

# Epidemiology of glaucoma in central Ethiopia

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## Abstract

- **AIM:** To evaluate the prevalence of glaucoma, treatment patterns and patient attitudes in Ethiopia.
- **METHODS:** A survey was administered to glaucoma patients in hospitals in Addis Ababa, Ethiopia.
- **RESULTS:** Of the 415 qualified patients, exfoliative glaucoma (17%) was most commonly found in the Gurage population (33%), whereas chronic angle-closure glaucoma (5%) was found in the Amhara/Tigre (6%) population ( $P=0.006$ ). Patients were treated with an average of  $1.4 \pm 0.8$  medications: 52% admitted recent noncompliance and 36% had undergone filtering surgery. Patients believed their physician was trying to help them (93%). God wanted them to receive treatment (89%) and their spouse was sympathetic to their disease (82%). Patients noted their community was unaware of their condition (87%) with Muslims [most common in the Gurage population (31%,  $P < 0.0001$ )] reporting this the most (25%,  $P=0.01$ ). Amhara/Tigre patients strongly believed their doctors were concerned about them (94%,  $P=0.04$ ).
- **CONCLUSION:** The prevalence of glaucoma type varies among ethnic groups in Ethiopia with exfoliation more common in the Gurage population and chronic angle-closure glaucoma more frequent in the Amhara/Tigre population.
- **KEYWORDS:** Ethiopia; glaucoma; attitudes; religion

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## INTRODUCTION

Glaucoma has been shown by numerous epidemiological studies to be a leading cause of blindness worldwide, ranging from 1%–2% of the population >40 years of age among various regions [1–4]. Of those with glaucoma, primary open-angle glaucoma is generally the most prevalent type. However, the predominant type of glaucoma, as well as the variance of the proportion of patients with secondary glaucomas, varies by region. For example, low-tension glaucoma has been shown to be the leading type of glaucoma in both Japan and South Korea [5,6]. In addition, in Southeast Asia in Indian and Chinese populations chronic angle-closure glaucoma has been noted to be equal, or greater in prevalence, to primary open-angle glaucoma [7,8]. It is important to identify the causes of glaucoma regionally for the purpose of educating physicians and the public and to allocate treatment resources appropriately.

Ethiopia is an Eastern African country that is an important commercial center with an approximate population of 74,777,981 (<https://www.cia.gov/cia/publications/factbook/>). The country consists of a complex composition of more than 80 ethnic groups of which the Amhara/Tigre and Oromo ethnic groups represent approximately two-thirds of the population. Ethiopia is almost evenly divided between Muslim and Christian communities. Unfortunately, very little information is available regarding the types of glaucoma, or attitudes towards this disease, in Ethiopia generally or within individual ethnic or religious groups.

The purpose of this survey was to evaluate the prevalence of the type of glaucoma, treatment patterns and patient attitudes towards community support systems based on ethnicity and religion in Ethiopia.

## MATERIALS AND METHODS

**Patients** This survey was conducted in Addis Ababa, Ethiopia, the capital and largest city, which is located centrally within the country with a population of approximately three million. Three government hospitals with ophthalmology departments were chosen for this survey (Ras-Desta Hospital, Menellik II Hospital and All Africa

Leprosy, Tuberculosis & Rehabilitation Training Centre). The hospitals draw patients primarily from the major ethnic groups from Ethiopia (Amhara/Tigre, Oromo and Gurage) as well as the two major religions (Christian and Muslim).

Patients included in this study were chosen consecutively and were known to have glaucoma of any type as demonstrated by: typical optic disc damage (i.e. optic disc rim thinning, notching or saucerization, or the presence of peripapillary nerve fiber layer hemorrhage), and potentially associated with typical glaucomatous visual field damage (i.e. nasal step, or paracentral, Seidel's or arcuate scotoma, or deep diffuse depression). The diagnosis of glaucoma was determined by dilated ophthalmoscopy and manual visual field testing (Goldmann perimetry).

