Pseudoexfoliation Syndrome: A comparative study of prevalence among the Gurungs of high altitude and low lands and Gurungs versus Tamangs and Sherpas

2060-2061

Principal Investigator

Dr. Suraj Shakya, M.S.

Co-investigators

Prof. Shashank Koirala, M.S.

Prof. Madan Prasad Upadhaya, FRCS

Dr Sunu Dulal, M.D

Dr Indra Man Maharjan, M.D.

Mr. Y.D. Sapkota, MPH

Tribhuvan University

Institute of Medicine

B.P.Koirala Lions Center for Ophthalmic Studies

Maharajgunj, Kathmandu

Himalaya Eye Hospital, Pokhara

Survey Team

Principal Investigator

Dr. Suraj Shakya, M.S.

Co-investigators

Prof. Shashank Koirala, M.S.

Prof. Madan Prasad Upadhaya, FRCS

Dr Sunu Dulal, M.D

Dr Indra Man Maharjan, M.D.

Mr. Y.D. Sapkota, MPH

Field Supervisors

Mr. Suresh Raj Sharma

Mr. Janardhan Dahal

Mr. Ravi Paudel

Field Administrator

Mr. Rajesh Neupane

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 successful. I on behalf of my team and the institute would like to thanks NHRC for this remarkable support.

It is my pleasure to pen down few lines of appreciation for my co-investigator **Professor Madan Prasad Upadhayay.** He has been a key person in generating the study and he has been a constant source of inspiration through out this work. He was always there providing the valuable suggestion and feedbacks whenever we were in need. We are very fortunate to have him as a one of our investigators.

I would also like to thank **Professor 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 pleased to have **Himalaya Eye Hospital** (HEH) and its team as a co-partner in this work. Part of this survey had taken place at this hospital in Pokhara and all the necessary infrastructure and equipments were provided by HEH. **Dr. Sunu Dulal, Dr. Indra Man Maharjan, Mr. Y.D. Sapkota** and all the members of HEH had provided tremendous help during the study time as well as during the time of report writing. I am highly obliged to Mr. Y.D. Sapkota for making this study more authentic by providing statistical data.

I must thank all my team members who had helped me during the survey work and accompanied me the study areas despite of their busy OPD schedule. My team members included Mr. Ravi Paudel, Mr. Suresh Sharma, Mr. Janardan Dahal, Mr. Rajesh Neupane, Dr. Madhu Thapa., Dr. Salma K.C, Dr. Nor Tschering, Dr. Daki Sherpa, Dr. Kaushilya Pradhan, Dr. Suprada Pokhrel, Dr.Pritha Ray, Dr. Shantanu Ganguly and Mr. Rabindra Ghishing.

This research work would not have been completed with out the help of various other people and organizations who helped us behind the scene. I would like to thank all of them at this juncture and like to mention their names as they are the one who helped us to get the sample for the survey. I am obliged to Sherpa Sewa Kendra and Rumjatar Gurung Samitee and also Heartfelt thanks to Mr Shree Raj Gurung who have gone out of way to help us whenever we were in need.

I would also like to thank **Mrs. Soma Thapa and Yubraj Thapa** who had helped us developing the oracle program for entering and analyzing all the data collected from the field. I would also like to thank Mr. Prakash Paudel and Mr. Jyoti Khadka for their valuable assistance. I would like to thank **Mrs. Ishwari Thapa** for helping me to formulate this report in the final format.

Last but not the least; I would also like to thank the administration and management unit of B.P. Koirala Lions Centre for Ophthalmic Studies for supporting us in conducting this survey by providing all the equipment and technical help. This would not have been possible without this valuable support.

CONTENTS

S.No.	Matter	Page No.
1.	Abstract	1
2.	Introduction	1
3.	Objectives	4
4.	Materials and Methods	5
5.	Results	8
6.	Discussion	10
7.	Conclusion	13
8.	Recommendations	14
9.	Tables	15
10.	Figures	19
11.	References	21

Abstract

As per recently availed data from a community survey of Pseudoexfoliation syndrome (XFS), it was found that Gurungs were affected more frequently than other ethnic groups. The question that arose after this report, whether Gurungs are at higher risk of developing Pseudoexfoliation by virtue of them being Gurung or by living at higher altitude needed to be answered. Secondly whether only Gurungs or other ethnic people similar to Gurungs are also affected by disease needed to be addressed. To address all this issue, a community-based survey was thus conducted.

