

# Clinical and epidemiological profile of patients with glaucoma attended at a clinic in the interior of the Amazon

## *Perfil clínico e epidemiológico dos pacientes com glaucoma atendidos em um ambulatório no interior da Amazônia*

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### ABSTRACT

**Objective:** To evaluate the prevalence and clinical-epidemiological profile of patients with glaucoma in Santarém-PA, from January 2016 to December 2017. **Methods:** Study descriptive, retrospective, quantitative and cross-sectional that was analyzed the medical records of 718 patients, both genders, attended by SUS in an ophthalmologic clinic from Santarém-PA. Was used an adapted record from a pre-existing model in the clinic and, after being searched, the data was systematized. **Results:** The study was found a prevalence of 6% (n=43), distributed in 6.8% (n=21) in 2016 and 5.4% (n=22) in 2017. Regarding gender, the majority corresponded to women (53.5% n=23) and 46.5% (n=20) were men. Primary open angle glaucoma demonstrated a higher prevalence, affecting 2.5% (n=18) of the patients. The age group demonstrated the predominance of the public over 40 years, 96% (n=24) of the 25 with the age was informed. Regarding chronic diseases, 42% had only arterial hypertension, 2% only diabetes mellitus, 5% had bot comorbidities, and 51% had no one. **Conclusion:** The prevalence found for glaucoma cases was higher than values of other studies about the subject in Brazil and abroad. Primary open angle glaucoma was the more prevalent in the public studied, especially in individuals over 40 years. The relation between chronic diseases and the manifestation of glaucoma or IOP elevation, reached a subtle indication to hypertension as a risk factor due to its higher prevalence, similar to the studies on the subject.

**Keywords:** Glaucoma; Glaucoma open-angle; Intraocular pressure; Diabetes Mellitus; Hypertension

### RESUMO

**Objetivo:** Avaliar a prevalência e o perfil clínico-epidemiológico dos pacientes acometidos pelo glaucoma em Santarém-PA, no período de janeiro de 2016 a dezembro de 2017. **Métodos:** Estudo descritivo, retrospectivo e quantitativo em que foram analisados os prontuários de 718 pacientes, de ambos os gêneros, atendidos pelo SUS no ambulatório de uma clínica oftalmológica em Santarém - PA. Foi utilizada uma ficha adaptada pelos pesquisadores a partir de um modelo pré-existente no local de coleta e, depois de colhidos, os dados foram sistematizados. **Resultados:** O estudo encontrou uma prevalência de 6% (n=43), distribuída em 6,8% (n=21) em 2016 e 5,4% (n=22) em 2017. Quanto ao gênero, a maior parte correspondeu ao sexo feminino (53,5%, n=23) e 46,5% (n=20) ao sexo masculino. O Glaucoma Primário de Ângulo Aberto demonstrou maior prevalência, acometendo 2,5% (n=18) dos pacientes. A faixa etária demonstrou predominância do público acima dos 40 anos, 96% (n=24) dos 25 com a idade disponibilizada. Também foi observado que 42% manifestavam hipertensão arterial isoladamente, 2% diabetes mellitus isoladamente, 5% combinação entre as duas e 51% não possuíam nenhuma comorbidade. **Conclusão:** A prevalência encontrada para os casos de glaucoma foi superior àquelas observadas em estudos nacionais e internacionais. O Glaucoma Primário de Ângulo Aberto teve maior prevalência, principalmente em indivíduos acima dos 40 anos. A relação entre doenças crônicas e a manifestação do glaucoma ou elevação da PIO apontou uma sutil indicação da HAS como fator de risco por conta de sua maior prevalência, semelhante aos estudos sobre o tema.

**Descritores:** Glaucoma; Glaucoma de ângulo aberto; Pressão intraocular; Diabetes Mellitus; Hipertensão

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## INTRODUCTION

**G**laucoma is an optical neuropathy with characteristic repercussion in the visual field classified as the leading cause of irreversible blindness, and the second largest cause of blindness in the world, being surpassed only by cataract.<sup>(1)</sup> In the global context in 2013, the prevalence of this disease was 3.54%, with 64.3 million people affected in addition to the projection of 76 million for 2020, and 111.8 million for 2040.<sup>(2)</sup> Nationally, studies on the subject are old, and the amount is scarce compared to international research indicating an estimated prevalence of 2-3% of the Brazilian population over 40 years of age, although the number tends to be much higher since about half of the patients ignore the disease.<sup>(3)</sup> In addition, the disease presented in Brazil a rate of 2.2 million patients treated by SUS in 2015 corresponding to a 245% increase when compared to the 900 thousand people treated in 2008.<sup>(4)</sup>

