THE PREVALENCE OF GLAUCOMA IN THIRD WORLD VERSUS FIRST WORLD COUNTRIES

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ABSTRACT

Background: Glaucoma is a complicated disease with much controversy over diagnosis and treatment. Risk factors include intraocular pressure, age, optic nerve head cupping, family history, corneal thickness, health status and race. Undiagnosed or untreated glaucoma can lead to optic nerve damage, visual field loss, and ultimately can even lead to total blindness.

Methods: A literature search was performed in attempts to compile data that would estimate glaucoma prevalence both in ***third world*** and ***first world*** countries. The data was compiled and statistical analysis was performed to determine if there is any significant difference in the prevalence of glaucoma in first world and third world countries. In addition, other factors such as age, race, and gender were also analyzed.

Results: The overall average prevalence of glaucoma in third world countries was found to be **6.64%** and the overall average prevalence of glaucoma in first world countries was **2.21%.** Statistical analysis comparing third world data versus first world data shows a highly statistically significant difference (P=0.0077).

Conclusions: The difference between glaucoma prevalence in first world and third world countries has been stated and still is statistically significant, but it remains unclear what the defining factor(s) between the two groups is/are. Certainly race, social-economic status, general health status and access to medical care are the commonly mentioned and studied ones.

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INTRODUCTION

Glaucoma is a complicated eye disease with much controversy over its diagnosis and subsequent treatment[1]. It is known as a progressive disease leading to optic nerve head (ONH) damage, nerve fiber layer (NFL) defects, and visual field (VF) loss. Increased intraocular pressure (IOP) is a significant risk factor, but there is no threshold for determining whether a patient has glaucoma based solely on IOP. One person may develop glaucoma with relatively low intraocular pressures while another may have increased pressure for many years and show no overt ONH or NFL damage. Other risk factors frequently mentioned for developing glaucoma include age, optic nerve head cupping, family history, corneal thickness, medical health status and race. Undiagnosed or untreated glaucoma can lead to optic nerve damage, visual field loss and ultimately leading to partial loss of vision to even total blindness.

Diagnosing glaucoma can vary depending on which country you live in and sometimes which practice you visit within that said country. According to "The Global Impact on Glaucoma," a study performed by the World Health Organization[1], visual field loss is the most significant factor for diagnosing glaucoma. However, visual field loss can often be a later manifestation of glaucoma and is therefore not always suitable for early detection of the disease. Also, HVF defects have not been found to be practical and/or reliable to investigate in large-scale population screenings in third world countries. Both assessment of the cupping of the optic disc and increased intraocular pressure have been commonly used as early indicators of glaucoma in a number of screening campaigns in first world countries[1].

A triad of signs, including the presence of at least two of the following, usually defines glaucoma being; elevated IOP, optic nerve head cupping, and visual field loss[2]. However, case definitions used in the various epidemiologic studies of the disease have differed on specific criteria. Only cases of primary open angle glaucoma that have had clear signs of optic nerve head damage and/or reproducible visual field loss are included in the prevalence estimates. In third world countries, there are certainly limited resources in which to adequately diagnose glaucoma. Diagnosis is usually dependent specifically on intra-ocular pressure, cup to disc ratio and less frequently visual field loss. In first world countries, the same criterion/triad is considered along with newer testing aiding in earlier diagnosis. Additional testing includes corneal pachymetry and various different methods of nerve fiber layer thickness analyses.

Glaucoma is the 2nd leading cause of vision loss worldwide (the 1st being cataracts), with 66 million people being affected and causing 6.8 million people to become legally blind[2]. According to "The Global Impact on Glaucoma,"[1] the prevalence of primary open angle glaucoma (POAG) among African American populations was taken to actually be more than **four times** that of Caucasians. Women were generally more at risk for primary angle closure glaucoma, and there showed to be a higher prevalence of this form of glaucoma among the Asian populations. Table 1 shows the geographical distribution of POAG by the nine defined regions. Approximately 70% of the world's cases of POAG are found in third world countries. The table shows that higher income areas have a lower prevalence of glaucoma, while lower income areas tend to show a higher percent of POAG.

