

# Family history of Glaucoma in patients diagnosed with Systemic Hypertension and Diabetes: The Colombian Glaucoma study.

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## Research Article

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# Abstract

## Background

It is estimated that worldwide, 76 million people have some type of glaucoma, 57.5 million are affected by Primary Open Angle Glaucoma (POAG), the relationship between family history of glaucoma and development of this disease has not been established so far in Latin American populations. We aim to establish the relationship between the Family History of Glaucoma in Colombian patients diagnosed with Systemic Hypertension (SH) and Diabetes Mellitus (DM).

## Methods

We conducted a cross-sectional study among hypertensive and diabetic patients in Colombia, 2,067 subjects older than 50 diagnosed with SH or DM were included. Participants underwent to a complete ophthalmic and medical examination, standardized questionnaires, and interviews aiming to evaluate participants' health conditions and lifestyles.

## Results

In patients with a Family History of Glaucoma an OR: 2.11 ( 95% CI 1.33–3.34) was assessed for the presence of glaucoma, confirmed POAG was more frequent in men of all ages, patients from 70 to 79 years of age, OR: 0.54 ( 95% CI 0.36–0.79), and patients older than 80 years of age, OR: 0.47.

## Conclusion

We established a relation between family history of Glaucoma in Colombian glaucoma patients diagnosed with SH and DM over 50 years of age. Screening for glaucoma should be recommended in high-risk groups, such as relatives of glaucoma patients.

## Introduction

Glaucoma is a heterogeneous group of diseases whose common characteristic is optic nerve damage. It is a severe pathology given its chronic and silent evolution that, if not treated in time, leads to blindness. It is estimated that worldwide, 76 million people have some type of glaucoma, 57.5 million are affected by Primary Open Angle Glaucoma (POAG), and 6.7 million have bilateral blindness caused by this pathology(1) .

There are few studies on the Latino population that establish the relationship between the family history of glaucoma and its prevalence (2,3). This relationship in Colombia, South America, is currently unknown, especially in patients with Systemic Hypertension (SH) and Diabetes Mellitus (DM).

Different studies have been conducted worldwide including different populations aiming to identify glaucoma presence in subjects with family history. A 10.4% prevalence of glaucoma was estimated in siblings of patients with POAG and the presence of enlarged cup-disc ratio was established as the most prominent feature in relatives of patients with glaucoma (4,5).

Other studies have highlighted that open-angle glaucoma tends to be more common in African Americans than Caucasians, establishing a frequency of 3.4 times more likely to develop the disease with a family history of glaucoma and an even higher if a sibling had glaucoma. A family history of glaucoma was also linked to a more severe form of the illness, younger age, higher maximum Intraocular Pressure, and higher rates of past glaucoma surgery (6).

The Barbados Eye Study evaluated a cohort of 3222 African - descent participants on a 9-year follow-up. Family history of glaucoma represented a Risk Ratio (RR) of 2.4 ( 95% CI, 1.3– 4.6) (7), this study was conducted seeking to investigate the transmission pattern(s) of glaucoma in a predominantly black population; The study included 207 POAG-affected probands and 1,056 of their relatives. Among the relatives examined, 10% had POAG, segregation analyses were performed to determine the mode of inheritance for glaucoma in these families, suggesting that POAG inheritance pattern is most likely due to a significant codominant gene (8).

Screening for glaucoma in the general population is often discouraged but is recommended in high-risk groups, such as relatives of glaucoma patients. Having a glaucoma patient is more likely to find relatives positive for the disease (9), Glaucoma patients may have at least one sibling who has the condition, although they may be completely unaware.

The Colombian Glaucoma study is a cross-sectional study among hypertensive and diabetic patients conducted in 6 cities in Colombia. It was designed to assess the prevalence and the relationships between these two vascular risk factors (10). This study aims to establish the relationship between family history of glaucoma among patients diagnosed with Systemic Hypertension and Diabetes Mellitus.