The classification of glaucoma is divided into <sup>(1)</sup> Primary Open-angle Glaucoma (POAG), Primary Closed-angle Glaucoma (PCAG), Secondary Glaucoma, Congenital Glaucoma, and Normal Pressure Glaucoma.<sup>(1)</sup> The development of the disease is characterized by optic nerve damage and visual field involvement with significantly better prognosis in cases of early diagnosis and treatment.<sup>(1)</sup> This peculiarity makes the late diagnosis associated with the chronicity of the disease and its risk factors account for the growth in the number of patients with glaucomatous irreversible blindness, mainly due to the fact that the regression of the disease requires careful control of IOP for maintaining optic nerve integrity.<sup>(5)</sup>

Regarding risk factors for the development of the disease, high IOP, age above 40 years, and family history are the most reported ones. Increased optic nerve excavation, ethnicity, decreased ocular perfusion pressure, diabetes mellitus, and genetic factors are also among the influencing variables. The disease is screened by detailed ophthalmologic evaluation to determine the existence and severity of the condition. The test consists of measuring visual acuity, pupillary examination for light reactivity, biomicroscopy, IOP measurement, and optic nerve evaluation. In cases of suspicion, diagnostic investigation may be aided by examinations such as gonioscopy, pachymetry and visual campimetry.<sup>(1)</sup>

Given the above, the objective of the present study was to describe the clinical and epidemiological profile of patients affected with glaucoma (H40.9 according to ICD-10) and treated at SUS in the ambulatory of Instituto de Olhos Nívia Saldanha in Santarém - PA, in the period from January 2016 to December 2017.

## METHODS

This is a retrospective, descriptive and quantitative study in which the medical records of 718 patients of both sexes treated between 2016 and 2017 in the municipality of Santarém were reviewed. The scenario for the research was Instituto de Olhos Nívia Saldanha (IONS), which was a reference center in Ophthalmology during the period mentioned.

The medical records of patients diagnosed with glaucoma treated at IONS were included, and those with illegible records and/or waiting for confirmatory examinations for the diagnosis were excluded.

Data was grouped and analyzed using descriptive statistics, using absolute and relative frequency resources with the program Microsoft Excel 2016.

The variables used in the survey were (1) prevalence of glaucoma patients treated, (2) types of glaucoma diagnosed, (3) city of origin, (4) age group, (5) gender, (6) therapeutic approach, (7) comorbidities examined, and (8) IOP values at the time of diagnosis.

Prevalence related to glaucoma cases was calculated using the formula  $P = n / TA$ , where P represents the prevalence, n corresponds to the number of glaucoma patients treated at IONS during the period of interest, and TA means the total number of treatments provided in the same period. The frequency of the other variables was calculated using the formula  $F = C / TG$ , where F is the frequency, C corresponds to the number of cases found for the variable of interest, and TG represents the total value of patients treated with glaucoma in the period of interest. The results were analyzed regarding to individualized years (2016 or 2017) and sets (2016 and 2017).

The diagnosed cases of glaucoma were divided into (1) Primary Open-Angle Glaucoma (POAG), (2) Primary Closed-Angle Glaucoma (PCAG), (3) Secondary Glaucoma, and (4) Congenital Glaucoma, excluding Normal Pressure Glaucoma due to the absence of diagnoses related to this type.

Regarding the age group, the values were organized into two groups: (1) patients under 40 years of age or, and (2) patients older than 40 years.

Regarding the therapeutic approach, due to the variety of results, the monotherapy nomenclatures were adopted to represent the isolated use of a drug, pharmacological association, corresponding to the combination of two or more drugs, and surgical procedure for interventions adopted in cases of insufficiency of the isolated pharmacological treatment. The lack of information about surgical procedures made it impossible to develop more detailed data. For this reason, the surgical procedures were only quantified in isolation, and related to the cases of glaucoma without any details about the type of instrument used, surgical methodology, and adjuvant drugs.

The analysis of comorbidities was directed to the presence of hypertension and diabetes mellitus observing the isolated and combined results of these pathologies in patients diagnosed with glaucoma.

Regarding IOP, the values related to the eye presenting glaucoma were considered, being considered as normal the results below or corresponding to 21 mmHg, and as elevated the values above 21 mmHg.

The study is part of a larger project entitled "Social and Clinical Profile of Patients Treated at a Public Ophthalmology Ambulatory" approved by the Research Ethics Committee of Campus XII de Santarém, Universidade do Estado do Pará, under CAAE: 82731518.0.0000.5168.