The survey showed that this disease irrespective of where they live affects all Gurungs. Almost 8% of Gurungs were affected by XFS. This disease did not affect Sherpas and 0.3% of Tamangs did have pseudoexfoliation.

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]

Pseudoexfoliation syndrome is associated with glaucoma in all the population, although the prevalence varies considerably[4]. 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.[5] Glaucomatous damage progresses more rapidly in patients with pseudoexfoliation than in those with just primary open angle glaucoma.[5] 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.[5,6,7,8] 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. 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%. [4] The prevalence has been 0% among Eskimos and 38% among Navaho Indians.[9] Recently completed community based survey on pseudoexfoliation syndrome conducted by B.P. Koirala Lions eye Center in collaboration with NHRC had reported that the Gurungs are at higher risk to develop pseudoexfoliation syndrome than others, accounting for 10.2% out of total population.[10] This particular study had screened Gurungs as well as non-Gurungs from hilly areas of Kaski district and Kavre district respectively. On completion of this study some relevant questions have aroused which remained unanswered till date. The most important query is that whether being a Gurung is a risk factor to develop pseudoexfoliation syndrome or being a Gurung and living in a high altitude is a risk factor...? The second interest is that whether just the

Gurungs or other ethnic group close to Gurungs is also affected by this disease? To answer these queries, we felt a need to conduct another community-based survey, which would compare the prevalence of pseudoedxfoliation among Gurungs living in high altitude versus low lands and Gurungs versus Tamangs and Sherpas.

Rational

The prime interest in pseudoexfoliation syndrome is due to its association with glaucoma, which is the foremost cause of irreversible blindness all over the world. Recently availed data has shown that pseudoexfoliation syndrome is more prevalent among Gurungs than the others. If that was true then, Gurungs from all over the country should be screened for the same and blindness prevention program should be focused more towards this high-risk group than the rest. This may remain as an assumption if not verified by conducting another study to find out whether all Gurungs are at higher risk to develop this disease irrespective of their location of residence and secondly whether only Gurungs or other ethnic group with close features like that of Gurungs are also affected. If we can prevail that being a Gurung is a risk factor not the high altitude or vise versa then that gives us the rough idea to plan our health care system in regard to prevention of irreversible blindness.

Therefore, a study is being designed to conduct a survey at community level to find out the answers to above questions and verify the facts whether just the Gurungs or also other group closer to Gurungs are affected by pseudoexfoliation and secondly whether risk for a Gurung is by the virtue of being a Gurung or by the virtue of living at high altitude.

Objectives

The main objective of this study is to compare the prevalence of pseudoexfoliation among the Gurungs living in low lands versus high altitude and to compare the prevalence among Gurungs versus Tamangs and Sherpas.

Specific Objectives:

- To screen the sampled population for Pseudoexfoliation Syndrome
- To estimate the prevalence of pseudoexfoliation among the Gurungs living in Kathmandu valley.
- To estimate the prevalence of pseudoexfoliation among the Gurungs living in Pokhara valley.
- To compare the prevalence of pseudoexfoliation from valley Gurungs with that of Ghandruk (High altitude) Gurungs.
- To estimate the prevalence of pseudoexfoliation among Tamangs and Sherpas from Kathmandu valley.
- To compare the prevalence rate of pseudoexfoliation between Gurungs, Tamangs and Sherpas.

Research Questions

1. Is risk for a Gurung is by the virtue of being Gurung or by the virtue of living at high altitude?
2. Are only Gurungs or other ethnic groups' closure to Gurung affected by pseudoexfoliation?

Methodology

Study design

This survey followed a descriptive, cross- sectional community based design.

Study Variables

Pseudoexfoliation syndrome- Dependent variable

Altitude- Independent variable

Ethnicity- Independent variable

Target Population

1. Gurungs from Pokhara and Kathmandu Valley
2. Sherpas and Tamangs from Kathmandu Valley

Sampling

Non-probability convenience sampling was done.

To compare with the previous report 1400 sample were enrolled 350 from each group.

Pokhara Gurungs- 350

Kathmandu Gurungs-350

Kathmandu Tamangs-350

Kathmandu Sherpas-350

Inclusion and Exclusion criteria

All individuals who were 30 years or above residing in study area at least for last three years were included in the study. Individuals who were from outside the study

area, who refused for enrollment, less than 30 years of age, having corneal opacity obscuring the anterior segment view and those with any active ocular disease that made them unable to undergo full examination as per protocol were excluded from the study.