Patients excluded from this study were those without glaucomatous optic disc or visual field changes with normal intraocular pressure or those with elevated pressures without the presence of glaucomatous optic disc or visual field damage (ocular hypertension). Patients were also excluded who did not desire to participate in the study, could not cooperate or understand the questions due to either language or cognitive skills.

**Methods** The survey was developed to evaluate the prevalence of different glaucoma types, treatment patterns and patient attitudes towards community support systems. After Ethics Committee approval and obtaining informed consent, the survey was administered by one of the investigators (AMA). The survey was read aloud to each patient because most of the patients either arrived to clinic late and this method was the most time efficient manner to administer the test, their vision was compromised or they were illiterate. The survey questions were written in English, but translated verbally by the investigator (AMA) into the respective ethnic group language. The same investigator recorded the responses to each question. The survey questions were developed at PRN Pharmaceutical Research Network, LLC (WCS) specifically for this study. All surveys were performed between July and November 2006.

**Statistics** The sample size was planned prospectively for this study, since this was a descriptive, non-comparative survey, it was not powered. However, sub-analyses were performed on each question based on the major religions and ethnic groups included in this trial.

The following tests were used to analyze the results between ethnic and religious groups. A one-way ANOVA was used to evaluate age and duration of diagnosis<sup>[9]</sup>. A Mann Whitney U

**Table 1 Patient characteristics (≥2% response shown)**

Characteristics	Details	n= 415	%
Age <sup>1</sup>	Average years	59.5±12.5	
Gender <sup>2</sup>	Male	255	61
	Female	159	38
Religion	Christian	364	88
	Muslim	51	12
Ethnicity	Amhara/Tigre	228	55
	Oromo	103	25
	Gurage	58	14
	Other	26	6
Glaucoma diagnosis	Primary open-angle	278	67
	Exfoliation	71	17
	Chronic angle closure	20	5
	Other	46	11
Family with glaucoma	Parents	18	4
	Siblings	12	3
	Parents and siblings, or children	7	2
	No	378	91
Length of glaucoma	Average years	3.5±3.7	
Concomitant diseases <sup>3</sup>	Hypertension	84	20
	Diabetes	53	13
	None	297	72

<sup>1</sup>Two patients did not provide; <sup>2</sup>One patient did not specify; <sup>3</sup>Multiple answers allowed

test was used to analyze ranked data and a Chi-square test to analyze non-ranked data or ranked data involving more than two columns. A Chi-square or Fisher's exact test was used, as appropriate, to evaluate data in a 2 × 2 table <sup>[9,10]</sup>. All statistical tests were non-paired, two-sided and used a *P* value of 0.05.

We also performed a multi-variant linear regression analysis separately for religion or ethnicity to test for statistical associations of these two parameters to individual questions that showed a significant difference by Chi square, Mann Whitney U or ANOVA testing.

## RESULTS

**Patients** We included 415 willing, consecutive, qualified patients in this study. No qualified patients were excluded from this study.

The survey drew most heavily from the Amhara/Tigre (*n*=228.55%), Oromo (*n*=103.25%) and Gurage (*n*=58.14%) ethnic groups (5% other ethnic groups). In addition, while primary open-angle glaucoma was the most prevalent type of glaucoma (*n*=278.67%), both chronic angle-closure (*n*=20.5%) and exfoliation glaucoma (*n*=71.17%) were represented in a strong minority of patients. The survey results for all patients are shown in Tables 1-3 and the significant factors for the religion and ethnic group sub-analyses are shown in Table 4.

