF THE OCULAR CONDITIONS

OCCUPATIONAL DISTRIBUTION AMONG SAMPLED POPULATION

Majority of the population were engaged in agricultural work accounting for 73.8% out of total, followed by housewives. There were some businessmen and some were involved in service.

TABLE 12

OCCUPATIONAL DISTRIBUTION

Occupation	Number	Percentage
Farmers	267	73.8%
Housewives	43	11.9%
Business men	21	5.8%
Service holder	19	5.2%
Teacher	5	1.4%
Tailoring	3	0.8%
No work	4	1.1%

DIFFERENT DIAGNOSIS MADE DURING THE SURVEY

Majorities were found to have normal eyes after detail evaluation, accounting almost for 87% of the total. No pseudo-exfoliation was seen in contrast to that of Ghandruk where almost 10% of the population had pseudo-exfoliation. Primary open angle glaucoma was seen in 4 cases, which were all referred to base hospital for the automated perimetry. Another 3 individuals were suspected to have primary open angle glaucoma and 9 primary angle closure suspect on the basis of gonioscopic findings.

TABLE 13

DIAGNOSIS OF THE OCULAR CONDITIONS

Diagnosis	Number
Normal eyes	316
Primary open angle glaucoma	4
Primary angle closure glaucoma	1
Primary open angle glaucoma suspect	3
Primary angle closure suspect	9
Cataract	22
Pseudophakia	10
Aphakia	3
Age related macular degeneration	9
Congenital Macular dystrophy	1
Optic atrophy	2
Retinitis pigmentosa	1

TABLE 14

**PREVALENCE OF PSEUDOEXFOLIATION AND GLAUCOMA IN TWO
STUDY AREAS**

Study area	Sample size	No of Pseudo- exfoliation / %	No of Glaucoma cases	No of Glaucoma suspects
Ghandruk(case)	333	34(10.2%)	11+10(6.30%)	31(9.30%)
Khopasi(control)	362	0(0%)	5(1.38%)	12(3.31%)

On comparing the data from two study places, it was obvious that pseudoexfoliation in Gurung population was seen predominantly than the other group. Glaucoma too was more frequently encountered in Gurung population than the control.

Discussion

Total of 1044 population from 247 households were surveyed in Ghandruk (case) and 1030 population from 238 households were surveyed in Khopasi (control). In Ghandruk, out of 398 individuals identified for the inclusion in the study, 333 people turned up for the examination covering 84% of the sampled population, similarly in control area, 362 out of 370 identified population turned up for the same. The major reason for drop out in Ghandruk was unavailability due to their job engagement outside the village, whereas the common cause for drop out in Khopasi was inability to leave their houses due to some or other reason.

Females outnumbered males accounting for 55.9% and 55.2% in Ghandruk and Khopasi respectively. As per 1998 census, Ghandruk had males 1.4 times greater than their counterparts but during the study, females showed higher attendance than males. Higher reporting by females could probably be explained by the fact that males were engaged outside the village due to their job responsibilities. This was indirectly proved by the fact that, among those who were lost for evaluation, 52 of them were out for the job in army service and all of them were males. In Khopasi, even census shows higher population of females than the males so, it could be easily explained why females were reporting more than the males.

Majority of the clinically surveyed population belonged to the age group 30-50 years in both the study areas accounting for 47.5% and 55.5% in Ghandruk and Khopasi respectively. Only 11.7% from Ghandruk and 10% from Khopasi belonged to the age

group above 70 years (Table 1). This most probably could be due to the short life span of the Nepalese population.

A characteristic of the sampled population in terms of ethnicity was found similar to the expected value. Even before starting the survey, a purposive sampling was done to include more of Gurungs in the study area and more of non-Gurungs in the control area. Therefore, in Ghandruk, Gurungs covered 82.58% population and in contrast, Khopasi had no Gurungs and it covered almost equal percentage of Chhetris, Brahmins and Tamangs. (Table 2 & 11)

On comparing the occupational status in both the study and control areas, it was found that agriculture was the main occupation in both these areas. Among the sampled population, farmers covered 63.06% and 73.8% in Ghandruk and Khopasi respectively. (Table 3 & 12) Second common group of population encountered in both these areas were housewives followed by retired army men in Ghandruk and Businessmen in Khopasi.

Looking into the disease pattern encountered during the survey, there had been significant differences seen in these two study areas. Out of total population screened, 67.9% from Ghandruk and 87.3% from Khopasi had no ocular problems and thus were labeled as "normal". In Ghandruk, 34 out of 333 were found to have pseudoexfoliation syndrome accounting for 10.2% out of total (Table 4) whereas in Khopasi not even a single case of pseudoexfoliation was found (Table 13).

Out of 34 cases of pseudoexfoliation syndrome, 10 of them had associated glaucoma accounting for 29.4% of total pseudoexfoliation cases (Table 5). Out of total population screened, 11 were found to have other types of glaucoma unassociated with pseudoexfoliation accounting for 3.30% (Table 4). Overall, 21 individuals (10 with pseudoexfoliation and 11 without) were found to have glaucoma accounting for 6.31% out of total sampled population. Apart from these, 5.71% of total examined population was suspected to have primary open angle glaucoma and 3.60% were primary angle closure suspects.

In contrary, only 1.38% of total screened population had glaucoma in Khopasi and 0.8% of the population was suspected to have primary open angle glaucoma. Primary angle closure suspects were diagnosed only in 2.5% of the total cases (Table 13).