Study Area

Study areas chosen were ward no 12 and 17 from Pokhara to survey Gurung population from Pokhara valley. For the Sherpa survey, Boudha area was chosen and similarly for Tamangs, Rani Ban from Ichangu was chosen. Since Gurungs in Kathmandu were scattered all over, a particular place was not chosen but all the Gurungs were called to the clinic with the help of their various committees.

Household survey was performed in every house from the targeted area by the local enumerators to bring all the individuals who fulfilled the inclusion criteria to the examination clinic. In case of Gurungs from Kathmandu, house hold survey was not done due to technical difficulty as they are scattered all over valley. They were brought to the examining clinic with the help from different Gurung Committees. Gurungs from Pokhara valley were all brought to the base hospital for examination.

Clinical survey

Every individual was first registered after acquiring verbal consent. 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.

Detail history as per pre-designed Performa was taken. They were also subjected to torch light evaluation and pupillary reactions, detail anterior segment evaluation with the help of table stand Slit lamp biomicroscope (Clement Clarke 904) especially to look for any evidence of exfoliative material in the iris and pupillary margin.

Intra-ocular pressure was recorded with the help of Perkin's tonometer, Kowa HA-2 (three times in each eye after instilling the topical anesthesia (4% Xylocaine). They were subjected to gonioscopic exam when and where necessary.

A drop 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 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. Those who required further investigation or surgical intervention were brought to the hospital.

Diagnosis Criteria

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.

Results

Total of 1356 population from different ethnic groups were included in this study. Out of these, 350 were Gurungs from Pokhara valley. 270 were Gurungs from Kathmandu, 365 were Sherpas and 371 were Tamangs from Kathmandu valley. Among total population examined, majority were females accounting for more 55% in all ethnic groups. Mean age groups ranged from 58 to 62 in four different groups of population enrolled in the study. (See table 1)

Pattern of diagnosis revealed significant difference between different study populations. Gurung population showed higher number of Pseudoexfoliation cases in contrast to Sherpas & Tamangs accounting almost for 8.2% out of total. Similarly primary open angle glaucoma (POAG) & POAG suspects were also seen more frequently among Gurungs where as primary angle closure (PAC) suspects and primary angle closure glaucoma (PACG) were seen more frequently among Sherpas and Tamangs. Cataracts and age related macular degenerations (ARMD) were seen more frequently among Tamangs. (See table 2)

While comparing the prevalence of pseudoeexfoliation syndrome among high altitude Gurungs and valley Gurungs, it was found that XFS was seen among both these population. (See table 3 & Figure 1) The odds ratio is 1.45 (95% confidence interval being 0.84-2.53) while high altitude Gurungs from Ghandruk were compared with

Pokhara valley Gurungs. The X^2 test showed no significant difference with P value > 0.1 at one degree of freedom. Comparison between High altitude Gurung and Kathmandu Valley Gurung also showed no significant difference. The odds ratio is 1.62 (95% confidence interval being 0.88-2.99) and p value 0.99.

On comparing the prevalence of XFS among Gurungs, Tamangs and Sherpas from valley, Gurungs were found to have higher prevalence of 8.2%. None of the Sherpas had XFS and only 0.3% of Tamang population showed the evidence of XFS. (See table 4 & Figure 2) This difference is highly significant with p value <0.001.

Calculating the hours of exposure to sunlight among valley Gurungs and correlation of sun hours with XFS revealed no clear cut effect of sun exposure on XFS as 357 individuals who gave the history of not being exposed to sunlight more than 3 hours per day but 34 of them did have XFS and in contrast there were individuals who were exposed to sunlight for longer period and only small number of them had XFS. (See table 5 & Figure 3) The odds ratio is 1.52(95% confidence interval being 0.8-2.92) and the p value is > 0.1.

Gender distribution among cases having XFS was studied and it was found that over 70% of them were males. The prevalence among males was 9.25% in contrast among females was just 2.5 %(Chi square test showed p value to be < 0.001). Detail evaluation of XFS cases was conducted to find out the laterality of involvement and its association with glaucoma. Laterality did not show much difference on whether being unilateral or bilateral as 46.2% having unilateral involvement. (See table 6)

Almost 35% of XFS cases had associated glaucoma and 3.8% of them were identified as glaucoma suspects. (See table 7)

Pseudoexfoliation syndrome was seen more frequently in elderly people in compare to younger ones. The prevalence of XFS was 3.9% among the age group 30-50 whereas it increased to 19.8% among the age groups 70 or more. (See table 8)

Discussion

Total of 1356 population from different ethnic groups were examined during the study. Females constituted higher number in most of the households surveyed and thus more females were examined during the study. On careful evaluation of 2001 census it was found that among Gurung population, females seem to be more than males by at least 30%, however Tamang & Sherpa population census did not show any difference in number. It could be explained by the fact that information gathered during the household survey revealed more male numbers are out of town for studies or work.

