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Research Article

DIET PATTERNS AND ENVIRONMENTAL CORRELATES TO DISEASE IN PSEUDO EXFOLIATION SYNDROME

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A B S T R A C T

Purpose: To evaluate the environmental conditions and diet patterns differences in patients with pseudoexfoliation syndrome (PXF) or glaucoma (PXG) from different in districts of Eastern India

Methods: This cross sectional study included 81 PXF and 38 PXG patients (pseudoexfoliation defined as presence of dandruff like material on ocular structures with or without raised IOP and disc changes) screened in the outpatient department from 2011-2013. The patients were administered a questionnaire regarding their diet, oil used, occupation, smoking habits, details of regular coffee/tea intake, vegetarian/non-vegetarian status and main diet of daily regional food intake. The climatic details of the place of origin (at the district level) were accessed from available online database of the state government climate board (http://www.imdorissa.gov.in)and details retrieved included average rainfall days, maximum and minimum temperature, humidity and wind speeds. These cases were compared with 111 controls seen during the screening period.

Results: The climatic conditions were not statistically different in PXF patients and controls suggesting no difference in populations sampled from different regions among cases or controls. Majority of cases (PXF n=42) and PXG (n=31) were from regions with significantly higher maximum daily temperature (district Khorda, 27 ± 1.6^0C) and were non-vegetarians (n=112) with more number of cases consuming fish in daily diet than controls (n=114). Those with PXG were associated with >coffee intake >3 cups and were residing in areas with higher maximum temperatures.

Conclusion: Cases with PXF/PXG in the State of Odisha in East India were non-vegetarians with maximum consumption of fish and >3 cups of coffee and belonged to regions with maximum daily temperature.

INTRODUCTION

Pseudoexfoliation syndrome (PXF) is a distinctly identifiable disorder characterised by deposition of flaky fibrillar material over ocular tissues which is presumed to be associated with unique environmental conditions.[1,2] In the eye, deposits are distributed over all ocular structures of the eye though the classical features are described based on lens deposits.[1-4] Lack of consistent genetic association of LOXL1 or other genes across different ethnic populations and association of other ocular findings of pterygium and climatic droplet keratopathy suggest possible role of environmental conditions in PXF pathogenesis.[5-8] Several associations of PXF including cataract, climactic droplet keratopathy and pterygium, suggest the role of radiation and environmental factors in PXF pathogenesis. [7-9]The prevalence of PXF varies from 0% to greater than 30% in different states across the globe.[9-15] The prevalence is known to increase with distance from the equator and is highest in Scandinavian countries including Sweden, Norway and Finland.[10,11] The prevalence is also higher in populations with high extremes on sunlight/UV light exposure.[6,15] Yet the association with higher latitude or sunlight exposure with PXF prevalence seems to be inconsistent with few regional exceptions and suggest that long term exposure to sunlight even in areas of lower latitude may cause PXF pathogenesis. It is assumed that maximum sunny days, hours of outdoor exposure or colder temperature during summer may predispose to PXF formation over long term. One retrospective cohort study in the united states involving majority of healthy European derived Caucasians found a 2 times higher risk for PXF in people spending ≥11 hours per week spent outdoors in high school to age 24 years compared with ≤5 hours per week.[16] In the Reykjavik Eye Study, time spent outdoors was not associated with an increased risk of XFS though the study only considered recent exposures and not cumulative exposures over long term.[15]

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Diet factors have also been an area of interest for complex diseases in the recent past. It may be possible that regional differences in environmental would drive different diet and lifestyle patterns that may also play a role in PXF pathogenesis. One study described possible role of daily coffee consumption >6 cups in PXF prevalence thought the causal role of this or other diets has not been investigated across other ethnic populations.[17] It is possible that environmental factors like sunlight and radiation exposure confer susceptibility to PXF formation and different phenotypes by an unknown mechanism. Our early study identified different phenotypes and characterise based on clinical features.[18] We also found higher prevalence of patients in this study from particular geographical regions of our state with differences in spoken language, diet patterns and lifestyle differences. We wanted to evaluate if environmental conditions and diet patterns driving lifestyle differences which are very different in districts of Odisha are associated with higher prevalence in this study.