## **Materials And Methods**

### **Study Design**

This study is a cross-sectional assessment of diabetic and hypertensive patients in six cities in Colombia, conducted from September 2014 to January 2019. At enrollment, individuals were  $\geq 50$  years old and treated with antihypertensive or anti-diabetic medications for at least one year. The diagnosis of DM and SH were verified according to the guidelines for each disease(11,12). All participants were selected from SH and DM control programs. The Universidad del Valle Institutional Review Board approved this study protocol (030-014), and all participants signed an informed consent form in order to receive attention. This research was conducted according to the tenants of the Declaration of Helsinki.

## Procedures

Each participant underwent a complete ophthalmologic examination, including visual acuity, refraction, slit-lamp examination, intraocular pressure (IOP), and pachymetry measurements. The IOP measurement was obtained from the average of three values by Goldmann tonometry. Gonioscopy was performed in a dark room using a 4-mirror gonio lens (Ocular Instruments Inc., Bellevue, WA) in primary position, with a slit beam less than 2 mm in height, followed by a dilated fundusoscopic examination with a 78 diopter (D) lens for evaluating the optic disc, (Ocular Instruments Inc., Bellevue, WA). Central corneal thickness (CCT) was calculated based on the average of three consecutive measurements using a PachPen handheld pachymeter (Accutome, iNC., Pennsylvania, USA).

In suspected cases of glaucoma, the diagnosis was confirmed using visual field (VF) test with the 24-2 Swedish Interactive Threshold Algorithm (Humphrey, Carl Zeiss Meditec, Inc) and optic nerve photos with a DRS camera (digital retinography system, Centervue, Fremont, CA, USA). Glaucomatous eyes had to have at least two consecutive, reliable, and repeatable standard automated perimetry examinations with either a standard pattern deviation (PSD) outside the 95% normal limits or a glaucoma hemifield test result outside normal limits. Reliable visual fields had rates of false positives, fixation losses, and false-negative errors of 20% or less to be included. Trained glaucoma specialists performed the examinations using standardized protocols.

Suspected and confirmed cases of glaucoma were defined according to the criteria specified by Foster et al.(12); confirmed glaucoma was defined as structural and functional evidence of glaucomatous damage in at least one eye that met the following criteria: 1) horizontal or vertical cup-disc ratio  $> 0.7$ , focal glaucomatous disc change (disc hemorrhage, neuroretinal rim notch, marked sloping of rim tissue, the narrowest remaining rim of 0.1 disc diameter or less), cup/disc asymmetry 0.2, associated with a glaucomatous Visual Field defect; 2) horizontal or vertical cup-disc ratio  $> 0.8$ , focal glaucomatous disc change, asymmetry  $> 0.3$  with an absence of functional evidence of glaucomatous damage (if the subject could not satisfactorily complete the Visual Field (VF) examination). Cases that did not meet all criteria were classified as suspected glaucoma. In addition, VF defects not explained by any other disease, like asymmetry across the horizontal midline, visual defects located in the mid-periphery, or clustered in neighboring test points, were defined as compatible with the disease.

Interviews and questionnaires were used to evaluate factors related to participants' lifestyles and other health conditions, including socioeconomic status, associated comorbidities, family history of glaucoma, education, and nutrition. In addition, a physical examination was performed that included measurement of height, weight, abdominal circumference, heart rate, systolic blood pressure (SBP), and diastolic blood pressure (DBP).

Blood pressure (BP) was measured in sitting after 5 minutes of rest using a sphygmomanometer (Welch Allyn, New York, U.S.). The cut-off values of BP were defined according to the guidelines for managing arterial hypertension of the European Society of Hypertension (ESH). (10) The Ocular Perfusion Pressure

(OPP) was defined as 2/3 Mean Arterial Blood Pressure (MABP) -IOP. The highest IOP value between the two eyes was used to calculate OPP.