Mean age of the examined population varied from 58 to 62 in four different groups of population enrolled in the study. This probably is due to the shorter life span of Nepalese population. Pattern of diagnosis made at the end of examination revealed gross difference

between various ethnic groups. Gurung population showed higher number of pseudoexfoliation cases in contrast to Sherpas and Tamangs. This was similar to the previous report, which has shown higher prevalence among Gurungs than non-Gurungs.[10] Other than XFS even POAG and POAG suspect were more frequently seen among Gurungs than rest of the groups. This probably could be due to the fact that glaucoma as such is a genetic disease, which is being seen more among certain ethnic group.

However, PAC suspect and PACG were found more in Sherpas & Tamangs, This could probably be due to the genetic predisposition of ocular anatomic structure which are responsible for angle closure. Cataracts & ARMD were seen more among Tamangs, which could not be explained by this study.

On comparing the prevalence of XFS between high altitude and valley Gurungs, it was found to be 12% among high altitude Gurungs followed by 8.6% among Pokhara valley Gurungs of 7.8% among Kathmandu valley Gurungs. The odd ratio is 1.45 (95% confidence interval being 0.84-2.53) while high altitude Gurungs from Ghandruk were compared with Pokhara valley Gurungs. The X^2 test showed no significant difference with P value > 0.1 at one degree of freedom.

Comparison between High altitude Gurungs and Kathmandu Valley Gurungs also showed no significant difference. The odd ratio is 1.62 (95% confidence interval being 0.88-2.99) and p value 0.99. This means all the Gurungs irrespective of where they live are predisposed to pseudoexfoliation syndrome.

While comparing the prevalence of XFS between Gurungs, Sherpas & Tamangs, it was found that, Gurungs showed the highest prevalence of all, accounting for 8.2% out of total where as Tamangs showed only 0.3% prevalence. The Sherpas had no XFS. This difference is highly significant with p value <0.001, which means Gurungs, are at higher risk to develop XFS than other ethnic groups. This study again supports the finding of the previous report given by the same group of investigators.

On evaluating the sun exposure time among valley Gurungs and correlating this with presence of XFS, it was found that out of 620 Gurungs examined, 263 gave the history of being exposed to the sunlight more than 3 hours per day out of which, only 17 had XFS. Similarly 357 gave the history of not being exposed to sunlight more than 3 hours per day, out of which 34 of them did have XFS. The odd ratio is 1.52 (95% confidence interval being 0.8-2.92) and the p value is > 0.1, which means sunlight exposure, could not be an important risk factor for the occurrence of XFS.

Gender distribution among cases having XFS were studied and it was found that over 70% of them were males despite of the fact that females were reported more at the screening clinic at the time of examination due to various facts as mentioned above. The prevalence among males was found to be 9.25% which was statistically significant as p value was < 0.001 as shown by Chi square test.

Laterality of XFS was evaluated which showed not much of difference being unilateral or bilateral. This report is again similar to that of previous one. Association of glaucoma

with XFS was studied and was found that 34.7% of the XFS had glaucoma where as 61.5% did not have associated glaucoma. This needs to be followed up for longer period as there have been some reports showing increasing prevalence of glaucoma among XFS cases with time.

Pseudoexfoliation syndrome was seen more frequently in elderly people in compare to younger ones. The prevalence of XFS was 3.9% among the age group 30-50 whereas it increased to 19.8% among the age groups 70 or more.

Conclusion

Pseudoexfoliation syndrome is more prevalent among Gurungs than any other ethnic populations in Nepal. Being a **Gurung is the risk factor for development of pseudoexfoliation syndrome**, it is **not the altitude that determines the risk.**

Prevalence of pseudoexfoliation increases with age. Association of glaucoma, an irreversibly blinding eye disease associated with this entity is seen in almost 35% of the cases and it is expected to increase with time.

Limitation of the Study

This study has got some limitations which was not possible for us to take care of, like for example we could not make this study a case control study which would have been better though. The study size itself is not big enough to represent country's profile. This study is still missing many other non common ethnic groups like Rai and Limbu etc.

