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Mini Review

Glaucoma Review

Priscilla O. Okunji¹, Ihuoma Ezebuihe², Robin Reese², Chinyere Okunji³

¹College of Nursing and Allied Health Sciences, Howard University, Washington DC, USA

²Helene Fuld School of Nursing, Coppin State University, Baltimore, Maryland USA

³Center for Sickle Cell Anemia, Howard University Hospital, Washington DC, USA

***Corresponding author:** Priscilla O. Okunji, College of Nursing and Allied Health Sciences, Howard University, 516 Bryant St NW, Washington, DC 20059, USA. Email: priscilla.okunji@howard.edu

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Introduction

Glaucoma is clinically known as the leading cause of blindness in the United States and the second cause of irreversible blindness in the world [1,2]. In 2016, NIH estimated that 2.7 million Americans were affected by glaucoma [3-5]. In twenty-twenty, about 79.6 million may have glaucoma globally as people are living longer than ever due to good nutrition and health care [6]. The cost of glaucoma management is on the rise with a projection of \$6.1 billion expected in the next two years, an estimation of 5.1% annual rate [7]. Glaucoma disproportionately affects African Americans, at the rate of about six to eight times than their Whites counterpart. Unfortunately, minorities including Hispanics are not aware of their diagnosis until it becomes too late [4].

Glaucoma is genetic and older adults and those who have chronic diseases such as diabetes are also at high risk [5]. Due to the nature of glaucoma, individuals do not know that they have the disease because they do not exhibit any signs and symptoms, only half of the individuals with the disease are even aware that they have the glaucoma [8]. The good news is that blindness caused by glaucoma can be controlled as blindness could be avoided if appropriate management and early diagnosis could be made prior to vision loss. The first part of this review is on glaucoma background, followed by the global and United States prevalence of glaucoma, resources or the agencies that have taken efforts to address the challenge, and barriers that exist which may impede glaucoma management. The review was concluded with the pharmacologic and non-pharmacological treatments, as well as summaries on the patient and primary care provider's implications.

Background

Glaucoma is caused by high Intraocular Pressure (IOP) of the eye leading to injury and death of the nerves cells. Reducing

the IOP is of utmost importance to decrease the severity of the disease. The two major forms of glaucoma are open-angle and angle-closure glaucoma. The Open Angle Glaucoma (OAG), also called primary or chronic glaucoma has been known to be the most common form of glaucoma. The term "Open Angle" means that the angle where the iris meets the cornea is wide and open and it accounts for at least 90% of all glaucoma cases which affect about three million Americans in the United States. OAG has symptoms and damage that are not overt [9]. Angle Closure Glaucoma (ACG) is a less common form of glaucoma caused by blocked drainage canals, resulting in a sudden rise in intraocular pressure. ACG has a closed or narrow angle between the iris and cornea and develops very rapidly with symptoms and damage that are usually very overt and warrants immediate medical attention. Research has shown that glaucoma frequently causes limitations in the activities of daily living and changes the patient's quality of life. Simeon et al., [10] in their research revealed the six main themes based on a profound change in lifestyle, casual diagnosis, independent research, fear of blindness, fear of being a burden to family, and fear of familial pathology. Two additional themes revealed that the participants of the project felt lucky not to have a deadly disease and were also uncertain about the future. The investigators concluded that negative aspects prevail over any positive facets and that a deep understanding of these experiences could help primary care providers deliver correct holistic support to patients suffering with glaucoma.

Further review of literature has shown that although cannabinoids decrease intraocular pressure, however, the effect would be transient and would be associated with frequent adverse effects. Using Epistemonikos, the largest database of systematic reviews in health, including MEDLINE, EMBASE, Cochrane, and among others, the authors extracted data from the systematic reviews, reanalyzed data of primary studies and provided some

useful knowledge using the GRADE approach [11]. This approach enabled the investigators identified five systematic reviews including three studies overall and all were randomized-controlled trials.