METHODS

This cross sectional study included new patients with PXF screened and photographed in the outpatient department from 2011-2013 for a study evaluating genetic and clinical characteristics of pseudoexfoliation glaucoma and syndrome, which was approved by the institutional review board of LV Prasad Eye institute, Odisha, India and adhered to the tenets of declaration of Helsinki. As protocol, a written informed consent is taken for all patients attending our clinic for investigations and examination. Details evaluated included slit lamp evaluation with slit lamp photographs, intraocular pressure (IOP) by Goldman applanation tonometry, +90D fundus biomicroscopy and Humphrey visual fields (Carl Zeiss Inc, Dublin, CA, USA, 24-2 SITA standard program). The demographic details retrieved from hospital database included area of origin, family history if glaucoma or pseudoexfoliation, migration to or from other geographic areas, nutrition status (undernourished/overweight/any malnutrition). The climatic details of the place of origin (at the district level) were sought from available online database of the state government climate board (http://www.imdorissa.gov.in)and details retrieved included average rainfall, maximum and minimum temperature, humidity and wind speeds. These data were collected for the period 2011-2012 and average of the data was from these data obtained from online database calculated for final analysis.

Inclusion criteria for pseudoexfoliation syndrome included those with evident classical dandruff or flaky exfoliation deposits on the pupil, lens or other ocular structures, radial pigment over the lens surface on clinical photographs with or without raised intraocular pressure (IOP) or disc changes. Both unilateral and bilateral cases screened from 2011-2012 were included. Glaucoma was defined as those with glaucomatous optic neuropathy evidenced by cupping (cup disc ratio >0.5), rim thinning, notch or retinal nerve fibre layer defects with corresponding visual field defects. Patients with uveitis, neovascular glaucoma, aphakia or pseudophakia or past laser procedures were excluded. Patients with associated findings like uveitis, previous laser or surgery done outside, trauma or posterior segment pathology were excluded. Visual field defects were classified as glaucomatous if glaucoma hemifield test outside normal limits or pattern standard deviation with probability <5%, which were reproducible over three baseline fields.

The patients screened during the period were administered a questionnaire regarding their diet, oil used (refined or mustard), occupation, smoking and drug addiction (tobacco/betel nut/others with duration) history, details of regular coffee/tea intake, vegetarian/non-vegetarian status and main diet of daily regional food intake (Odisha being a coastal area, this included fish/crabs/prawn/others), table S1. The questionnaires were administered to the patients in a blinded manner by a single optometrist blinded to the clinical details of the patient. The questionnaires were administered wither by telephonic conversation or in written form administered in both English and local language known to the patient. Illiterate patients were administered the questionnaire verbally and their answers recorded by the optometrist in their local language. Patients unable to fill or complete the questionnaire or were unclear on aforementioned details, were excluded.

For comparison, we included 111 controls which were patients attending glaucoma service for routine cataract surgery without any ocular disease, normal IOP<21mm Hg and normal optic disc.

Frequency of diagnosis (PXF or PXG) was evaluated using chi-square statistics while continuous variables between the two with controls were compared using one way ANOVA statistics. Differences in variables among cases (PXF and PXG) or controls were analysed by student "t" test with significance level set at $p<0.05$.