## RESULTS

In the present study, we reviewed the medical records of 718 patients corresponding to the number of visits to the survey location (Instituto de Olhos Nívia Saldanha) between 2016 and 2017. Regarding the diagnosed cases of glaucoma, Table 1 shows a prevalence of 6% (n = 43). The distribution of results by year

surveyed corresponded to 6.8% (n = 21) in 2016, and 5.4% (n = 22) in 2017.

Regarding the gender of the glaucoma patients found in 2016 (6.8%, n = 21), 52% (n = 11) corresponded to males, and 48% (n = 10) to females. Of the 5.4% (n = 22) diagnosed with glaucoma in 2017, 41% (n = 9) corresponded to males, and 59% (n = 13) to females. The frequency ratio of males and females by type of glaucoma presented was, respectively, 50% / 50% (n = 9/9) for the POAG, 85.7 / 14.3% (n = 6/1), for PCAG, 50/50% (n = 1/1) for Secondary Glaucoma, and 0 - 100% (n = 0/1) for Congenital Glaucoma, as shown in Table 2. In addition, table 2 also shows a slight predominance (53.5% / n = 23) in the frequency of female patients diagnosed with glaucoma between 2016 and 2017.

Regarding the type of glaucoma found, Primary Open-Angle Glaucoma was more prevalent (2.4%; n = 17) compared to

**Table 1**  
Demonstration of prevalence of patients diagnosed with glaucoma

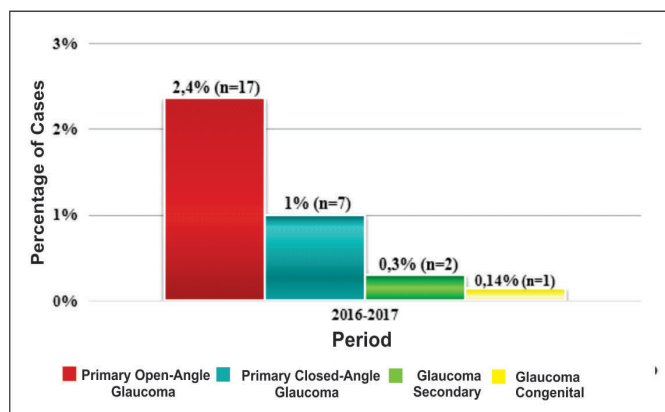
| Year  | Treatment carried out | Patients with glaucoma |     |
|-------|-----------------------|------------------------|-----|
|       |                       | n                      | %   |
| 2016  | 307                   | 21                     | 6.8 |
| 2017  | 411                   | 22                     | 5.4 |
| Total | 718                   | 43                     | 6.0 |

**Table 2**  
General and specific distribution of prevalence of glaucoma diagnoses and their relation to gender frequency of patients

| Variables                            | 2016      |            | 2017      |             | TOTAL     |             |
|--------------------------------------|-----------|------------|-----------|-------------|-----------|-------------|
|                                      | n         | %          | n         | %           | n         | %           |
| <b>Diagnoses of glaucoma</b>         | <b>21</b> | <b>6.8</b> | <b>22</b> | <b>5.4</b>  | <b>43</b> | <b>6</b>    |
| Males                                | 11        | 52         | 9         | 41          | 20        | 46.5        |
| Females                              | 10        | 48         | 13        | 59          | 23        | 53.5        |
| <b>Types of glaucoma diagnosed</b>   |           |            |           |             |           |             |
| <b>POAG</b>                          | <b>8</b>  | <b>2.6</b> | <b>10</b> | <b>2.4</b>  | <b>18</b> | <b>2.5</b>  |
| Males                                | 4         | 50         | 5         | 50          | 9         | 50          |
| Female                               | 4         | 50         | 5         | 50          | 9         | 50          |
| <b>PCAG</b>                          | <b>5</b>  | <b>1.6</b> | <b>2</b>  | <b>0.5</b>  | <b>7</b>  | <b>1</b>    |
| Males                                | 4         | 80         | 2         | 100         | 6         | 85,7        |
| Females                              | 1         | 20         | 0         | 0           | 1         | 14.3        |
| <b>Secondary glaucoma</b>            | <b>1</b>  | <b>0.3</b> | <b>1</b>  | <b>0.24</b> | <b>2</b>  | <b>0.3</b>  |
| Males                                | 1         | 100        | 0         | 0           | 1         | 50          |
| Females                              | 0         | 0          | 1         | 100         | 1         | 50          |
| <b>Congenital glaucoma</b>           | <b>0</b>  | <b>0</b>   | <b>1</b>  | <b>0.24</b> | <b>1</b>  | <b>0.14</b> |
| Males                                | 0         | 0          | 0         | 0           | 0         | 0           |
| Females                              | 0         | 0          | 1         | 100         | 1         | 100         |
| <b>Type of glaucoma not reported</b> | <b>7</b>  | <b>2.3</b> | <b>8</b>  | <b>1.9</b>  | <b>15</b> | <b>2.1</b>  |