**Table 2 Patient treatment**

Treatment	Details	n= 415	%
Currently prescribed	Timoptic, pilocarpine	151	36
	Timoptic	141	34
	Other	58	14
	None	65	16
Surgery	Yes	148	36
	No	267	64
Surgery type	Trabeculectomy	128	31
	Other	21	5
	None	266	64
Missed doses	2-5 times	162	39
	6-10 times	37	9
	Other	16	4
	None	200	48

**Table 3 Patient attitudes (≥2% response shown)**

Attitudes	Details	n= 415	%
If I miss	I fail to help myself	159	38
	I do not care	35	8
	I feel guilty	18	4
	None	199	48
I believe my doctor	Is trying to help me	319	77
	Is trying to help me and has concern for me	68	16
	Has concern for me	26	6
My community's attitude	Does not know	363	87
	Sympathetic	50	12
My spouse's attitude	Sympathetic	339	82
	Does not know	26	6
	Supportive	8	2
	NA	42	10
Based on religion I think	God wants me to receive treatment	331	80
	Is merciful and is able to heal me	22	5
	Both of the above	39	9
	Other	23	6

Of the qualified patients: the average age was 59.5 ±12.5 years; 61% patients were male and 38% were female; 20% had systemic hypertension, 13% had diabetes and 1% had heart disease; and 8% patients had a family history of glaucoma. The average length of follow-up was 3.5± 3.7 years. In regard to treatment, patients were treated with an average of 1.4±0.8 medications, of whom 52% admitted some level of noncompliance throughout the previous month. Thirty-six percent of patients had undergone filtering surgery (mostly trabeculectomy, 31%) with or without associated cataract extraction.

In regard to patient attitudes toward their support groups, generally: patients strongly believed their physician was trying to help them (93%) and most indicated their spouse was sympathetic (82%), but that their community was not aware of their condition (87%). Patients overwhelmingly believed God wanted them to receive treatment (89%).

**Sub-analysis Based on Ethnicity and Religion** There were a greater percentage of Muslims ( $n=18.31\%$ ,  $P<0.0001$ ) in the Gurage populace. In contrast, the Amhara/Tigre and Oromo populations demonstrated the highest prevalence of Christians (range 87%-95%). Patient and treatment characteristics generally were similar among the two religious and three ethnic groups. There were, however, a greater percentage of exfoliation patients ( $n=19.33\%$ ,  $P= 0.006$ ) in the Gurage populace. In contrast, the Amhara/Tigre and Oromo populations demonstrated the highest prevalence of chronic angle-closure (range 5%-6%).

Further, several statistical differences occurred in responses to the survey based on religion or ethnicity. A statistically greater number of Muslims than Christians indicated their community was aware of their glaucoma ( $P = 0.01$ ). In contrast, patients in the Amhara/Tigre ethnic group expressed stronger belief that their doctor had a concern for them than the other population groups ( $P= 0.04$ ).

**Multi-variant Linear Regression** The multi-variant linear regression analyses showed religion was a risk factor for glaucoma type ( $P=0.036$ ) and religion was a risk factor for community awareness ( $P= 0.023$ ).

**DISCUSSION**

Several previous studies have evaluated the prevalence of low vision and blindness in Ethiopia [11-15]. Alemayehu and associates [11] surveyed a rural population of approximately 61000 in Central Ethiopia and showed a prevalence of blindness of 1.1%. Of these individuals, 872 patients were later examined and the causes of the visual loss were found to be corneal (32%), cataract (25%), atrophied globe(s) (20%) or glaucoma (17%).

Zerihun and Mabey[12] evaluated low vision in 7 423 patients in the Jimma zone and found a prevalence of blindness of 0.85% and low vision of 1.7%. Cataract and aphakia (52.4%), corneal opacity and phthisis bulbi (25.4%), and glaucoma (9.5%) were the major causes of vision loss[12]. Further, Melese and coworkers[13] evaluated 2 693 patients in the Gurage zone and noted a prevalence of blindness of 7.9% and low vision of 12.1%. Cataract (46.1%), trachoma (22.9%), and glaucoma (7.6%) were the major causes of vision loss.