Recommendations

- Since Pseudoexfoliation Syndrome is more prevalent among Gurung population in Nepal, there should be preventive programs focusing on early detection and management of Glaucoma for this high-risk population.
- A community base survey to find out various other risk factors among Gurungs for developing this disease needs to be conducted.
- A genetic study should probably be an ultimate goal.

Table-1

Demographic Features of Different Population Examined

Ethnic group	Parameters	Numbers
Gurungs	Total population	350
	Males	121 (34.6%)
Pokhara	Females	229 (65.4%)
	Mean Age (SD)	58 (9.740)
	Total population	270
	Males	112 (41.5%)
	Females	158 (58.5%)
Kathmandu	Mean Age (SD)	59 (8.262)
Sherpas	Total population	365
	Males	152 (41.6%)
	Females	213 (58.4%)
	Mean Age (SD)	59 (10.110)
Tamangs	Total population	371
	Males	167 (45.0%)
	Females	204 (55.0%)
	Mean Age (SD)	62 (10.262)

Table -2
Pattern of Diagnosis

Diagnosis	Pokhara Gurungs	Kathmandu Gurungs	Sherpas	Tamangs
Normal	**200**	**174**	**207**	**195**
XFS with glaucoma	**10**	**8**	**0**	**0**
XFS without glaucoma	**18**	**13**	**0**	**1**
XFS with glaucoma suspect	**2**	**0**	**0**	**0**
Cataract	39	17	20	40
Pseudophakia	16	9	14	9
Aphakia	6	3	6	10
POAG suspect	**29**	**16**	**12**	**18**
PAC suspect	**8**	**7**	**24**	**29**
POAG	**16**	**12**	**9**	**14**
PACG	**2**	**1**	**13**	**14**
Ocular hypertension	2	1	0	1
ARMD	4	6	4	17
Others	17	21	14	26

Table -3

Comparing Prevalence of XFS among
High altitude and valley Gurungs

XFS	High altitude (n=275)	Pokhara Valley (n=350)	Kathmandu Valley (n=270)
Present	33 (12%)	30 (8.6%)	21 (7.8%)
Absent	242	320	249

Table -4
Comparing Prevalence of XFS among
Gurung, Tamang and Sherpa
From valley

Ethnicity	Total population	No.	%
Gurungs (Pokhara +Kathmandu)	620	51	8.2
Sherpas	365	0	0
Tamangs	371	1	0.3

Table -5
Sun hour's exposure among
Valley Gurungs & correlation with XFS

Sun exposure	XFS	
	Present	Absent
Negative (1 - 3 hours per day)	34	323
Positive (> 3 hours per day)	17	246

Table: 6 Gender Distribution among the cases Of XFS

Gender	No. of XFS(Total sample)	percentage
Male	37 (400)	71.15 %(9.25%)
Female	15 (591)	28.85 %(2.5%)

Table -7
Laterality of XFS

Laterality	Number	%
Unilateral	24	46.2
Bilateral	28	53.8
Total	**52**	**100.0**

Table -8
Association of glaucoma in cases of XFS

XFS	Number	%
With glaucoma	18	34.7
With no glaucoma	32	61.5
With glaucoma suspect	2	3.8
Total	**52**	**100**

Table -9
Prevalence of XFS in relation to age among Gurungs

Age	XFS	Total Population	%
30 - 50	8	203	3.9
51 - 70	19	296	6.4
70 of >	24	121	19.8