## Sample size and Statistical Analysis

### Sample Design

For the calculation of the sample size, the following formula was applied, where a precision represented in a relative standard error (Esrel) less than or equal to 2.3% is assumed, and an expected proportion of the event  $p = 50\%$  to maximize the sample size, a reliability level of 95%, a design effect (Deff) of 1 and a population over 50 years of age for Colombia in 2014 equal to 10,672,965 inhabitants (DANE Redatam+SP - ECLAC/CELADE – Estimates based on the 2005 Population Census). For the final sample size calculation, a non-response percentage of 10% was considered.

The following expression was used for the estimation of the sample size:

$$n = \frac{NpqDeff}{N(Esrel \cdot p)^2 + pqDeff}$$

N	=	10.672.965
p	=	50%
q=1-p	=	50%
Esrel	=	2.3%
Deff	=	1
preliminary n	=	1.890
% of no respond	=	10%
Final N	=	2.079

Continuous variables were summarized with mean± standard deviation (SD) or median and Interquartile range (IQR), while categorical variables were described with proportions.

The patients were divided into three groups according to the status of diagnosis of Glaucoma: confirmed cases, suspected cases, and those without glaucoma. Binary and categorical characteristics were compared using a chi-square or Fisher's exact tests. A multinomial logistic regression model was applied to determine factors associated with glaucoma. Model selection was performed using a backward selection methodology, and variables with p values <0.20 in bivariate analysis were included. Odds Ratios

(OR) Were estimated with a 95% confidence interval, and goodness-of-fit was evaluated using a likelihood ratio test and the smallest model deviance. A level of significance of 0.05 was used. All analyses were carried out using Stata13® (STATA Corp, College Station, TX, USA).

## Results

A total of 2085 subjects participated in the interview and ophthalmologic examination, with 18 being excluded due to one or more exclusion criteria. The participants' average age was 65.93% (1324) female, 11.0% (227) had only DM, 59.6% (1231) had only SH, and 29.4% (608) had both diseases. Of the 2067 SH and DM patients, 142 had confirmed glaucoma and 226 had suspected glaucoma (Table 1).

[Insert Table 1 here]

### Glaucoma prevalence

The prevalence of confirmed POAG was 5.6% [95% CI: 4.6-6.0], with those with SH only having a higher prevalence. Furthermore, the proportion of suspected cases was higher among DM participants. The prevalence of POAG by age and gender is described in (Table 2).

**Table 2.** Prevalence of POAG

Glaucoma	Total % [95%CI]	DM % [95%CI]	SH % [95%CI]	DM/AP % [95%CI]
Confirmed	5.6 [4.6-6.6]	4.8 [2.4-8.5]	6.2 [4.9-7.7]	4.4 [2.9-6.4]
Suspect	9.1 [7.8-10.4]	11.4 [7.6-16.3]	8.6 [7.1-10.3]	10.5 [8.2-13.2]
Total	14.6 [13.1-16.2]	16.3 [11.7-21.5]	14.9 [12.9-16.9]	13.5 [10.9-16.5]

POAG: Primary open angle glaucoma; SH: Arterial Hypertension; DM: diabetes Mellitus; CI: Confidence interval

Confirmed POAG was more frequent in men of all ages. (Table 3).

**Table 3.** Prevalence of POAG according to sex and age

Age	Confirmed POAG			Suspected POAG		
	Women % [95%CI]	Men % [95%CI]	Total % [95%CI]	Women % [95%CI]	Men % [95%CI]	Total % [95%CI]
50-59	2.7 [1.5-4.9]	6.8 [3.9-11.6]	4.0 [2.7-5.9]	9.5 [7.0-12.8]	11.9 [7.9-17.6]	10.2 [8.0-13.0]
60-69	3.5 [2.2-5.6]	6.0 [3.8-9.4]	4.5 [3.2-6.1]	9.3 [7.0-12.1]	8.4 [5.7-12.1]	8.9 [7.1-11.1]
70-79	6.8 [4.5-10.1]	11.3 [7.7-16.1]	8.6 [6.5-11.3]	7.4 [5.0-10.8]	8.1 [5.2-12.5]	7.7 [5.7-10.2]
>80	5.6 [2.3-12.8]	8.9 [3.3-21.6]	6.7 [3.5-12.4]	10.1 [5.3-18.4]	11.1 [4.6-24.2]	4. [6.3-16.9]