RESULTS

Of 346 patients with pseudoexfoliation patients from East India screened by a single clinician from 2011-2013 at the glaucoma service, a total of 122 patients with documented clinical photographs by the same technician (DP) fulfilling inclusion criteria were included for the study. Of those excluded, 144 had history of trauma, neovascular glaucoma or posterior segment involvement (retinal vein occlusive disease). A total of 112 patients were excluded because of aphakic/pseudophakic status in one or both eyes while 72 patients with no reliable visual field data and 8 with no fundus view due to significant cataract were also excluded. Of 122 selected, 81 with poor quality photographs or unco-operative patients were excluded. A total of 119 (PXF n=81, PXG, n=38) were included for the study which comprised of 95 bilateral cases and 74 farmers, Table 1.

Table 1 Clinical and demographic characteristics with diet patterns among patients with pseudoexfoliation in the state of Odisha, India

Variable	Pseudo exfoliation cases N=119	Controls N=111	P value
Age (years)	69±9.2	67±5.7	0.6
Laterality			
Unilateral:bilateral	24:95	NA	
Occupation			
Business, n(%)	5 (4.2)	10 (9.09))	0.1
Farmers, n(%)	74 (62.1)	88 (79.2)	0.004
Housewife, n(%)	19 (15.9)	12(10.8)	0.05
Teacher, n(%)	3 (2.5)	0 (0)	0.13
Retired official, n(%)	19 (15.9)	1(0.9)	<0.001
Urban: rural	60:59	50:61	0.1
Literacy: Illiterate	89:30	74:37	0.2
Rainfall (rainy days)	250±59.2	238±60.1	0.9

Humidity (%)	71±7.7	70±8.1	0.7
Max temperature(^{0}C)	27±1.6	26±2.2	0.07
Minimum temperature (^{0}C)	13±.2.1	14±1.3	0.9
Smoking history (n)	45	56	0.06
Diet patterns			
Non veg, , n(%)	113 (94.9)	81 (72.9)	0.8
Fish intake, , n(%)	114 (95.7)	98 (88.2)	0.9
Mustard oil, , n(%)	83 (69.7)	76 (68.4)	0.9
Coffee intake>3 cups, n (%)	20 (16.8)	11(9.9)	0.02
Cereals, n (%)	115 (96.6)	101 (90.9)	0.7
Legumes, n (%)	111 (93.2)	97 (87.3)	0.7
Olive oil, n (%)	18 (16.2)	11(9.9)	0.02

The mean age of patients with and without PXF was not statistically significant, Table 1. The climatic conditions were not statistically different in PXF patients and controls suggesting no difference in populations sampled from different regions among cases or controls, Table 1.

Table 2 shows the distribution of PXF patients in different districts of the state showing lowest rainfall and maximum temperature in Khorda district from where the majority cases of PXF (n=42) and PXG (n=31) were seen, Figure 1.

Table 2 Locations of districts in Odisha, India, with geographical location and annual climatic conditions of the regions where pseudoexfoliation syndrome or glaucoma is prevalent

Name of district in odisha	Number of patients	Latitude	Longitude	Maximum temperature	Rainfall	Humidity
Angul	2	24'52'N	72'52'E	27	221.5	74
Bhadrak	6	21'03'N	86'33'E	25	245.7	62
Puri	14	19'48'N	85'52'E	27	297.9	74
Balasore	24	21'30'N	86'54'E	27	221.5	62
Jajpur	1	20'57' N	86'07'N	28	246.1	61
Khorda	42	20'11'N	85'40'E	29	196.2	83
Dhenkanal	1	20'40'N	85'38'E	28	344.8	82
Jagatsingpur	5	20'16'N	86'10'E	26	343.7	81
Kendrapada	5	20'30'N	86'28'E	26	333.3	80
keonjhar	1	21'30'N	85'30'E	26	343.6	66
Sambalpur	2	21'28'N	84'01'E	26	343.6	66
Sundargarh	1	22'07'N	84'01'E	26	229.2	82
Nayagarh	4	20'08'N	85'08'E	21	203.5	62
Jharsaguda	1	21'51'N	84'01'E	27	382.9	64
Ganjam	9	19'22'N	85'06'E	28	342	81
mayurbanj	2	21'56'N	86'46'E	26	312.8	62