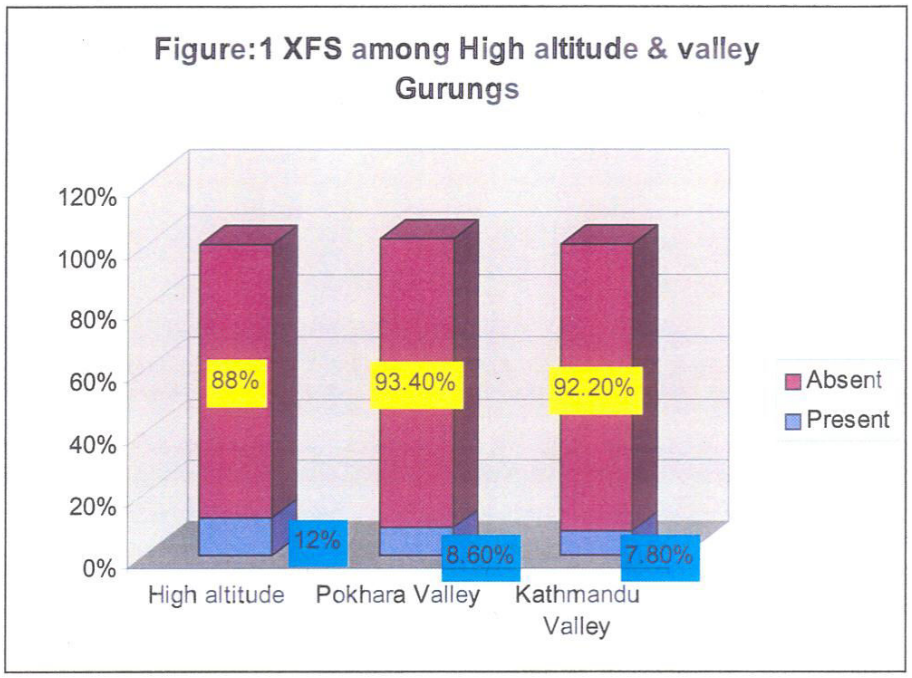


Figure:1 XFS among High altitude & valley Gurungs
120%
100%
80%
60%
40%
20%
0%
88%
12%
93.40%
8.60%
92.20%
7.80%
High altitude
Pokhara Valley
Kathmandu Valley
Absent
Present

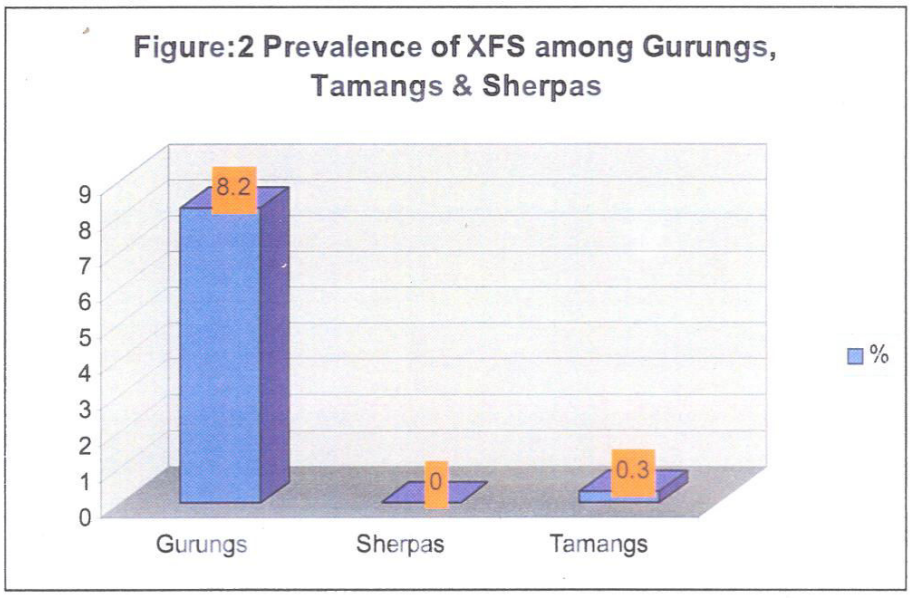
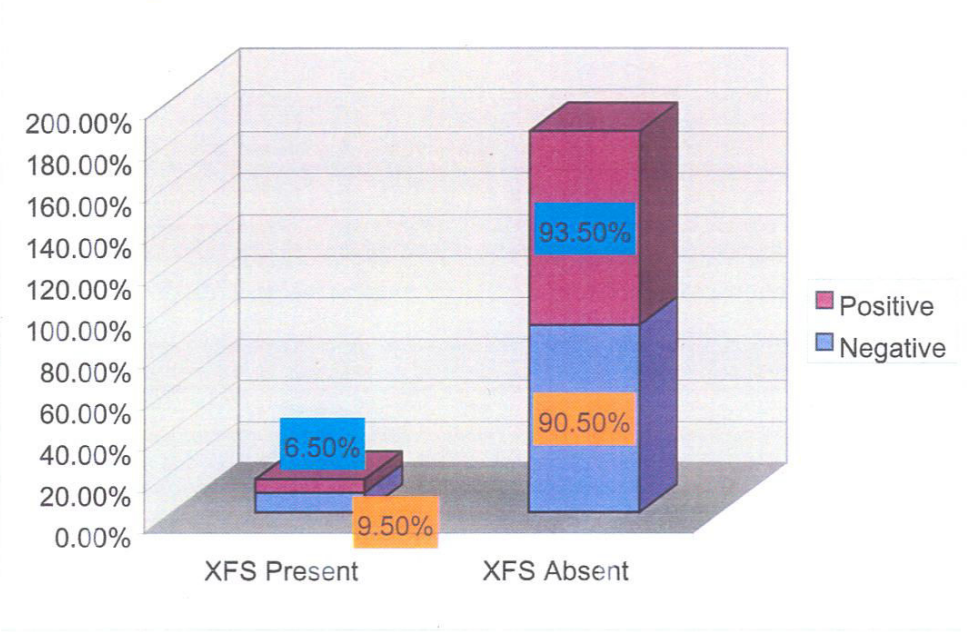