POAG: Primary Open-Angle Glaucoma; PCAG: Primary Closed-angle Glaucoma

Primary Closed-Angle Glaucoma, which corresponded to 1% (n = 7). The remainder is comprised by the prevalence of Secondary Glaucoma (0.3%; n = 2) and Congenital Glaucoma (0.14%; n = 1), as shown in Figure 1.



**Figure 1:** Distribution of prevalence by type of glaucoma.

Based on the values presented in table 3, and considering only the cases between 2016 and 2017 in which the city of origin was informed, the results show a frequency of 87.5% (n = 21) for glaucoma patients in Santarém, and only 12.5% (n = 3) corresponding to other locations, which is justified by the fact that Santarém supplies the treatment demands of municipalities located in the surrounding area.

About age group, Table 3 shows that most patients diagnosed with glaucoma are older than 40 years. Excluding cases not reported in the study period, this age group corresponds to 96% of cases, and shows 4% of individuals aged 40 years or less. The average age obtained was equivalent to 63.5 years.

Regarding the presence of Noncommunicable Diseases (NCDs), as shown in Table 3, it was found that 51% (n = 22) had no comorbidity, whereas 49% (n = 21) manifested some disease or combination. Among those presenting some comorbidity, 5% (n = 2) presented an association between Diabetes Mellitus (DM) and Systemic Arterial Hypertension (SAH), 2% (n = 1) only DM, and 42% (n = 18) only SAH diagnosed.

Regarding IOP, the results presented 67% (n = 29) of cases with values above 21 mmHg at the time of diagnosis (Table 3).

Regarding the therapeutic approach, pharmacological association was predominant (53% / n = 23) in relation to monotherapy (26% / n = 11) and surgical treatment (16% / n = 7), as shown in the table 4.

Only 16% (n=7) of the patients underwent surgical procedures (Table 4), and trabeculectomy was applied to 17% (n = 3) of patients with POAG, and iridectomy to 0.57% (n = 4) of patients with PCAG, as shown in Table 5.

## DISCUSSION

The glaucoma prevalence values found in the present study significantly exceed most of the values found in other studies at national level, since according to the Ministry of Health the prevalence of glaucoma in the Brazilian population corresponds to about 3%, half of the 6% verified in the present study.<sup>(4)</sup> Comparing to the Glaucoma Project, a study carried out

**Table 3**  
Frequency statement of variables related to glaucoma patients

| Variableness                   | 2016 |      | 2017 |      | Total |    |
|--------------------------------|------|------|------|------|-------|----|
|                                | n    | %    | n    | %    | n     | %  |
| <b>City of Origin</b>          |      |      |      |      |       |    |
| Santarém                       | 9    | 42.9 | 12   | 54.5 | 21    | 49 |
| <b>Other cities</b>            | 2    | 9.5  | 1    | 4.5  | 3     | 7  |
| Not informed                   | 10   | 47.6 | 9    | 41   | 19    | 44 |
| <b>Age group</b>               |      |      |      |      |       |    |
| 40 years or less               | 0    | 0    | 1    | 5    | 1     | 2  |
| Older than 40 years            | 9    | 43   | 15   | 68   | 24    | 56 |
| Not informed                   | 12   | 57   | 6    | 27   | 18    | 42 |
| <b>Comorbidities analyzed</b>  |      |      |      |      |       |    |
| Systemic Arterial Hypertension | 10   | 47.6 | 8    | 36.5 | 18    | 42 |
| Diabetes Mellitus              | 0    | 0    | 1    | 4.5  | 1     | 2  |
| Hypertension and Diabetes      | 1    | 4.8  | 1    | 4.5  | 2     | 5  |
| No comorbidities               | 10   | 47.6 | 12   | 54.5 | 22    | 51 |
| <b>IOP value at diagnosis</b>  |      |      |      |      |       |    |
| ≤ 21 mmHg                      | 3    | 14   | 3    | 13.6 | 6     | 14 |
| > 21 mmHg                      | 13   | 62   | 16   | 72.7 | 29    | 67 |
| Not informed                   | 5    | 24   | 3    | 13.7 | 8     | 19 |