POAG: Primary open angle glaucoma; CI: Confidence interval

## Family History of Glaucoma and the relationship with the disease

The following explanatory variables were considered in the multivariate logistic analysis (glaucoma as a response variable): smoking, age, gender, ethnicity, Body Mass Index (BMI), Intraocular Pressure (IOP), Central Corneal Thickness, Abdominal Perimeter, Family History of Glaucoma, socioeconomic level, Ocular Perfusion Pressure, Systolic Perfusion Pressure, Diastolic Perfusion Pressure, SH, DM, Systolic Pressure, Diastolic Pressure, optic Nerve Hemorrhage.

Patients aged 70 to 79 years had an OR of 2.64 ( 95% CI 1.46 - 4.78), women had an OR of 0.37 ( 95% CI 0.23 - 0.60), IOP had an OR of 0.80 ( 95% CI 0.47 - 1.39), Central Corneal Thickness had an OR of 0.80 ( 95% CI 0.68 - 0.94), High Socioeconomic status had an OR of 0.35 ( 95% CI 0.13 - 0.93), Family History of Glaucoma presented an OR: 2.11 ( 95% CI 1.33 - 3.34), Diastolic Perfusion Pressure presented an OR: 0.73 ( 95% CI 0.62 - 0.85), Systolic Blood Pressure presented an OR: 1.2 ( 95% CI 1.13 - 1.38), Optic disc hemorrhage presented a OR: 8.72 ( 95% CI 1.61 - 47.07). ( Table 4 )

[Insert Here Table 4]

## Family history of Glaucoma

In multivariate logistic analysis (Family history of Glaucoma as a response variable), the explanatory variables taken into account were: smoking, age, sex, ethnicity, Body Mass Index ( BMI), Intraocular Pressure ( IOP), Central Corneal Thickness, Abdominal Perimeter, socioeconomic status, Ocular Perfusion Pressure, Systolic Perfusion Pressure, Diastolic Perfusion Pressure, HT, DM, Systolic Pressure, Diastolic Pressure, Self Diagnosis of Glaucoma, education level, marital status, occupation. Patients from 70 to 79 years of age presented an OR:0.54 ( 95% CI 0.36 - 0.79); also, patients older than 80 years of age presented an OR: 0.47 ( 95% CI 0.23 - 0.90). Likewise, women presented an OR: 1.53( 95% CI 1.07 - 2.2). High-risk Abdominal Perimeter presented an OR: 1.57 ( 95% CI 1.00 - 2.43). Higher-income socioeconomic status presented an OR: 2.95 (95% CI 1.05 - 8.31 ), compared to Lower socioeconomic status with an OR: 1.89 (95% CI 1.13 - 3.16 ) and middle socioeconomic status with an OR: 2,67 (95% CI 1.49 - 4.78 ). Self-diagnosis of Glaucoma presented an OR: 3.69 ( 95% CI 2.16 - 6.27). Professional degree presented an OR: 1.66 (95% CI 1.20 - 2.28) for the presence of a Family history of Glaucoma.