Table 1.

Distribution of primary open angle glaucoma by World Bank Region[1]

	% of Global Total of POAG
Established Market Economies	17.6
Former Socialist Economies of Europe	7.2
Latin America and the Caribbean	6.7
Sub- Saharan Africa	19.4
Middle East, North Africa and South West Asia	5.2
China	20.1
India	12.9
Other Asian and Pacific Countries (high income)	3.6
Other Asian and Pacific Countries (low income)	7.2

METHODS

A literature search was done to compile data that estimated glaucoma prevalence both in third world and first world countries. The first world studies that were used were: Baltimore Eye study, Beaver Dam eye study, Roscommon Glaucoma Study, and the Eye Prevalence Research Group (EPRG) estimation of glaucoma in the United States. The third world studies were: St. Lucia, Barbados, West Bengal, and Bangladesh.

The Baltimore Eye study[3] collected data from both Caucasian and African Americans from an urban population. Data was sorted in terms of prevalence between race and age. The Beaver Dam[4] and Roscommon[5] studies took data from a rural Caucasian population, while the EPRG of the US[6] data was calculated from a compilation of eight different previous studies (grouped by age, race and gender). Both the St. Lucia[7] and Barbados[8] studies used strictly African American patients and analyzed on basis of gender and age. The West Bengal study[9] was conducted with a rural Indian population, while Bangladesh[10] population was both a rural and urban Indian population analyzed by both gender and age.

Most studies of glaucoma that have been conducted in recent years generally use the International Society of Geographic Epidemiology of Ophthalmology (ISGEO) standards to diagnose a patient as glaucomatous[9]. These standards have three different criterions: 1) a vertical C/D ratio greater than the 97.5th percentile of normal (usually 0.7) with a visual field defect, 2) a C/D ratio greater than the 99.5th percentile of normal (usually 0.85), or 3) visual acuity

less than 20/200 and intra-ocular pressure greater than 32mm Hg. A glaucoma suspect has disc changes, but not a visual field defect, a visual field defect but not disc changes, disc hemorrhages, IOP greater than the 97.5th percentile, and/or angle closure[3,4,5,6,7,8,9,10].

The numbers that were compared in this study were only based on the diagnosis of definite glaucoma, not on glaucoma suspects. The data was compiled and statistical analysis (using an unpaired t-test and corresponding P-values) was performed to determine if any significant difference in the prevalence of glaucoma in first world and third world countries.

RESULTS

The total number of patients examined in each study is shown below in Table 2.

Table 2- Number of patients examined

Number Examined	
	n
West Bengal	1324
Bangladesh	2347
Baltimore	5308
Barbados	4314
Beaver Dam	4926
Roscommon	2186
St. Lucia	1679
total	**22084**

The data was first analyzed on basis of sex; male results are shown in Table 3 and female results are shown in Table 4. As noted, the values obtained for data from the United States study were given only in prevalence form in five year increments, therefore the two values were averaged in order to compare with other studies. The data from the Beaver Dam study was grouped using slightly different age groups and was adjusted as shown. Lastly, the St. Lucia data showed results for > 70 and was plotted in the 70-79 age group. The asterisks apply to all of the following charts.