**Table 4**  
Frequency statement related to type of therapeutic approach applied to glaucoma patients

| Variables                          | 2016 |     | 2017 |     | Total |    |
|------------------------------------|------|-----|------|-----|-------|----|
|                                    | n    | %   | n    | %   | n     | %  |
| <b>Monotherapy</b>                 | 6    | 29  | 5    | 23  | 11    | 26 |
| β-Blockers                         | 5    | 83  | 2    | 40  | 7     | 64 |
| I.A.C                              | 1    | 17  | 2    | 40  | 3     | 27 |
| A.P.P                              | 0    | 0   | 1    | 20  | 1     | 9  |
| <b>Pharmacological association</b> | 11   | 52  | 12   | 54  | 23    | 53 |
| β-Blockers + I.A.C                 | 9    | 82  | 9    | 75  | 18    | 78 |
| β-Blockers + A.P.P ou A.α-A        | 2    | 18  | 3    | 25  | 5     | 22 |
| I.A.C and A.P.P                    | 0    | 0   | 0    | 0   | 0     | 0  |
| <b>Surgical procedure</b>          | 4    | 19  | 3    | 14  | 7     | 16 |
| Iridectomy                         | 4    | 100 | 0    | 0   | 4     | 57 |
| Trabeculectomy                     | 0    | 0   | 3    | 100 | 3     | 43 |
| Not informed                       | 0    | 0   | 2    | 9   | 2     | 5  |

CAI: Carbonic Anhydrase Inhibitors; PPA: Prostaglandin and Prostanamide Analogues; A. -A: -adrenergic agonists

in southern Brazil from the screening of 1,636 patients older than 40 years, the result is similar: the survey identified a prevalence of glaucoma of around 3.4%.<sup>(6)</sup> In addition, other Brazilian studies have also identified a prevalence of glaucoma cases ranging from 1.9 to 2.3%.<sup>(7,8)</sup>

At international level, the results of the present study are also higher, since the prevalence rate of glaucoma in the world population is about 3.6%. The increase evidenced by the results of the present study is worrying, as glaucoma is the leading cause of irreversible

blindness in the world, and is the third leading cause of blindness in Brazil.<sup>(2,4,9)</sup> In addition, this increase reinforces the claim that the prevalence of this disease is higher in Latin and African descent individuals.<sup>(1)</sup> Finally, these results are consistent with the prediction proposed by Tham et al. that diagnosed cases of glaucoma exceed 110 million worldwide by 2040, thus suggesting a negative change in the scenario due to the increase in worldwide prevalence.<sup>(2)</sup>

This regional increase in the prevalence of glaucoma is reaffirmed by the fact that the Brazilian population faces a

period of aging with a reduction in the age pyramid bases and apex widening, as well as the world population. This phenomenon makes it possible for people to have a greater life expectancy of 60 years or older, mainly due to the reduction in birth rates and

fertility rates. Thus, there is an even greater trend regarding the onset of problems such as glaucoma, as it is related to senility.<sup>(10)</sup>

The predominance in frequency found in females compared to males for the diagnosis of POAG differs from the results of

**Table 5**  
**Statement of the frequency related to the type of therapeutic approach applied to patients with POAG and PCAG**

| Variables                 | 2016 |     | 2017 |     | TOTAL |     |
|---------------------------|------|-----|------|-----|-------|-----|
|                           | N    | %   | N    | %   | N     | %   |
| POAG                      | 8    | 2,6 | 10   | 2,4 | 18    | 2,5 |
| Trabeculectomy            | 0    | 0   | 3    | 30  | 3     | 17  |
| Pharmacological treatment | 8    | 100 | 7    | 70  | 15    | 83  |
| PCAG                      | 5    | 1,6 | 2    | 0,5 | 7     | 1,0 |
| Iridectomy                | 4    | 80  | 0    | 0   | 4     | 57  |
| Pharmacological treatment | 1    | 20  | 2    | 100 | 3     | 43  |

POAG: Primary Open-Angle Glaucoma; PCAG: Primary Closed-Angle Glaucoma

other national and international studies. A study carried out in Minas Gerais<sup>(8)</sup> showed 70% of female patients diagnosed with POAG, whereas in international studies men curiously have a higher susceptibility of about 36% in relation to women for the development of POAG, the most prevalent type of glaucoma globally.<sup>(2)</sup> This difference can be explained by the fact that men are more likely to seek medical attention only at significant stages of the disease, especially when there is interference in daily activities, as evidenced by the study by Crabb et al., who, after analyzing the campimetry of 32,147 patients, found that the probability of late diagnosis among men is 16% higher than the same probability for women. In addition, women tend to value eye exams more often, with more frequent visits to health services. At these times, glaucoma is discovered, and consequently women reach earlier diagnoses.<sup>(11)</sup> Thus, although men are more prone to the development of POAG, women end up being more diagnosed.