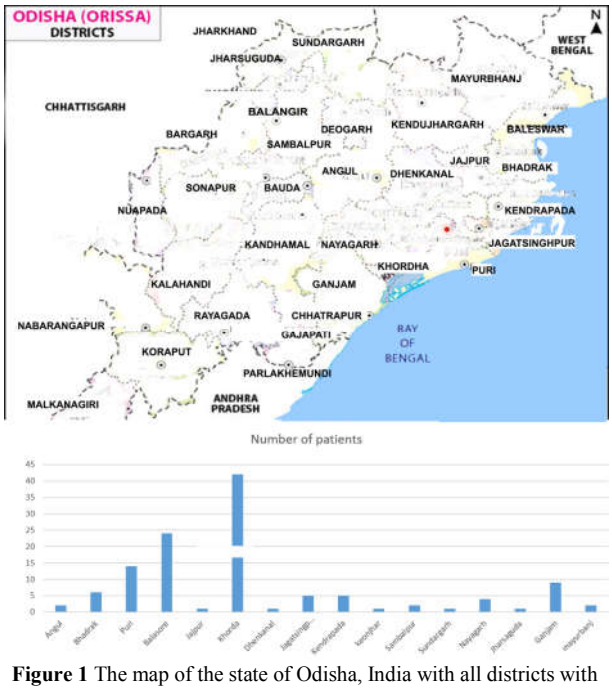

Figure 1 The map of the state of Odisha, India with all districts with graph showing total number of psedoexfoliation cases seen from each districts seen in this study.

The most common occupation among patients with and without glaucoma was farming (61%-62%) while the rest were urban dwellers involved with office work, teaching or business work, Table 1. Hours of daily outdoor work was inconsistent throughout the year or in different years among the same patients varying (daily average ranging from 4- 13 and 5-12 hours hours in both cases and controls, respectively) which therefore could not be included for any meaningful analysis and was not significantly associated with higher prevalence in that region.

The maximum temperature of the regions belonging to patients with glaucoma was statistically higher than those without glaucoma, p=0.009, Table 3. The annual average rainfall days and minimum temperature and humidity were not statistically different in eyes with and without glaucoma, Table 4.

Table 3 Comparison of characteristics between patients with pseudoexfoliation syndrome and glaucoma in Odisha, India

Variable	Pseudoexfoliation glaucoma N=38	Pseudoexfoliation syndrome N=81	P value
Age	69±9.8	67±7.5	0.2
Laterality Unilateral:bilateral	6:32	18:63	0.7
Occupation			
Business, n(%)	2 (5.2)	3 (3.7)	0.2
Farmers, n(%)	24 (63.1)	50 (61.7)	0.7
Housewife, n(%)	3 (7.8)	16 (19.7)	0.04
Teacher, n(%)	1 (2.6)	2 (2.4)	0.9
Retired official, n(%)	8 (21.05)	11 (13.5)	0.06
Urban: rural	20:18	40:41	0.6
Literacy: Illiterate	15:23	74:7	0.6

Table 4 Comparison of annual climatic conditions between patients with pseudoexfoliation syndrome and glaucoma in Odisha, India

Variable	Pseudoexfoliation glaucoma N=38	Pseudoexfoliation syndrome N=81	P value
Rainfall (rainy days)	247±61.2	256±57.1	0.4
Humidity (%)	71±7.5	70±8.1	0.5
Max temperature (^{0}C)	29±1.2	26±2.2	0.009
Minimum temperature (^{0}C)	13±.2.1	13±1.9	0.4
Smoking/tobacco history	30	15	0.05
Diet patterns			
Non veg, n(%)	37 (97.3)	76 (93.8)	0.5
Fish intake, n(%)	37 (97.3)	77 (95.06)	0.3
Mustard oil, n(%)	25 (65.7)	58 (71.6)	0.5
Coffee intake>3 cups, n(%)	15 (39.4)	5 (6.1)	0.02
Cereals, n(%)	37 (97.3)	78 (96.2)	0.4
Legumes, n(%)	36 (94.7)	75 (92.5)	0.5
Olive oil, n(%)	3 (7.8)	15 (18.5)	0.5