Prevalence (Global & US)

Data obtained from different literature sources as indicated in the literature review section revealed that a comprehensive and global study of gender on Primary Open-Angle Glaucoma (POAG) prevalence showed that men have higher percentage (36%) of developing glaucoma than their women counterparts [2]. With a total of 37 pooled studies, the regression model was sufficiently powered to detect a difference between the sexes with a substantial evidence that men are more likely to develop POAG globally [2]. However, there was a contrasting study that revealed that older women have higher prevalence rate of glaucoma due to their longevity when compared to the male gender. The investigators also found that there was a high prevalence (58%) of individuals with glaucoma who live in the cities than their counterparts who live in the rural areas [2]. This may explain in part the higher prevalence of myopia in urban areas.

The 2017 Center for Disease Control (CDC) data confirmed that in a total population of more than 142 million with 648,393 of those between age 40 and older, that more than 2.7 million older Americans have primary open-angle glaucoma in United States. As shown in figures 1-3, the authors of this review have reanalyzed data of primary studies and generated graphical representations of the prevalence of glaucoma in the United States, using the National Institute of Health (NIH) data. Figure 1 showed that African Americans between the age of 40 and above have high prevalence of glaucoma when compared with their counterparts in other races. In addition, blacks between age range 65-74 have higher prevalence (13.11%) and approximately 20% highest prevalence after age 75 when compared with other races at same age range.

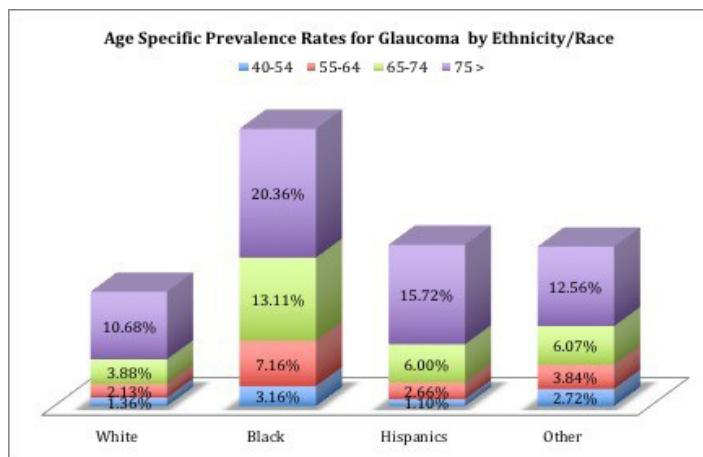


Figure 1: Bar chart.

Gender specific prevalence in glaucoma has showed that African American men have a higher prevalence of glaucoma (25.15%) when compared to other male counterparts at age 75 years and above as shown in figure 2. In addition, the African American women account for approximately 18% of glaucoma prevalence when compared to other races at same age group (Figure 3).

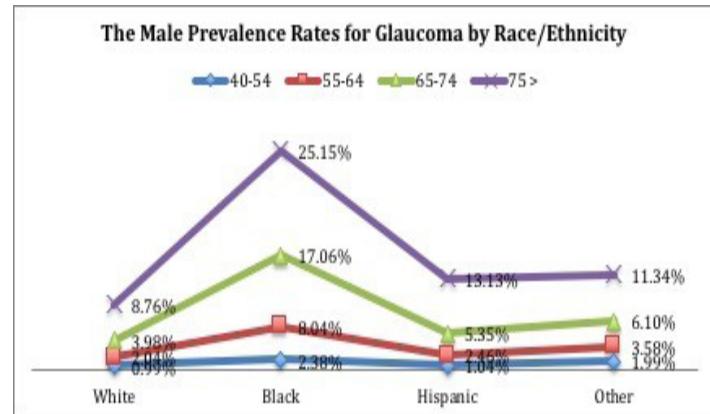


Figure 2: Line graph.