Evaluation of the disease pattern has created another horizon to think over as the study was originally proposed to see whether pseudoexfoliation is more prevalent among Gurungs. However, this report has shown not just the pseudoexfoliation that was more prevalent among Gurungs, but also glaucoma in general. The most probable reason for this could be that pseudoexfoliation occurs more frequently in glaucoma patients than non-glaucoma population as per various reports emerging from different parts of the world.^{21, 22} Therefore, since pseudoexfoliation is more prevalent among the glaucoma population, it can be assumed that people with glaucoma will also exhibit signs of pseudoexfoliation more commonly than normals. Conversely, the high prevalence of pseudoexfoliation could be the contributing factor to the high prevalence of glaucoma in the Gurung population.

Out of 34 cases that had shown the evidence of pseudoexfoliation syndrome, 10 of them (29.4%) also had confirmed glaucoma. Twenty-two of them (64.7%) did not have glaucoma and 2 (5.9%) were suspected to have glaucoma. There have been various reports showing prevalence of glaucoma among the cases of pseudoexfoliation syndrome ranging from 7% to 22.7%.¹⁴ There has been a belief that the risk of developing glaucoma is cumulative over time.⁸ The risk of developing glaucoma within 10 years of time in cases of pseudoexfoliation is approximately a tenfold higher than that found in the general population. Among the cases of pseudoexfoliation syndrome, 12 eyes had associated cataract of immature variety.

Pseudoexfoliation was seen more frequently in males than the females accounting for 64.7% out of total (Table 6). This report is similar to that of South African population as shown by Baetholomew RS.²³ The elderly aged people were predominantly affected by this disease, which was seen more after the age of 50 accounting for almost 65% out of total. This report is again similar to that of Forsius's report, which says that the incidence of pseudoexfoliation becomes double every decade after 50 years. In this series we had only 8 cases after the age of 70 but this is probably due to the fact that we had very few individuals who were above this age.

On comparing the prevalence of pseudoexfoliation in respect to the different age grouped population, it clearly showed that the prevalence of pseudo-exfoliation goes higher with the age (Table 7).

While comparing the frequency of monocular versus binocular involvement, no significant difference was encountered. There were 47.1% of the cases that showed

unilateral involvement whereas 52.9% of them showed bilateral involvement. There have been varied reports on the laterality, some reporting unilateral as the commonest entity and the others reporting as bilateral to be the common one. This series had showed no difference between two.

The most important and the prime objective of this study were to see *whether Gurungs are at the higher risk of developing pseudoexfoliation syndrome*. In an attempt to find out the ethnic distribution among the cases, it was found that 97.1% of the total pseudoexfoliation cases belonged to the single ethnic group 'Gurungs'. Only one person who had the disease belonged to the ethnic group called Brahmin (Table 9). On the other hand, there was found 0% of pseudoexfoliation among control group of population where the major population belonged to Chhetri and Brahmin. This has definitely proved that Gurungs are more at risk of developing pseudoexfoliation than the rest. Few questions still remain unanswered by this study are 1) whether being a Gurung or being a Gurung and living in high altitude is a risk factor for developing pseudoexfoliation syndrome? 2) Are there any other ethnic groups close to Gurungs affected by this disease? 3) Whether Gurungs share any genetic characteristics with Scandinavians? 4) Whether it is gene or ecology that is responsible for this disease? There have been many literatures originating from different parts of the world showing varied prevalence among different races and different geographical locations.^{11,12,13,14} The highest prevalence being reported among Icelanders (25%) and the lowest being Eskimos (0%). Further survey to answer all above questions should be carried out in the future. Carrying out a survey to include Gurungs from low lands would be beneficial to see whether it is the ethnicity or the altitude that plays a role in giving rise to pseudoexfoliation.

While looking at the magnitude of this disease among Gurung population, almost 10 out of 100 Gurungs are suffering from pseudoexfoliation, 6 out of 100 are suffering from other glaucoma and 9 out of 100 are being suspected to have glaucoma. Therefore, with the Gurung population of 5,43,571 in Nepal (Census 2001), it is estimated that 54,357 Gurungs are suffering from pseudoexfoliation with or without glaucoma and 32,614 of them are suffering from other type of glaucoma. Another population of 48, 921 is suspicious of having glaucoma. On the other hand, while assuming the lowest prevalence of glaucoma as seen in Khopasi (1.38%), an estimated 3,20,160 people are suffering from glaucoma and around 7, 67, 920 people are suspected to have glaucoma in Nepal. Keeping this in mind, government should be focusing not just on the cataract blindness but also should promote prevention of blindness programs due to glaucoma.

CONCLUSION

The community survey, focused on special entity of the disease had been completed with various eye-opening features in two different communities and with future recommendations. Ghandruk predominated by Gurung population was surveyed against the control area Khopasi with major ethnic groups of Brahmins and Chhetris. The majority of the sampled population were females and belonged to the age group between 30-50. Most of the people were involved in agricultural work than any other.

Pseudoexfoliation syndrome was more prevalent among Gurungs than other ethnic groups. This disease predominantly affected males. The prevalence of pseudoexfoliation syndrome increases with every decade of life.

At this stage, one needs to explore that whether risk of developing pseudoexfoliation is due to virtue of them being Gurung or being at altitude. For this, we need to conduct further studies to see the prevalence of pseudoexfoliation in Gurungs living at planes.

Besides higher prevalence of pseudoexfoliation, *Gurungs were also seemed to be vulnerable to develop other types of glaucoma*. It is not surprising to see this, as this has been the fact that the glaucoma and pseudoexfoliation can occur in presence of each other.

RECOMMENDATIONS

- Nation wide glaucoma survey should be conducted.
- A combined survey on Pseudoexfoliation and Glaucoma could be economical and less time consuming for the country like Nepal.
- The government /private eye care sectors should be focusing not just on the primary and tertiary care but also should be carrying out preventive programs focusing on early detection and blindness prevention. Therefore, one should conduct screening camps for targeted high-risk population.

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