Most patients in this study were non-vegetarian (n=112) with history of fish intake in 114 of 119 PXF patients, Table 1 and 3. In addition, they consumed non-vegetarian food including chicken, mutton while only 30% consumed other animal products. Smoking/tobacco history was present in 45 cases and coffee intake >3 cups daily was present in 28 cases which was not different from controls. Comparing PXF and PXG eyes, more number of patients with PXG had coffee intake >3 cups and smoking/tobacco history, Table 4. Patients with intake of mustard oil (n=83 of 119) had more severe disease at presentation, p=0.05 with no variation compared to controls or between those with or without glaucoma. There was a marginal difference in number of patients with fish intake with PXF as compared to controls though other diet patterns

including cereals, legumes or others were not significantly different between PXF cases and controls, table 1.

In summary, majority of cases (PXG+PXG) were non-vegetarians and more number of cases consumed fish in daily diet than controls. Those with PXG were associated with >coffee intake >3 cups and smoking history residing in areas with higher maximum temperatures with no difference in other climatic conditions or diet patterns.

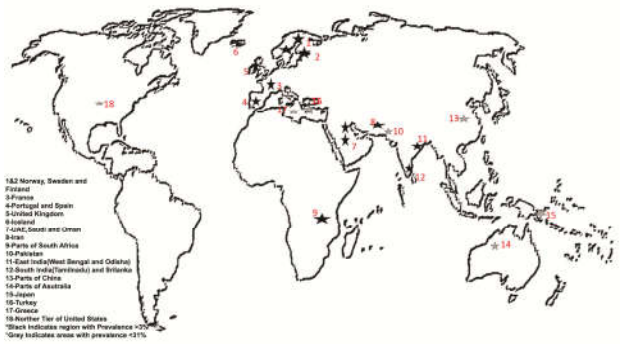

Figure 2 The world map showing areas with maximum prevalence of pseudoexfoliation showing most regions close to the sea or coast including Scandinavian countries (including Iceland, Norway Sweden), Saudi Arabia, Turkey, South and East India, Pakistan, Sri Lanka, parts of China, Africa and Australia, Japan and norther tier of Unites states.

DISCUSSION

This study found daily maximum temperature as the environmental condition associated with increased prevalence of PXF in East India while other climatic condition like annual rainfall days or humidity were no significantly different in cases and controls. Hours of outdoor activity was very inconsistent and variable in both cases and controls and was not associated with higher prevalence of PXF in that region though this study was underpowered to detect this difference. Most were non-vegetarian with common factor being mustard oil and fish consumption. We also evaluated other climatic conditions none of which were found to be significantly different in patients with PXF. We did not evaluate the genetic factors in our cohort and therefore cannot comment if a combination for genetic and environmental factors may be different in this cohort.

The prevalence of PXF varies from 0-30% in different countries across the globe suggesting both genetic and environmental conditions conferring susceptibility to the disease.[10-15, 19-24] Majority of our patients were farmers with many hours of outdoor exposure in cases and controls. The daily outdoor hours varied widely in patients which could not be analysed meaningfully in this study. Yet we found almost equal proportion of patients working >6 hours of outdoor work among controls and cases (data not shown) though we cannot rule out the effect of prior hours of exposure in our cohort and also lifestyle differences induced in different geographical regions. Ultraviolet radiation and sunlight exposure has been resumed to play an important role for predisposition of PXF.[6-9, 25,26] The causal role of radiation exposure or sunlight exposure has not been proven though the association of PXF with other associations like spheroidal degeneration, cataract and pterygium raise the possibility of a causal role in pathogenesis of the entity. The Reykjavik Eye Study did not find any association of outdoor work with increased risk of PXF though similar studies from clinics in US and Israel reported a 4% increased odds of PXF.[15,24] The latter study evaluated cumulative hours of exposure over a lifetime which different from our study which analysed daily hours of work. We do not believe that calculation of lifetime exposure could have given different results since both cases and controls had similar daily hours with varying hours over the year. The latter study also reported difference in risk with use of sunglasses with the US site conferring protection while the same could not be reproduced at the Israeli site. The differences between earlier studies could be because of possible gene-environment interactions where the exact role of incident versus reflected UV light and their causal role of PXF pathogenesis can be proven only after combining with genetic predisposition across different ethnic populations.