Figure:2 Prevalence of XFS among Gurungs, Tamangs & Sherpas
9
8
7
6
5
4
3
2
1
0
8.2
0
0.3
Gurungs
Sherpas
Tamangs
%

Figure:3 Correlation between Sun exposure & XFS



References

[1]Schlotzer-Schrehardt U., Naumann G.O.H: Trabecular meshwork in pseudoexfoliation Syndrome with and without glaucoma; a morphometric, ultrastructural study, Investigative Ophthalmology and Visual Science, 36: 9, 1750-1764,1995.

[2]Krishnadas R, Nirmalan P.K, Ramakrishnan R: Pseudoexfoliation in a rural population of Southern India, the Aravind Comprehensive Eye Survey, American Journal of Ophthalmol, 135: 830-837, 2003.

[3]Catherine A. Mccarty, Hugh R. Taylor: Pseudoexfoliation Syndrome in Australian adults, American Journal of Ophthalmol, 129:5 629-633, 2000.

[4]Forsius, H: Prevalence of pseudoexfoliation of the lens in Finns, Lapps, Icelanders, Eskimos and Russians. Trans Ophthalmol Soc, UK, 99:296, 1979

[5]Henry, J.C, Krupin T, Schmitt M: Long-term follow-up of pseudoexfoliation and the development of elevated intra-ocular pressure. Ophthalmology 94:545-52, 1987

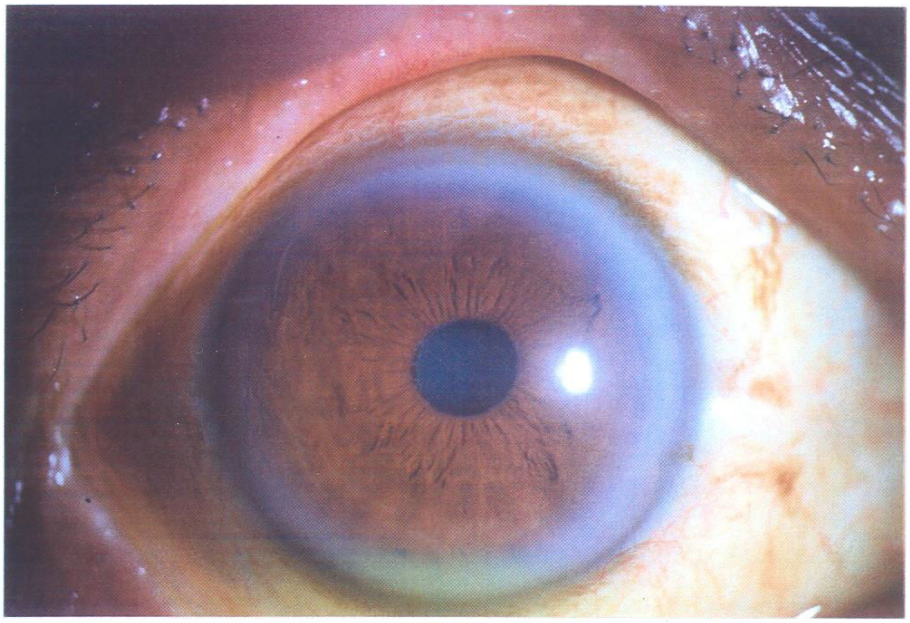
[6]Rotchford Alan P, Kirwan, J. F, Muller, M.A: Temba Glaucoma Study; a population based cross sectional survey in Urban South Africa, Ophthalmology 110: 376-382

[7]Ramakrishnan R., Nirmalan P.K, Krishnadas R: Glaucoma in a rural population of Southern India, The Aravind comprehensive eye survey, Ophthalmology 110: 1484-1490, 2003.