Table 3- Prevalence of open angle glaucoma in men

Men							
	West Bengal	Bangladesh	Barbados	St. Lucia***	Beaver Dam**	US*	Roscommon
Age							
30-39		3.4		1.9			
40-49		3.3	4.1	4.7		0.42	
50-59	3.5	3.6	10.4	7.6	0.55	0.92	0.65
60-69	4.2	2.3	15.5	13.9	1.30	1.91	1.74
70-79	7.1	3.2	24.1	14.2	3.33	3.44	3.72
>80	4.8	2.0	31.7		4.53	6.08	2.82
total	**4.25**	**3.2**	**13.3**	**8.3**	**1.99**	**1.48**	**2.00**

*US data averaged 50-59=age of 50-54 and 55-59, 60-69=avg of 60-64 and 65-69, 70-79=avg of 70-74 and 75-79
**Beaver Dam 43-54=50-59, 55-64=60-59, 65-74=70-79 and >75=>80
***St. Lucia 70-79=>70

Table 4- Prevalence of open angle glaucoma in women

Women							
	West Bengal	Bangladesh	Barbados	St. Lucia***	Beaver Dam**	US*	Roscommon
Age							
30-39		0.7		4.7			
40-49		2.7	3.0	8.7		0.94	
50-59	1.9	2.9	5.8	9.2	1.38	1.16	0.77
60-69	1.8	4.4	8.4	15.8	1.28	1.77	1.79
70-79	3.9	2.4	16.9	6.7	2.15	3.19	2.67
>80	8.0	0.0	24.4		4.81	8.57	3.23
total	**2.4**	**2.5**	**8.5**	**8.9**	**2.21**	**2.19**	**1.76**

The average prevalence of glaucoma for men in third world countries (i.e. West Bengal, Bangladesh, Barbados and St. Lucia) was 7.26%, and the average prevalence for glaucoma in first world countries was 1.82%. Statistical analysis reveals an unpaired t-value of 2.585 or P = 0.0147, which is a statistically significant difference between glaucoma prevalence in third world versus third world countries. The average for women in third world countries was 5.58% and 2.05% in first world, which is also found to be a statistical significance (P = 0.0314). In each study, it is found that glaucoma prevalence increased with age. The prevalence was found to be higher in males in four of the seven studies with gender specificity, while three of the seven (United States, Beaver Dam, and St. Lucia) found that the higher prevalence was in females.

The Baltimore, Beaver Dam, and Roscommon studies specified data for a specifically Caucasian population; while the Barbados, St. Lucia and Baltimore studies showed data for an African American population. The data is shown below in Table 5.

Table 5- Prevalence of glaucoma by race

Caucasian				African American		
	Baltimore	Beaver Dam**	Roscommon	Baltimore	Barbados	St. Lucia
Age						
30-39						3.95
40-49	0.92			1.60	3.6	7.28
50-59	0.41	1.0	0.72	4.67	7.8	8.73
60-69	1.76	1.3	1.76	6.59	11.4	15.18
70-79	3.47	2.7	3.2	10.58	20.3	9.51
>80	2.16	4.7	3.05	13.8	27.2	
total	**1.71**	**2.1**	**1.88**	**5.59**	**11.5**	**8.76**

The difference between prevalence of glaucoma in Caucasian and African American patients is found to be extremely statistically significant (P = 0.0003). The average of Caucasian patients was 1.90%, and the average of African American patients was 8.62%. In other words, the study found that the likelihood of glaucoma in an African American was 4.54 times as likely as in a Caucasian.

The prevalence of all patients examined (both male and female of all races) is shown below in table 6.

Table 6- Overall prevalence in all studies

TOTAL	Barbados	West Bengal	Bangladesh	St. Lucia***	Baltimore	US*	Beaver Dam**	Roscommon
Age								
30-39			1.8	3.95				
40-49	3.6		3.1	7.28	0.8	0.68		
50-59	7.8	2.7	3.4	8.73	2.4	1.04	1.0	0.72
60-69	11.4	2.9	3.3	15.18	3.4	1.83	1.3	1.76
70-79	20.3	5.4	3.1	9.51	5.3	3.30	2.7	3.20
>80	27.2	6.5	1.5		5.5	7.74	4.7	3.05
total	**11.5**	**3.4**	**2.9**	**8.76**	**3.0**	**1.86**	**2.1**	**1.88**

The average prevalence of glaucoma overall for third world countries is 6.64% and the average prevalence of glaucoma overall in first world countries is 2.21%. Statistical analysis comparing third world data versus first world data shows a very statistically significant difference (P = 0.0077).