Our study found higher fish intake or non-vegetarian food in cases and higher smoking history and coffee intake in those with PXG. While coffee intake >3 cups has been reported to be higher in PXF, other dietary factors have not been reported in earlier studies.[6,17] A close look at earlier studies reveal that majority of people investigated include fishermen or have intake of fish as possible diets.[19-24] Closer look at places with more prevalence of PXF also show that many areas are closer to the sea or coastal areas where fish intake may be common dietary supplements, Figure 2.[10,11,15] The role of nutrition. lifestyle and vascular factors in PXF have been debated in several studies so far with no conclusive evidence of a causal relationship in disease pathogenesis.[6,10,12] and It may be interesting to study the total consumption of common diets (like fish) intake among cases and controls in particular geographic areas across the world and combine this information with genetic and environmental conditions prevalent in that area to arrive at a combined risk proportions conferred by each or a combination of common risk factors in cases. These methods have been well elucidated for other diseases in earlier studies for other complex diseases driven by lifestyle or diet patterns.[27,28] It is unclear how fish intake may predispose to changes in the anterior segment or blood vessels to cause pseudoexfoliation or cause onset of glaucoma. One such mechanism may be in the form of metal (specifically mercury which has been associated with neurodegenerative diseases) overload due to industrial spillage which accumulates in the resident fishes causing indirect exposure over long term ingestion in local residents consuming fish.[29] This entity being a basement membrane disorder could also have possible triggers in the form of sunlight/UV light or even cumulative environmental triggers including specific diet patterns which cause changes over long term exposures. While these postulations may be purely a deduction from common findings in earlier studies, a properly designed study evaluating combination of diet and environmental factors are important to answer and confirm their possible associations in PXF.

Such investigations would entail monitoring of not only common diets across different ethnic populations but also other diet histories with their nutritional status. It would involve huge sample sizes to prove the causal relationship between diet intakes across different global locations and also would involve inclusion of both rural and urban populations to assess the differential role of general lifestyles compared to diet history in pathogenesis of PXF. Such studies which would also require longitudinal follow up to evaluate development of PXF to prove a causal role than an association.

Incident ultraviolet (UV) light may predispose to pterygium or spheroidal degeneration on the ocular surface. Yet intraocular changes induced by incident light may not be the mechanism for PXF formation or disease onset. The role of the iris has attracted recent attention of many focus groups evaluating its role in PXF pathogenesis. While pattern of PXF deposits and other features point towards a dysfunctioning blood aqueous barrier and primary site of dysfunction being blood vessels at the iris, it is possible that chronic exposure to sunlight or high temperatures by incident UV light may cause specific changes at the iris blood vessels. It is also possible that long term exposure to radiation/UV light may induce genetic changes or alteration in protein misfolding which would also trigger development of PXF. While the role of genetic factors in PXF has been explored with LOXL1 Being implicated in disease pathogenesis, the role of LOXL1 in this disease remains unclear with different ethnic populations being conferred susceptibility or protection against disease with the similar gene variants. The reason for disparities in gene susceptibility across different ethnic populations raises questions of possible gene-gene interactions which may be different in different ethnicities and also possible gene-environment-diet interactions which has not been explored in any study.