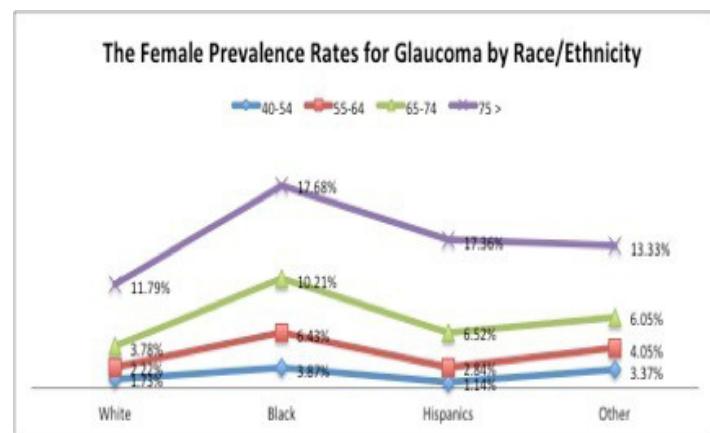


Figure 3: Line graph.

Resources/Agencies that Have Taken Initiatives/ Efforts to Address the Challenge

Many individuals' suffering from impaired vision have benefitted from many outreach programs. For example, in a study of about 64% of African Americans, 88% participants older than 40 years were provided with needed dilated eye exam with two optometrists involved in diagnosis [8]. These activities resulted to the detection of increased new cases of glaucoma-related disease with mostly open angle glaucoma. The outreach program also reported that patients' knowledge was improved regarding glaucoma management with evidenced of 35% increase in the projected outcomes [8]. *Wills Eye Institute's program* is another project that have engaged participants from underserved communities armed

at screening hundreds of individuals for glaucoma for the past one year, emphasizing the need for more resources use in eye services. The *Johns Hopkins University* has the most current initiative and has just recently been added to visual health institute. More than a thousand participants received eye exam free of charge in the first inception of this program. The Johns Hopkins program is being expanded and it is projected that additional hundreds of participants are expected to join each year [8].

Barriers that May Impede Glaucoma Management

Barriers to successful treatment of glaucoma could be attributed to the recognition that glaucoma is subject to the same concerns as comparable asymptomatic chronic diseases that relies largely on medical treatment for control. Currently, much more attention is being focused on the issues surrounding the initiation and continuation of adequate treatment for glaucoma as well as continuing recommended follow-up and monitoring for progression of the disease. The factors that are contributing to this increased awareness include:

Medication compliance: treatment failure rates are highly correlated to inadequate compliance with treatment and ability to generate data measuring therapeutic success in treatment of chronic diseases. Neglecting to take medications as prescribed is a major barrier among the patient-related factors leading to decreased compliance. Several past studies have been reviewed in the context of current medical therapy and have been found to still apply. However, the use of navigators and new technologies are available to help patients remember their medications. An example of such technology is the tool being used as a special dosing aid for travoprost.

Another well-recognized patient-related factor is *medical comorbidities* (e.g., arthritis, dementia) that may interfere with administering eye drops and impact side effects of medications [8]. Recent research has shown that patients often make active choices not to comply with prescribed therapy. Social and environmental situations also play a prominent role in patient noncompliance. These issues can be particularly challenging when attempting to modify patient behavior. It is recognized that inadequate patient-provider communication in busy clinical settings is a major source of patient dissatisfaction as well as decreased compliance. There is an increasing recognition that lowering of IOPs is necessary to prevent progression of moderate to severe glaucoma, as shown in some glaucoma intervention studies. This means that more complex regimens of topical eye drop therapy are being prescribed, potentially leading to increased problems with patients' ability to manage their therapy. Enhanced patient education and communication about the different facets of glaucoma treatment and the importance of regular follow-up must be emphasized

among the interventions to help improve treatment outcomes.

A third major category of barriers to compliance relates to *characteristics of the health care system* in the United States. Patients who rely on alternative settings and providers, such as walk-in clinics and emergency departments, are much more vulnerable to reduced compliance with therapy for chronic diseases. This is further compounded with another area of concerns which include the *increasing cost of medical treatment* along with the fact that more-expensive, non-generic medications are often recommended for first-line treatment of glaucoma.