[Insert Here Table 5]

## Discussion

Our results suggest that family History of Glaucoma presented an OR: 2.11 ( 95% CI 1.33–3.34) for the presence of glaucoma. The results were similar to previous studies that showed a positive relationship between family history and Glaucoma. The patients were more likely to present the disease if one or more family members had Glaucoma. In a study by Tielsch et al., POAG was shown to be associated with a history of glaucoma in siblings at a greater rate (OR = 3.69) than in parents (OR = 2.17) or children (OR =

1.12)(5). The Blue Mountains Eye Study also supported our results. 8.6% of people had glaucoma in a parent or sibling, 10.5% of women, and 5.9% of males. Parents indicated a Positive family history (6.4%) more than siblings (2.6%). Glaucoma affects mothers (5.0%) and sisters (1.6%) more than fathers (1.5%) and brothers (1.2%). After controlling for glaucoma risk variables, including IOP, 15.7% of glaucoma patients had a first-degree family history, compared to 8.3% of controls (13).

Doshi et al. evaluated 289 patients with the diagnosis of POAG, 219 with Ocular Hypertension (OHT), and 5624 persons with no evidence of either POAG or OHT, the authors concluded that first-degree relatives who had a positive family history of glaucoma were shown to be at an increased risk for POAG.(OR, 1.92; 95% CI,1.25–2.94), this study also found a history of glaucoma among siblings to be a stronger and more significant risk factor than a similar history among parents and children (siblings OR, 3.47; CI, 1.91–6.30) (parents OR, 1.56; CI, 0.88 – 2.74) (children OR, 1.02; CI, 0.11– 9.41) (2).

In a survey of 47 previously diagnosed POAG patients, 41 had no prior awareness of any family history of the disease, and 11 had no prior knowledge of any family history, new instances were found after examining all adult members of POAG families establishing that 27% of previously diagnosed POAG patients did not know of their glaucoma family history, these data show that a more significant proportion of adult POAG is inherited and POAG risk in first-degree relatives is around ten times higher than in persons without a family history of glaucoma. However, relatives are often uninformed of their risk, even decades after therapy has begun in their family (14).

In our results, women presented an OR: 1.53 ( 95% CI 1.07–2.2) also, patients from 70 to 79 years of age presented an OR: 0.54 ( 95% CI 0.36–0.79), and patients older than 80 years of age presented an OR: 0.47 ( 95% CI 0.23–0.90) for family History of Glaucoma with statistical significance. Similar results were found by O'Brien et al., wherein age-adjusted analysis among POAG cases, positive Family History was associated with female gender ( $P < .001$ ), younger age ( $P < 0.001$ ), use of hypertension medication ( $P = .03$ ), hypertension ( $P = .006$ ), and prior glaucoma surgery ( $P = .02$ ) (6).

Our study on Self-diagnosis of Glaucoma presented an OR: 3.69 for Family History of Glaucoma ( 95% CI 2.16–6.27). Despite, previous studies did not support these results, a German population survey interviewed 2,742 men and women. Fifty-one percent of the population had active knowledge of “glaucoma,” and 75% had a passive understanding of the term. Only 8.4% correctly recognized a basic glaucoma definition, lack of knowledge in the general population may be a significant cause of failure to detect glaucoma (15).

High-risk Abdominal Perimeter presented an OR: 1.56 for a Family History of Glaucoma with statistical significance ( 95% CI 1.00–2.43). Although no previous studies show an association between obesity and a family history of glaucoma, there is evidence between obesity and glaucoma. Ling et al. performed a meta-analysis of 15 studies, including 2,445,980 people. Adiposity and glaucoma were associated in females (RR 1.31; 95 percent CI 1.05–1.64) but not in males (RR 1.11; 95 percent CI 0.77–1.60). The pooled RR for cohort and cross-sectional studies was 1.00 (95% CI, 0.84–1.20) and 1.22 (95% CI, 0.89–1.66). Adiposity raises IOP, and abdominal adiposity raises the risk of glaucoma (16).