We only took cases photographically documented at the glaucoma service by a single clinician to avoid selection bias and to ensure uniformity of diagnosis. We therefore cannot calculate the prevalence of PXF or PXG from this hospital based study with smaller sample collected during a specified period. We also did not collect family history which therefore could not be adjusted while seeing the influence of several variables in disease pathogenesis. We only administered a questionnaire evaluating common diet in the regions to evaluate and explore any difference in diet patterns in this region which could explain the higher prevalence among certain districts. We are unsure if using known methods of assessing diet patterns could have given any different information. Both hypothesis driven and exploratory studies of analysing diet patterns in cross sectional study designs. Yet, establishment of a causal role mandates long term follow up of patients and diet patterns in large clinical trials.

A global massive effort needs to be undertaken to prove the causal role of climatic conditions which should involve areas of maximum prevalence of PXF aiming to study the combined effect of environment, sunlight exposure, diet and nutritional and outdoor work with development of PXF over time. This combined with assessment of genetic predisposition would give answers how these factors play a combined role to PXF development in any population rather than either of them having isolated causal role.

References

1. Vesti E, Kivelä T (2000). Exfoliation syndrome and exfoliation glaucoma. *Prog Retinal Eye Res* 19 (3):345-68.
2. Layden WE, Shaffer RN. Exfoliation syndrome (1974). *Am J Ophthalmol* 78 (5): 835-41.
3. Naumann GO, Schlotzer-Schrehardt U, Kuchle M (1998). Pseudoexfoliation syndrome for the comprehensive ophthalmologist. Intraocular and systemic manifestations. *Ophthalmology*105 (6): 951-968.
4. Schlötzer-Schrehardt U, Naumann GO (2006). Ocular and systemic pseudoexfoliation syndrome. *Am J Ophthalmol* 141(5):921-937.
5. Thorleifsson G, Magnusson KP, Sulem P *et al* (2007). Common sequence variants in the LOXL1 gene confer susceptibility to exfoliation glaucoma. Science.317 (5843):1397-1400
6. Taylor HR (1979). Pseudoexfoliation, an environmental disease? Trans Ophthalmol Soc U K.99 (2): 302-7.
7. Resnikoff S, Filliard G & Dell'Aquila (1991). Climatic droplet keratopathy, exfoliation syndrome, and cataract. *Br J Ophthalmol* 1991; 75 (12): 734-736.
8. Zuclich JA (1989). Ultraviolet-induced photochemical damage in ocular tissues. *Health Phys*. 56 (5):671-682.
9. Forsius H, Forsman E, Fellman J, Eriksson AW (2002) Exfoliation syndrome: Frequency, gender distribution and association with climatically induced alterations of the cornea and conjunctiva. Acta Ophthalmol. Scand. 80 (5): 478-484
10. Krause U, Alanko HI, Kärnä J, Miettinen R, Larmi T, Jaanio E, Ollila OI, Takala J (1988): Prevalence of exfoliation syndrome in Finland. Acta Ophthalmol Scand (Suppl) 184 (1):120-122.
11. Ringvold A, Blika S, Elsas T, Guldahl J, Brevik T, Hesstvedt P, Johnsen H, Hoff K, Høisen H, Kjørsvik S (1988). The Middle-Norway eye screening study. I. Epidemiology of the pseudoexfoliation syndrome. Acta Ophthalmol Scand. 66 (6): 652-658.
12. Colin J, Le Gall G, Le Jeune B, Cambrai MD (1988). The prevalence of exfoliation syndrome in different areas of France. Acta Ophthalmol Suppl. 184:86-9
13. Khanzada AM (1986): Exfoliation syndrome in Pakistan. *Pakistan J Ophthalmol*. 2(4): 7-12.
14. Konstas AGP, Dimitrakoulias N, Kourtzidou O, Filidis K, Bufidis T, Benos A (1996). Frequency of exfoliation syndrome in Greek cataract patients. Acta Ophthalmol Scand. 74 (5): 478-482.
15. Arnarsson A, Jonasson F, Damji KF, Gottfredsdottir MS, Sverrisson T, Sasaki H (2010). Exfoliation syndrome in the Reykjavik Eye Study: risk factors for baseline prevalence and 5-year incidence. *Br J Ophthalmol*. 94 (7):831-5
16. Kang JH1, Wiggs LJ, Pasquale LR (2014). Relation between time spent outdoors and exfoliation glaucoma or exfoliation glaucoma suspect. *Am J* Ophthalmol. 158(3): 605-614.
17. Pasquale LR, Wiggs JL, Willett WC, Kang JH (2012). The Relationship between caffeine and coffee consumpt ion and exfoliation glaucoma or glaucoma suspect: a prospective study in two cohorts. Invest Ophthalmol Vis Sci. 53 (10):6427-33
18. Rao A, Padhy D (2014).Pattern of pseudoexfoliation deposits on the lens and their clinical correlation--clinical study and review of literature. PLoS One. 5:e113329 doi: 10.1371/journal.pone.0113329
19. Bartholomew RS (1973): Pseudocapsular exfoliation in the Bantu of South Africa. II. Occurrence and prevalence. *Br J Ophthalmol*. 57 (1): 41-45.
20. Sood NN (1968): Prevalence of pseudoexfoliation of the lens capsule in India. Acta Ophthalmol Scand. 46 (2): 211-214.
21. Yalaz M, Othman I, Nas K (1992): The frequency of exfoliation syndrome in the Eastern Mediterranean area