Pharmacological and Non-Pharmacological Treatment

Primary care providers manage glaucoma and should refer patients to specialists when needed. Usually, patients diagnosed with glaucoma are on two or more medications for treatment. Primary care providers are to be aware of possible systemic side effects of eye drops and potential drug interactions. Administration methods include drug reformulation into microscopic capsules or spheres with reduction in the amount of preservatives which may lead to adverse effects [12]. Reformulation could also be achieved by incorporation of polymers, collagen shields, gels, or liposomes. These strategies have allowed greater cell specificity and stability sustainability. Other techniques that are under development include the use of slow-release implants, including those designed for sustained release of prostaglandin by the implant embedded into the eye via intracerebral injection. Topical medications have also been delivered into the conjunctival fornices with the use of other reliable devices [13].

Non-Pharmacological Treatments: Research has shown that the quasi-experimental pilot study by Pandey et al. [14] on the benefits of Muscle Energy Technique (MET) and Myo- Facial Release (MFR) have not been fully explored. A current study in a tertiary care teaching hospital showed that using the above technique, a total of 12 patients with POAG age ranging between 15 to 30 years were recruited through criteria base convenience sampling. The investigators in their findings concluded from the pre and post assessment that MET and MFR reduced IOP. This study has confirmed that this technique could be used as one of the feasible and cheapest treatments in the future of POAG management [14]. It is also important to note that tonometry will continue to improve the accuracy of IOP measurement, especially as more is being learned about corneal biomechanical properties as well as improved imaging techniques. Furthermore, nanotechnology-base treatments may also provide immense promise in glaucoma treatment overcome. Topical agents used in the medical management of glaucoma are provided as shown below according to Morrison (2000) [15] (Table 1).

Beta Blockers Drops (Example: <i>Timolol</i>)	Parasympathomimetic (Example: <i>Pilocarpine</i>)	Adrenergic Drop (Example: <i>Epinephrine</i>)	Carbonic Anhydrase Inhibitors (Example: <i>Diamox</i>)
<p>*Suppress aqueous suppression *Topically administered</p> <p>*Systemic side effects: asthma, CHF bradycardia, and CNS disturbance</p>	<p>Increase aqueous Side effects: constricted pupils and other ocular effects</p> <p>Systemic side effects: diarrhea, sweating and bronchospasm</p>	<p>Dual effects: decreases inflow and increase outflow Systemic side effects: increased blood pressure and palpitations</p>	<p>*Suppress aqueous production *Side effects include electrolytes imbalance</p>

Table 1: Classes of drugs and their specific examples in the medical management of glaucoma: mechanism of action, administration and side effects.

There are many steps a primary care provider could take to help protect patients with glaucoma and related eye diseases and at the same time lower the risk of vision loss from glaucoma especially among blacks, minorities and underserved population. These steps include the following:

Identify high-risk group and perform basic eye health screening using Snellen's chart, cover-uncover tests, confrontation tests, noting PERRLA bilateral and consensual pupils' responses, etc. to detect eye problems/glaucoma early. Prescription of needed eye drops can stop glaucoma from progressing. Referring those at risk or diagnosed with glaucoma to the specialists as needed. There should be health literacy/education for those who are at risks.

Other ways that primary care providers could provide safety for the medications are by avoiding prescribing errors as in: writing legibly; using e-prescribing when possible; never abbreviate a drug name; monitoring for drugs with similar names; paying close attention to decimal points, and never write take as directed. Finally, always being specific about the dosing, avoiding misleading abbreviations (i.e. qd is often seen as qid) and always write something in the "Refill" section of the script.

Conclusion

In conclusion, primary care providers and their patients are a team. Primary care providers will be able to manage this condition as glaucoma usually affects peripheral vision first, the essence for peripheral screening. Patients should be educated on how to take their medicines as prescribed and instructed to report any possible side effects to their eye care specialist. The primary care provider should work with the patient ensuring that patients are timely scheduled to continually monitor the disease progression and eye pressure in particular.

Finally, it is therefore imperative that primary care providers understand the prevalence of age-related eye disorders, particularly glaucomatous conditions to assist policy makers in developing better policies and interventions for the detection, treatment and planning of public health strategies. Primary care providers could enhance treatment outcomes by patient education and

reinforcement of the importance of medication adherence. This could be done by careful assessment and recognition of adverse reactions from glaucoma medications and surgical procedures. The implication being that if glaucoma could be detected early, vision loss could be prevented with a goal to fulfilling the 2020 World Health objectives.

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