**Table 4 Factors significant for religion or ethnicity**

		Christian n=364	Muslim n=51	P value	Amhara/Tigre n=228	Oromo n=103	Gurage n=58	P value
Religion	Christian				216	90	40	<0.0001
	Muslim				12	13	18	
Ethnicity	Amhara/Tigre	216	12	<0.0001				
	Oromo	90	13					
	Gurage	40	18					
Diagnosis	Primary open-angle	251	27	0.1	154	75	31	0.006
	Exfoliation	61	10		40	8	19	
	Chronic angle closure	16	4		14	5	1	
	Other	36	10		20	15	7	
I believe my doctor	Is trying to help me	278	41	0.88	164	87	48	0.04
	Is trying to help and has concern for me	60	8		43	10	9	
	Has concern for me	24	2		21	4	1	
My community	Does not know	325	38	0.01	203	90	48	0.52
	Is sympathetic	37	13		25	12	9	

In contrast, Bedri and Alemu<sup>[14]</sup> evaluated glaucoma patients specifically for the prevalence of exfoliation in Addis Ababa. Of 432 patients, 108 (25%) had exfoliation. In addition, Teshome and Regassa<sup>[15]</sup> studied the prevalence of exfoliation in 229 cataract surgery patients in Addis Ababa and 39.3% had exfoliation. The mean age of these patients was 63.7 years and the authors thought the syndrome was presenting in patients younger than typical for Europe.

Unfortunately, little information is available regarding the types of glaucoma or treatment patterns in Ethiopia regionally or among specific ethnic or religious groups. The purpose of this survey was to evaluate the prevalence of the type of glaucoma, treatment patterns and patient attitudes towards community support systems based on ethnicity and religion in Ethiopia.

Primary open-angle glaucoma was the most prevalent type of glaucoma found in this study. However, a clinically important minority of patients demonstrated several types of glaucoma found primarily in other parts of the world. Exfoliation glaucoma was noted in 17%. This finding was fairly consistent with the findings of Bedri and Alemu(25%)<sup>[14]</sup>, but was lower than those found by Teshome and Regassa (39%)<sup>[15]</sup>. However, we did not evaluate a specific cataract surgical population which might have influenced the prevalence of exfoliation in our study<sup>[16]</sup>. The overall prevalence of exfoliation for Ethiopia generally appeared less than that in many European countries where this type of glaucoma is common (25%-75%, generally in Baltic and Mediterranean countries), although it was higher than that

found in countries with a known low prevalence such as the United States (3%)<sup>[2]</sup>. Among individual ethnic groups evaluated in our study, the prevalence of exfoliation glaucoma was highest in the Gurage population (31%) and lowest in the Amhara/Tigre (18%) and Oromo groups (8%). Of interest also was a 5% prevalence of chronic angle-closure glaucoma that was higher in the Amhara/Tigre (6%) and Oromo (5%) ethnic groups. Chronic angle-closure occurs at a very low percent in all populations, but is high in the Indian and Chinese populations in East Asia<sup>[17,18]</sup>. The reason for the slightly higher prevalence of chronic angle-closure glaucoma in this study than in most world populations is not clear.

Patient characteristics were generally similar across the religious and ethnic groups. The prevalence of a positive family history for glaucoma and gender distribution was similar, while the average patient age of approximately 60 years appeared slightly younger compared to several previous reports from other parts of the world<sup>[2,19-21]</sup>. The reason for the younger age is not known exactly. However, Teshome and Regassa<sup>[15]</sup> noted that their Ethiopian exfoliation population was younger than typically found in Western countries. In addition, African-Americans have been described in several previous reports as developing glaucoma earlier than Caucasians<sup>[2]</sup>.

The incidence of diabetes (13%) and systemic hypertension (20%) was consistent in our patients with Western countries, while the percent with cardiovascular disease appeared low (1%)<sup>[22]</sup>. This may reflect the overall younger glaucoma

populations in Ethiopia that may not have had the time to develop clinically manifest cardiovascular disease from their diabetic and hypertensive conditions.

Treatment characteristics were generally the same across the religious and ethnic groups. The number of patients in this study prescribed at least two medicines (42%) appears similar to that of other Western countries<sup>[23]</sup>. In contrast, the level of compliance may be lower than Western countries<sup>[24]</sup>. However, it must be noted that the accuracy of self-reported compliance generally is suspected.