In our study higher-income socioeconomic status presented an OR: 2.95 (95% CI 1.05–8.31 ), compared to Lower socioeconomic status with an OR: 1.89 (95% CI 1.13–3.16 ) and middle socioeconomic status with an OR: 2.67 (95% CI 1.49–4.78 ) for the presence of Family History of Glaucoma, No previous studies have shown an association between socioeconomic status and a family history of glaucoma, but strong evidence establishes the link between socioeconomic status and glaucoma. In a Canadian study, a total of 290 people were studied, with 151 (52.1%) having mild glaucoma, 79 (26.7%) having intermediate glaucoma, and 60 (21.0%) having advanced disease at the time of diagnosis, when compared to an estimated one-fifth (20%) of patients in each of the five socio-economic categories, patients with newly diagnosed glaucoma were less likely to originate from the poorest neighborhood areas (16.21%) (P = 0.56). At first presentation, people in the wealthiest neighborhood regions had a slightly reduced probability of developing intermediate or advanced glaucoma at first presentation (prevalence ratio 0.66, 95% CI: 0.43–1.02, P = 0.06) than those in the lowest neighborhood areas (17).

To our knowledge, this is the first program-based study to report the relationship between family history of glaucoma in glaucoma patients diagnosed with SH and DM over 50 years of age in Colombia, we included patients from six cities in Colombia allowing a representativeness of the population, laying the basis to elucidate and conduct other studies in Latin-American populations due to the important burden of the disease in developing countries.

Comprehensive medical history results can help identify glaucoma suspects before glaucomatous changes are observed. A complete history can help guide judgments regarding the types of objective tests that should be performed during a clinical evaluation. When objective tests suggest equivocal or conflicting diagnostic results, the potential usefulness of a complete history, including a family history of glaucoma in decision making, may be more significant (18).

Referral to family history of glaucoma results may be beneficial in therapy and the adequacy of follow-up programs and their diagnostic potential. Higher-risk groups may be the most cost-effective strategy for lowering the volume of undetected glaucoma. Patient history seems feasible for identifying individuals at increased risk for developing glaucoma (19).

## Conclusions

A relationship between Family History of Glaucoma in Colombian glaucoma patients diagnosed with SH and DM over 50 years of age was elucidate in our study, it is important to improve and promote knowledge of the disease in the general population, encouraging patients with POAG to inform family members about the need for glaucoma screening and follow-up.

## Declarations

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**Author contribution:**

Conception and design of the study: Rivera C, Ferreira MC, Muñoz E, Ankur S. Aristizabal JC

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**Availability of Data and Materials:** The datasets analyzed during the current study and that support the findings of this study are available from Collective Innovations, but restrictions apply to the availability of these data, due to internal privacy policies. Data are however available from Rivera C. Upon reasonable requests and with permission of Collective Innovations.

**Ethics approval and consent to participate:**

This study protocol was approved by the institutional review board of Universidad Del Valle, this study protocol (030-014). All methods were carried out in accordance with the Helsinki Declaration and according to Colombian research regulations resolution No. 008430 of 1993, article 11, numeral A. All participants signed an informed consent form in order to receive attention.