of Turkey. Acta Ophthalmol Scand (Copenh).70 (2): 209-231.
22. Rudkin AK, Edussuriya K, Sennanayake S, Senaratne T, Selva D, Sullivan TR, Casson RJ (2008). Prevalence of exfoliation syndrome in central Sri Lanka: the Kandy Eye Study. Br J Ophthalmol. 92 (12):1595-8.
23. Krishnadas R, Nirmalan PK, Ramakrishnan R, Thulasiraj RD, Katz J, Tielsch JM, Friedman DS, Robin AL (2003). Pseudoexfoliation in a rural population of southern India: the Aravind Comprehensive Eye Survey. *Am J Ophthalmol*. 135 (6):830-7.
24. Kang JH, Loomis S, Wiggs JL, Stein JD, Pasquale LR (2011) Demographic and geographic features of exfoliation glaucoma in 2 United States-based prospective cohorts. Ophthalmology.119 (1):27-35.
25. Stein JD, Pasquale LR, Talwar N, Kim DS, Reed DM, Nan B, Kang JH, Wiggs JL, Richards JE (2011) Geographic and climatic factors associated with the exfoliation syndrome. Arch Ophthalmol.129 (8):1053-1060.
26. Rosenthal FS, Phoon C, Bakalian AE, Taylor HR (19880. The ocular dose of ultraviolet radiation to outdoor workers. Invest Ophthalmol Vis Sci. 29 (4):649-656.
27. Schulze MB, Hoffmann K (2006). Methodological approaches to study dietary patterns in relation to risk of coronary heart disease and stroke. *Br J Nutr*. 95 (5):860-869.
28. McCullough ML, Feskanich D, Stampfer MJ, Giovannucci EL, Rimm EB, Hu FB, Spiegelman D, Hunter DJ, Colditz GA, Willett WC. (2002). Diet quality and major chronic disease risk in men and women: moving toward improved dietary guidance. *Am J Clin Nutr*. 76 (6):1261-1271
29. Chang LW, Hartmann HA (1972). Ultrastructural studies of the nervous system after mercury intoxication. II. Pathological changes in the nerve fibers. Acta Neuropathol.20 (4):316-34

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