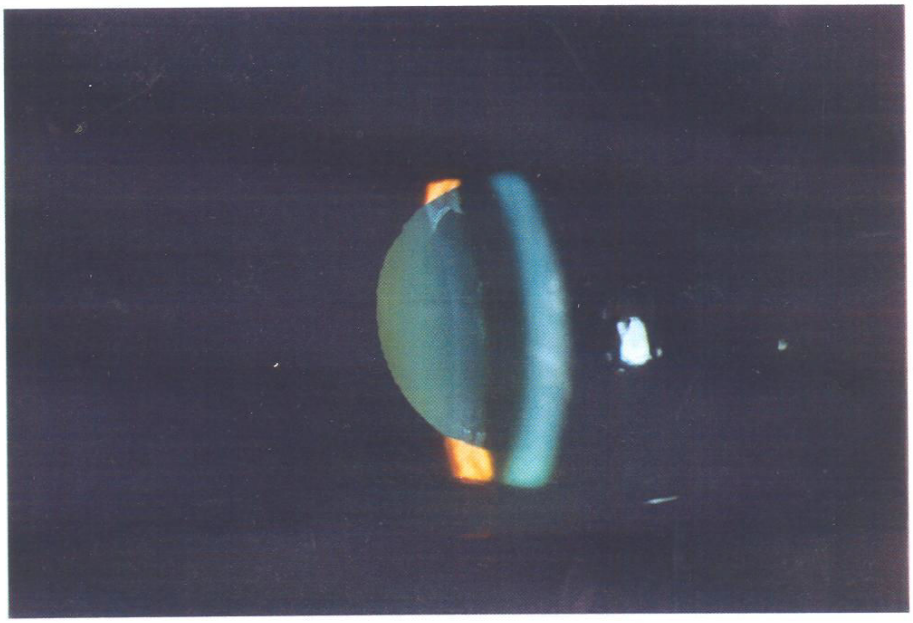
[8]Dell, WM: The epidemiology of the pseudoexfoliation syndrome, J Am Optometric Assoc 56:113, 1985

[9]Faulkner, HW: Pseudo-exfoliation of lens among the Navajo Indians, Am J Ophthalmol 72: 206, 1971

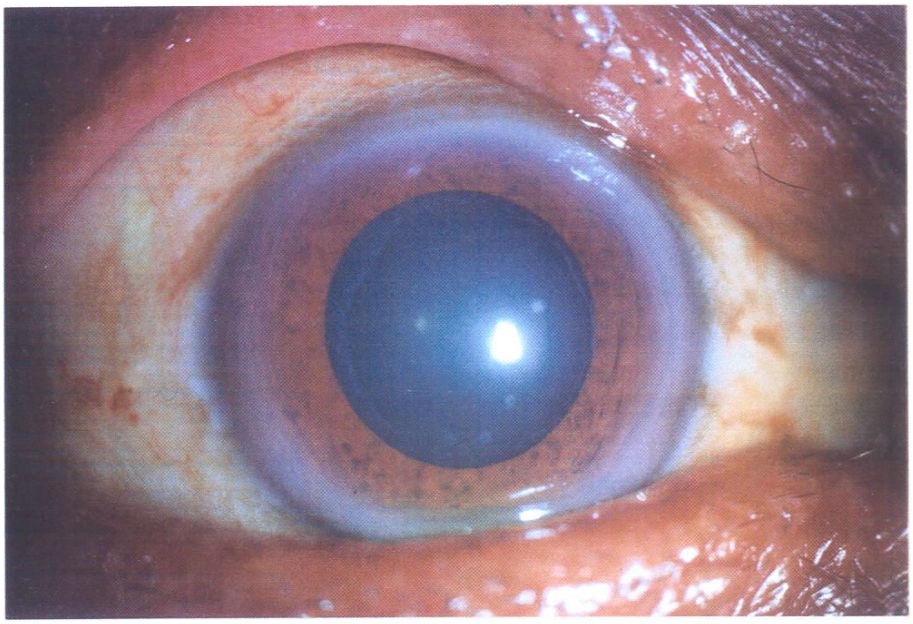
[10] Shakya S, Koirala S, Upadhaya MP: Community survey of Pseudoexfoliation syndrome among Gurungs and non-Gurungs , Report submitted to NHRC, 2003



Picture 1 : EXFOLIATIVE MATERIAL IN THE PUPILLARY MARGIN



Picture 2 : EXFOLIATIVE MATERIAL IN THE LENS



Picture 3 and 4: EXFOLATION OF THE LENS CAPSULE