Overall, the number of patients who received surgery for glaucoma appears higher in Ethiopia (36%) than other Western countries<sup>[25]</sup>. The reason for this is not known. Physicians in Ethiopia frequently choose surgery over medical therapy early in the clinical course, when they believe non-compliance may be a problem. In addition, patients had limited access to prostaglandins, which may have led to a greater need for surgery. Several studies have indicated that the need for surgery has decreased over the last decade where the prostaglandins have become available<sup>[26,27]</sup>. Another factor may be that since Ethiopians are primarily of the black race, which is known to have more severe glaucoma, then surgery was more often required<sup>[2]</sup>.

Regarding patient attitudes toward their support groups, generally patients had a positive image of their doctor, believed that God was positive towards them receiving treatment and had disclosed the existence of their illness to their spouse. However, their community was generally unaware of their disease.

Nonetheless, several differences in patient attitudes existed based on religious or ethnic differences. First, patients in the Amhara/Tigre tribe more often expressed that the doctor had a specific concern for them. The reason for this was unknown and did not appear to affect compliance; second, a higher percentage of Christian patients indicated the community was not aware of their disease. This was also positive by multivariate analysis. The meaning for this finding is not completely clear. The level of awareness by the community was not examined by the survey. Further, glaucoma awareness as a disease in Ethiopia appears generally low. Consequently, a person's knowledge of an acquaintance with glaucoma may be interpreted as merely 'an eye problem' and not this specific ocular condition.

This study suggests that the prevalence of glaucoma type varies among ethnic groups in Ethiopia with exfoliation being more common in the Gurage, and chronic angle-

closure glaucoma in the Amhara/Tigre and Oromo populations. In addition, some variance in patient treatment attitudes is dependent upon religious preference and ethnicity.

This study was limited by the central geographical location within Ethiopia of Addis Ababa and the surrounding environs. Consequently, a more urban and Christian population, derived from several ethnic groups, are represented in this study. Since Ethiopia is made up of numerous ethnic groups, and is about half Muslim, future studies might concentrate on other geographic regions to capture a different ethnic profile and include more Islamic patients. Future study in Ethiopia is also needed to describe the prevalence of glaucoma among the general population, the response to treatment and glaucomatous progression rates. Acknowledgements: We give our thanks to financial support clinically from Teleios, Inc., a private foundation.

### REFERENCES

- 1 Ritch R, Shields MB, Krupin T (eds). *The Glaucomas*. 2nd ed. St Louis: Mosby Inc 1996
- 2 Shields MB. *A study guide for glaucoma*. Baltimore: William & Wilkins; 1982
- 3 Goldschmidt E, Fuchs J, Raitta C. Glaucoma prevalence in the Nordic countries. Estimates based on glaucoma drug consumption. *Acta Ophthalmol (Copenh)*1989; 67(2):204–210
- 4 Friedman DS, Wolfs RC, O'Colmain BJ, Klein BE, Taylor HR, West S, Leske MC, Mitchell P, Congdon N, Kempen J. Eye Diseases Prevalence Research Group. Data Center for Preventive Prevalence of open-angle glaucoma among adults in the United States. *Arch Ophthalmol* 2004;122:532–538
- 5 Shiose Y, Kitazawa Y, Tsukahara S, Akamatsu T, Mizokami K, Futa R, Katsushima H, Kosaki H. Epidemiology of glaucoma in Japan—a nationwide glaucoma survey. *Jpn J Ophthalmol* 1991;35:133–155
- 6 Choe YJ. The prevalence of glaucoma in Korean adults. *Invest Ophthalmol Vis Sci* 1993; 34:1286
- 7 Sihota R, Agarwal HC. Profile of the subtypes of angle-closure glaucoma in a tertiary hospital in north India. *Indian J Ophthalmol*1998; 46:25–29
- 8 Chew PT, Aung T, Aquino MV, Rojanapongpun P; EXACT Study Group. Intraocular pressure-reducing effects and safety of latanoprost versus timolol in patients with chronic angle-closure glaucoma. *Ophthalmology*2004;111:427–434
- 9 Book SA. *Essentials of Statistics*. New York: McGraw-Hill Book Company; 1978
- 10 Moses LE, Emerson JD, Hosseini H. Statistics in practice. Analyzing data from ordered categories. *N Eng J Med*1984; 311:442
- 11 Alemayehu W, Tekle-Haimanot R, Forsgren L, Erkstet J. Causes of visual impairment in central Ethiopia. *Ethiop Med J*1995; 33:163–174
- 12 Zerihun N, Mabey D. Blindness and low vision in Jimma Zone, Ethiopia: results of a population-based survey. *Ophthalmic Epidemiol*1997; 4:19–26
- 13 Melese M, Alemayehu W, Bayu S, Girma T, Haileselassie T, Khandekar R, Worku A, Courtright P. Low vision and blindness in adults in Gurage Zone, central Ethiopia. *Br J Ophthalmol*2003;87:677–680
- 14 Bedri A, Alemu B. Pseudoexfoliation syndrome in Ethiopian glaucoma patients. *East Afr Med J*1999; 76:278–280
- 15 Teshome T, Regassa K. Prevalence of pseudoexfoliation syndrome in Ethiopian patients scheduled for cataract surgery. *Acta Ophthalmol Scand* 2004; 82: 254–258