**Consent for publication:** Not applicable

**Declaration of conflicting interests:** The authors declare no conflicts of interest

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## Tables

**Table 1.** Sociodemographic, clinical and ocular characteristics of cases with and without POAG

Variable	Confirmed (n = 142)		Suspect (n = 226)		No Glaucoma (n = 1699)		p value	Total (n = 2067)	
	n	%	n	%	n	%		n	%
Age n (%)									
50 - 59	25	17,61	73	32,30	480	28,25	0,001	578	27,96
60 - 69	48	33,80	93	41,15	664	39,08		805	38,95
70 - 79	57	40,14	44	19,47	445	26,19		546	26,42
>80	12	8,45	16	7,08	110	6,47		138	6,68
<b>Sex n (%)</b>									
Female	70	49,30	149	65,04	1,105	64,05	0,001	1,324	65,93
Male	72	50,70	77	34,96	594	35,95		743	34,07
<b>Race n (%)</b>									
Latino (mestizo)	116	81,69	164	72,57	1,348	79,34	0,012	1628	78,76
African - Colombian	13	9,15	29	12,83	118	6,95		160	7,74
White	13	9,15	33	14,60	233	13,71		279	13,50
<b>Marital Status n (%)</b>									
Other	55	38,73	81	36,00	734	43,23	0,083	870	42,13
Married/Free Union	87	61,27	144	64,00	964	56,77		1,195	57,87
<b>Educational Level n (%)</b>									
High school or less	114	81,43	172	76,79	1,257	75,22	0,242	1,543	75,82
professional degree	26	18,57	52	23,21	414	24,78		492	24,18
<b>Smoker n (%)</b>									
Non smoker	79	56,03	142	63,39	1,029	60,74	0,593	1,25	60,71
former smoker	57	40,43	75	33,48	593	35,01		725	35,21
Smoker	5	3,55	7	3,13	72	4,25		84	4,08
<b>Systemic Diagnosis n (%)</b>									
DM	14	9,86	33	14,60	180	10,60	0,422	227	10,99
SH	89	62,68	129	57,08	1013	59,66		1231	59,58
DM/SH	39	27,46	64	28,32	505	29,74		608	29,43
<b>IOP</b>									

Mean (DE)	15,4	5,03	15,06	4,19	13,93	2,77	0,000	14,15	3,19
<b>OPP n (%)</b>									
<40	34	24,11	52	23,42	221	13,19	0,000	307	15,06
41 - 50	63	44,68	100	45,05	818	48,81		981	48,11
51 - 60	31	21,99	63	28,38	541	32,28		635	31,14
>60	13	9,22	7	3,15	96	5,73		116	5,69
Mean (DE)	45,8	11,75	46,09	7,89	48,05	7,61	0,000	47,69	8,03

IOP:Intraocular Pressure; CCT: Central, Corneal Thickness; IQR: Interquartile Range; OPP: Ocular perfusion pressure; DBP: diastolic blood pressure; SBP: systolic blood pressure; BMI: Body mass index; ; DM: diabetes Mellitus; SH: Systemic Hypertension.

**Table 4**

**Multinomial logistic regression**

Glaucoma	Glaucoma				Glaucoma suspect			
	Coef. (RRR)	[95% Conf	Interval]	Sig	Coef. (RRR)	[95% Conf	Interval]	Sig
smoking status: base Non smoker	1	.	.		1	.	.	
former smoker	1.169	.746	1.832		1.01	.706	1.445	
smoker	.893	.299	2.668		.778	.318	1.906	
age (years): base 50-59	1	.	.		1	.	.	
60-69	1.236	.684	2.233		.944	.645	1.383	
70-79	2.646	1.464	4.783	***	.574	.349	.944	**
> 80	1.609	.613	4.224		1.053	.518	2.142	
Sex: base Male	1	.	.		1	.	.	
Female	.379	.239	.602	***	.978	.663	1.442	
ethnicity: base : Latino, Mestizo, Non White	1	.	.		1	.	.	
African- colombian	1.06	.515	2.182		1.807	1.07	3.052	**
White	.641	.306	1.346		1.344	.85	2.124	
Body Mass Index : base: Normal Weight	1	.	.		1	.	.	
Overweight	.78	.456	1.335		1.126	.73	1.739	
Obesity	.848	.452	1.592		1.224	.733	2.041	
Intraocular Pressure (mmHg)	.803	.685	.941	***	.828	.717	.956	**
Corneal Central Thickness (microns)	.991	.985	.997	***	.995	.99	1	**
Abdominal Perimeter: base Low risk	1	.	.		1	.	.	
Increased risk	.978	.491	1.948		.935	.557	1.569	
high risk	1.206	.622	2.336		.624	.372	1.045	*
Family history of Glaucoma: base No	1	.	.		1	.	.	
Yes	2.11	1.333	3.342	***	1.013	.683	1.502	
Socioeconomic Level: base Level 1	1	.	.		1	.	.	
Level 2	.559	.29	1.076	*	1.083	.633	1.853	
Level 3	.605	.321	1.141		.82	.474	1.418	
Level 4	.513	.236	1.115	*	.847	.446	1.609	
Level 5	.353	.133	.938	**	.839	.379	1.861	
Level 6	.197	.022	1.737		1.42	.426	4.731	
Ocular Perfusion Pressure	.962	.91	1.016		.966	.924	1.01	
Diastolic Perfusion Pressure	.733	.627	.857	***	.776	.673	.895	***
Systolic Perfusion Pressure	1	.	.		1	.	.	
Systemic Hypertension: base No	1	.	.		1	.	.	
Yes	1.372	.609	3.089		.634	.378	1.062	*
Diabetes Mellitus: base No	1	.	.		1	.	.	
Yes	.879	.555	1.391		1.116	.768	1.624	
Systolic Blood Pressure	1.253	1.134	1.385	***	1.191	1.086	1.305	***
Diastolic blood Pressure	1	.	.		1	.	.	
Optic Nerve hemorrhage: base No	1	.	.		1	.	.	
Yes	8.723	1.616	47.073	**	1.974	.206	18.934	
Constant	1.646	.04	66.918		3.583	.184	69.882	