DISCUSSION

There are many different factors other than socio-economic status that may have played a significant role in this review. One main issue in our study is that in two of the studies from developing countries (Barbados and St. Lucia), the populations are entirely composed of African American patients, while the remaining two are from Indian populations. Yet on the other hand, two of the studies from developed countries were strictly from a Caucasian population (Roscommon and Beaver Dam), while the remaining two were chiefly from a population mixture. It remains uncertain if the statistical difference is due to the variations in race, variations in socioeconomic status, or to both.

There are several other factors that may also confound the data. In studies that focused specifically on a group living in one area, there are still variations in diet, lifestyle, nutrition, medical conditions, (hypertension, diabetes, obesity, etc.) and access to health care that can vary prevalence. Each study chosen also used a different methodology and there are differences in social behavior, environmental factors, and genetic predisposition. It is also difficult to fully estimate prevalence when data is based on a limited sample size from each of these different areas.

It can be somewhat complex to determine the prevalence of glaucoma in third world countries because of the lack of epidemiologically valid data on forms of glaucoma and the amount of visual loss created. A frequent source of difficulty in determining epidemiological data was the high number of undiagnosed cases of glaucoma in third world countries. The rate of diagnosis is directly proportional to the level of availability of health care, and in developing, rural areas there is often limited access to basic and valid eye care (optometry or ophthalmology) services. There are also differences in

prevalence found in rural versus urban areas, again simply because of differences of availability of these health care services.

In more highly developed countries such as the United States, there have been advancements in technology that have allowed for earlier detection of glaucomatous damage. Assessment of the retinal nerve fiber layer thickness appears to be more sensitive and specific for the evaluation of glaucoma damage, especially early in the course of the disease, than direct estimation of cup-to-disc ratio. Quantitative assessment of nerve fiber layer thickness holds promise for early detection of glaucoma and objective follow-up of disease progression. As measurement techniques become more refined and the characteristics of the retinal nerve fiber layer in normal individuals and patients with glaucoma become more widely understood, objective measures (such as optical coherence tomography and scanning laser polarimetry) may prove to be the standard of care versus visual field tests for diagnosis and follow-up in patients who have glaucoma. These newer technologies may also have use in the recognition of early damage in patients at risk for glaucoma[11].

The advantages to these newer technologies (such as OCT, HRT and GDx) are that they are basically objective type tests, the printouts are relatively easy to interpret, and that it requires only basic technical skill to run[12]. Disadvantages include that the equipment is very expensive, insurance reimbursements are questionable, the media must be clear, and there is a scarcity of normative data[13]. Although these newer devices would seem to be beneficial in diagnosis of glaucoma in developing countries, it is simply not realistic or feasible at the present time.

As an eye care professional (doctor), it can be somewhat frustrating to be aware of the number of undiagnosed cases of glaucoma in the US and worldwide. One wonders what can be done to help curve this # 2 cause of blindness that in many cases, is a manageable disease. The first step would be implementing a basic health care system into these underdeveloped countries. At the primary level, basic health care workers should check visual acuities and assess gross pupil color. If the acuity is decreased and the pupil is still "black" (no cataract), the patient should be referred to the secondary level for additional testing. At the secondary level, ophthalmic nurses or medical assistants could be trained to measure cup to disc ratio and check intra-ocular pressure. Any findings with an IOP of more than 28, or a C/D of more than 0.6 should be referred to the tertiary level for additional testing/treatment. At the tertiary level, the health care providers can assess visual field or whatever additional testing is available[14]. This would be an advantageous method of assessing the people who need treatment the most help, while maximizing the eye care practitioner's time.

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