- 16 Hietanen J, Kivela T, Vesti E, Tarkkanen A. Exfoliation syndrome in patients scheduled for cataract surgery. *Acta Ophthalmol (Copenh)*1992; 70:440-446
- 17 Dandona L, Dandona R, Mandal P, Srinivas M, John RK, McCarty CA, Rao GN. Angle-closure glaucoma in an urban population in southern India. The Andhra Pradesh eye disease study. *Ophthalmology*2000; 107:1710-1716
- 18 Ningli W, Wenbin Z, Tiancai Y, Qiang Y, Mingying L, Meihua L. Studies of primary angle closure glaucoma in China. *Yan Ke Xue Bao*1997; 13:120-124
- 19 Rudnicka AR, Mt-Isa S, Owen CG, Cook DG, Ashby D. Variations in primary open-angle glaucoma prevalence by age, gender, and race: a Bayesian meta-analysis. *Invest Ophthalmol Vis Sci*2006; 47 (10):4254-4261
- 20 Wright JE. The Bedford glaucoma survey. In: Hunt LB (ed) Glaucoma. Epidemiology, early diagnosis and some aspects of treatment. Edinburgh: E & S Livingston Ltd; 1996
- 21 Podgor MJ, Leske MC, Ederer F. Incidence estimates for lens changes, Macular changes, open-angle glaucoma and diabetic retinopathy. *Am J Epidemiol*1983; 118(2):206-212
- 22 Beers MH, Berkow R (eds). The Merck Manual of Diagnosis and Therapy. 17th ed. Whitehouse Station: Merck and Company Inc; 1999
- 23 Yanoff M, Duker JS (eds). Ophthalmology. 2nd ed. St. Louis: Mosby Inc; 1999
- 24 Stewart WC, Konstas AG, Pfeiffer N. Patient and ophthalmologist attitudes concerning compliance and dosing in glaucoma treatment. *J Ocul Pharmacol Ther* 2004; 20(6):461-469
- 25 Baudouin C, Rouland JF, Le Pen C. Changes in medical and surgical treatments of glaucoma between 1997 and 2000 in France. *Eur J Ophthalmol*2003;13:53-60
- 26 Lindblom B, Nordmann JP, Sellem E, Chen E, Gold R, Polland W, Williamson W, Buchholz P, Walt JG, Groleau D, Curry A, Evans SJ. A multicentre, retrospective study of resource utilization and costs associated with glaucoma management in France and Sweden. *Acta Ophthalmol Scand* 2006; 84(1):74-83
- 27 van der Valk R, Schouten JS, Webers CA, Beckers HJ, van Amelsvoort LG, Schouten HJ, Hendrikse F, Prins MH. The impact of a nationwide introduction of new drugs and a treatment protocol for glaucoma on the number of glaucoma surgeries. *J Glaucoma*2005;14(3):239-242