\*\*\*  $p < .01$ , \*\*  $p < .05$ , \*

\*  $p < .1$

**Table 5**

**Logistic regression**



Family history of Glaucoma	OR	[95% Conf	Interval]	Sig
Smoking status : base No smoker	1	.	.	
former smoker	.802	.606	1.063	
smoker	.938	.489	1.797	
Age ( years): base 50-59	1	.	.	
60-69	.922	.672	1.264	
70-79	.54	.364	.8	***
> 80	.467	.24	.908	**
Sex : base Male	1	.	.	
Female	1.535	1.071	2.2	**
ethnicity: base Latino - Mestizo -Non white	1	.	.	
African - colombian	1.193	.772	1.842	
White	.85	.577	1.252	
Body Mass Index (BMI): base Normal Weight	1	.	.	
Overweight	1.356	.973	1.889	*
Obsesity	.986	.666	1.462	
Intraocular Pressire (IOP) mmHg	1.014	.951	1.081	
Central Corneal Thickness (micronss)	.999	.996	1.003	
Abdominal Perimeter: base : low risk	1	.	.	
increased risk	1.565	1.007	2.433	**
high risk	1.233	.802	1.895	
Socioeconomic Level: base Level 1	1	.	.	
Level 2	1.885	1.126	3.156	**
Level 3	2.383	1.426	3.982	***
Level 4	2.666	1.486	4.782	***
Level 5	2.263	1.14	4.496	**
Level 6	2.952	1.049	8.309	**
Ocular Perfusion Pressure	.993	.959	1.027	
Systolic Perfusion Pressure	.988	.93	1.051	
Diastolic Perfusion Pressure (omitted)	1	.	.	
Systemic Hypertension : base No	1	.	.	
Yes	.808	.515	1.266	
Diabetes Mellitus : base No	1	.	.	
Yes	.803	.602	1.07	
Systolic Blood Pressure	1.015	.979	1.052	
Diastolic Blood Pressure (omitted)	1	.	.	
Have you been diagnosed with glaucoma: base No	1	.	.	
yes	3.685	2.166	6.271	***
Education Level: base: high school	1	.	.	
professional degree	1.658	1.203	2.285	***
marital status: base : free union	1	.	.	
married	1.106	.847	1.445	
occupational status: base: retired	1	.	.	
independent - employee	.831	.576	1.201	
home duties	1.022	.719	1.452	
Constant	.06	.006	.614	**

\*\*\*  $p < .01$ , \*\*  $p < .05$ ,

\*  $p < .1$

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