In view of these findings, the results regarding POAG by gender suggest that there was an improvement in men's search for ophthalmic medical care, thus contributing to a greater detection of POAG cases in this gender, and consequently less discrepancy in relation to female results.

Moreover, the frequency of men for PCAG of 85.7% (n = 6) considerably exceeded the frequency of women (14.3%, n = 1), which is in contrast to national and international studies. In the glaucoma project, for example, it was found that 100% of patients with PCAG were females.<sup>(6)</sup> In the study by Chiu et al., the incidence of women with PCAG was higher than men.<sup>(12)</sup> This divergent result has positive and negative sides, as it suggests a decrease in the search of women for ophthalmological appointments, but also raises the possibility of an increase in the search of men for the ophthalmologist, resulting in a greater number of diagnoses, which would be positive since PCAG is the second most common form of the disease, and may lead to the development of glaucomatous optic neuropathy resulting in greater damage to the patient's prognosis and quality of life.<sup>(13)</sup>

It is worth noting that cases with no information about the type of glaucoma (Table 2) may have influenced the results of gender frequency by type of glaucoma, so the conclusions about this specific part of the variable should be carefully analyzed. More detailed retrospective studies are needed to clarify the changes observed in comparison with international studies on the subject.

The results shown in figure 1 corroborate the research related to the glaucoma category found, which attests higher POAG numbers than PCAG. This can be verified in the glaucoma project, with prevalence of 2.4% for POAG and 0.7% of PCAG, and in the meta-analysis by Tham et al., with prevalence between 1.90 and 6.54% for POAG in Latin America, and 0.14 and 3% for PCAG in the same location. What is striking is the proximity of PCAG prevalences found in Asia, between 0.43 - 2.32%, and that of the present study of 1% (n = 7), as Asia corresponds to the highest prevalence of PCAG manifestation worldwide.<sup>(2,6,14)</sup>

It is important to emphasize that the disease affects Latin and Afrodescendant individuals in greater amount, and therefore any increase in the numbers related to this public is a phenomenon that can be given more attention by health services, as it reinforces the estimated 11.2 million people with bilateral blindness due to glaucoma by 2020.<sup>(1,2)</sup>

However, the value found for secondary glaucoma (0.3%) is a positive point, as it suggests a national prevalence close to the minimum value reported by international studies on the subject ranging from 0.1 to 0.8%, except for a study in Nigeria which reported a prevalence of 8%.<sup>(6,15,16)</sup>

But the values found for congenital glaucoma (0.14%) are worrying, because the international prevalence corresponds to values between 0.03% and 0.05% with variations according to region and ethnicity, except for the Slovaks who present the highest values with 0.08%.<sup>(17)</sup> This significantly greater difference from the worldwide findings on this subject raises the need for more specific studies to identify the justification for this finding.

Regarding the age group of the population studied, there is coherence in the comparison with research related to the subject, because according to the meta-analysis produced by Quaranta et al., there was a predominance of ages between 45 and 70 years after the analysis of 18 studies involving the efficacy of monotherapies and pharmacological combinations in a public diagnosed with glaucoma.<sup>(18)</sup> This fact was also observed in the meta-analysis produced by Lin et al. (2014), who found a predominant variation between 40 and 75 years by analyzing 32 studies related to the treatment of glaucoma.<sup>(19)</sup> Finally, this relation was exposed the same way by 3 more recent studies conducted in 2014, 2015 and 2018 revealing an audience over 40 years old as the vast majority of glaucomatous investigated, and

was the minimum cut used as a risk factor both nationally<sup>(5,20, 21)</sup> and internationally.<sup>(14)</sup>

This consistency is relatively positive, as it suggests that the age range most affected by glaucoma did not increase over time, which would cause more patients to manifest disease symptoms early and prevalence-related rates to increase. On the other hand, the fact that glaucoma is more frequent above 40 years of age increases the possibility of association with the most common health problems in this phase of life, such as DM, SAH, and other comorbidities. In addition, the potential for greater impairments to sight in a shorter time is greater, thus contributing to the relatively early presentation of irreversible damage in the population studied.<sup>(2,22)</sup>

The rate found regarding the presence of DM associated or not with SAH (7%) is lower compared to the national study by Ribeiro et. al (2018), whose evaluation of 425 glaucoma patients identified the presence of DM in 17.9%.<sup>(24)</sup> Compared to international studies, the results of the present study are similar: in Cheng's research, the analysis of 160 glaucomatous patients found only 9.4% with DM.<sup>(24)</sup> The same was found in the study by Hou et al., who analyzed 143 patients with glaucoma and compared the progression of the disease between two groups defined by the presence or absence of diabetes.<sup>(25)</sup> The result was that there was no significant difference in the progression of the visual condition between both groups.

In addition, several other international studies reinforce the low association between glaucoma and DM as a risk factor.<sup>(26-30)</sup> Another factor to reinforce this mild association is the fact that the research location of the present study is considered a specialized ophthalmology clinic, and as the annual evaluation of type 2 diabetes is routine according to SBD (2018), the trend would be to detect more glaucomatous cases in the presence of DM, which did not occur.<sup>(29)</sup>

However, research has been developed resulting in discussions that still allow considering the risk relation between DM and glaucoma. An example of this is the meta-analysis by Zhao et al., whose result states that diabetes and its duration, as well as fasting glucose levels, were associated with a significant increase in the risk of glaucoma.<sup>(30)</sup> Therefore, although not unanimous, this cause and effect relation should be taken into account, and further studies are needed to clarify the real role of DM as a predictive risk factor for glaucoma, mainly because it is a chronic disease and its careful treatment is closely linked to the prevention of other diseases.

Regarding SAH, its higher frequency (48%/n=18) in glaucoma patients compared to DM is also observed in the national survey by Ribeiro et al., which resulted in the identification of 49.2% of glaucoma patients with SAH.<sup>(23)</sup> At international level, the study by Khatri et al. identified SAH in 36% of individuals studied, in addition to 9.5% for DM and 6.8% for the presence of both comorbidities.<sup>(31)</sup> These results suggest that SAH is a risk factor for the development or worsening of glaucoma, which corroborates the meta-analysis by Bae et al. showing that individuals with hypertension have a risk of approximately 1, 2 times higher to develop glaucoma than individuals without hypertension.<sup>(32)</sup>

In addition, SAH was considered in the analysis by Khatri et al. as a risk factor for a worse prognosis in the development of glaucoma due to the possible concomitant increase in IOP, since for each positive alteration of PA of 10 mmHg change, IOP is elevated around 0.2 mmHg, added to the fact that patients with glaucoma are more often diagnosed with hypertension than the general population.<sup>(31,33)</sup> Finally, recent research states that

glaucoma patients have significantly more comorbidities than the general population, which is justified by the retrospective study by Lin et al. where 50.5% of glaucomatous patients had SAH.<sup>(34,35)</sup>

Regarding IOP, the results presented 67% (n = 29) of cases with values above 21 mmHg at the time of diagnosis. These values differ from most national and international studies, as untreated glaucoma patients do not necessarily have high IOP as shown in the study by Ribeiro et al. whose IOP analysis of 425 glaucoma patients identified values <21mmHg in more than half of the patients.<sup>(23)</sup> Internationally, Cheng's survey (2016) monitored 160 patients, and found initial IOP values <21 mmHg in all patients studied.<sup>(24)</sup> The studies by Kim et al. and Karvonen et al. reached basically the same conclusions: in the former, after analyzing 1,128 patients with eye problems, of the 18 glaucoma cases found about 77.7% (n = 14) had IOP <21mmHg; in the latter, of the 83 glaucoma patients found 89% had IOP <21 mmHg.<sup>(36,37)</sup>

A possible explanation for the divergent results of the present study would be the diagnosis of late-stage glaucoma, and therefore greater damage contributing to the exacerbation of pre-existing IOP. However, IOP may be increased at the time of glaucoma diagnosis due to several factors that do not necessarily correspond to glaucoma.<sup>(38)</sup> Therefore, verifying the true cause of elevation and adequate IOP measurement in glaucoma patients requires high-quality periodic ophthalmic examinations, and more specific long-term evaluations in addition to optic nerve analysis and follow-up of other variables to clarify the cause and consequence relation between elevated IOP and glaucoma development.

The predominance in the use of  $\beta$ -Blockers (64% / n = 7) in the monotherapy treatment of glaucoma shown in table 4 shows adequacy to current guidelines on the subject. According to the Ministry of Health's protocol for the treatment of glaucoma, IOP reduction is the primary goal of the therapy, given the subsequent reduction in disease progression rates from this initiative, with  $\beta$ -blockers being a good treatment for this due to the strong evidence of its hypotensive efficacy and high likelihood of association with other classes, such as carbonic anhydrase inhibitors and prostaglandin and prostamide analogues.<sup>(1)</sup> However, from the analysis of 1,915 studies, the meta-analysis of the network by Li et al. showed the greater efficacy in reducing IOP in 3 months by prostaglandin analogues whose use is preferred in developed countries, and lower systemic side effects when compared to  $\beta$ -blockers.<sup>(39)</sup>

However, the increased availability of  $\beta$ -Blockers in developing countries such as Brazil may explain the higher frequency of their use compared to prostaglandin analogues. Another important detail is that according to Almodin et al., although prostaglandin analogues are the most potent hypotensive agents available today, their ocular adverse effects are common, such as pruritus, conjunctival hyperemia, ocular irritation, ocular pain, burning, and cilia alteration, making this class a second alternative in controlling intraocular pressure.<sup>(40)</sup>

Regarding the pharmacological association, the higher frequency of the use of  $\beta$ -blockers and inhibitors of carbonic anhydrase reveals equivalence to the order established by the protocol of the Ministry of Health.<sup>(1)</sup> In addition, the combined therapies proved to be as effective, and in some studies even more potent than individual components, according to Cohen et al.<sup>(41)</sup> However, the use of a pharmacological combination instead of monotherapy should be avoided and should be restricted to primary failure or therapy with medication taken alone, and/or depending on the magnitude of IOP reduction, as

combined therapies have major side effects, according to more recent studies.<sup>(5)</sup>

The reduced use of trabeculectomy for the treatment of POAG can be justified from the analysis of international recommendations on the subject, since the European Society of Glaucoma states that the goal of treatment is to maintain the patient's visual function and related quality of life at a sustainable cost.<sup>(42)</sup> Therefore, the surgical procedure may present higher treatment costs in terms of inconvenience and side effects, as well as financial implications for the individual, requiring careful evaluation according to its actual effectiveness in the patient in question. In addition, surgical procedures are generally used when there is difficulty in controlling disease progression by the pharmacological method, or in cases of prognosis that is significantly positive for immediate surgery.

It is also noteworthy that according to Motlagh's retrospective comparative study, trabeculectomy in the treatment of glaucoma is related to significant results in decreasing intraocular pressure and the number of drugs used compared to drug treatment in patients with Open-Angle Glaucoma.<sup>(43)</sup>

In addition, in the long term, surgical therapy has positive results in the patient's quality of life due to the "freedom" from chronic use of eye drops, an important obstacle to treatment adherence.<sup>(20)</sup> However, the period referring to the prescription, the procedure itself, and the immediate postoperative period are considered sources of anxiety and discomfort for the patient, causing psychological damage according to Lemaitre et al.<sup>(44)</sup> and thus demonstrated by the Guedes study evaluating 607 glaucoma patients who were randomized between clinical and surgical treatment. The assessment of quality of life with 3 questionnaires showed that patients undergoing trabeculectomy had lower scores mainly related to discomfort at the surgery site.<sup>(45)</sup>

Regarding iridectomy, it was observed in 57% (n = 4) of PCAG cases, suggesting agreement with the worldwide recommendations because this type of procedure associated to drug therapy is the definitive treatment mostly used according to the European Glaucoma Society,<sup>(46)</sup> as conjunctival scar is minimal or absent, and it is an effective low-risk procedure to alleviate pupillary block by reducing the pressure difference through the iris with increasing use in suspected PCAG as a prophylactic activity according to Wright et al.<sup>(47)</sup>

## CONCLUSION

The present study found a regional prevalence of glaucoma higher than those found in other regions by national and international studies. This may be related to the fact that the research location is considered an ambulatory specialized in ophthalmology, which theoretically increases the likelihood of patients with major visual problems being admitted. However, this increase may also be a regional reality, mainly because it is a Latin American population carrying a greater risk for the onset of primary open-angle glaucoma. Therefore, the findings discussed raise the need for further studies on the subject to try to clarify the real causes of this modification.

POAG was the most prevalent type, which demands greater dissemination of information about this pathology to the population, as it usually does not present symptoms until there is a significant loss of vision. In addition, age older than

40 years and IOP values above 21 mmHg also showed high frequency in most of the results, suggesting them as influential risk factors. The gender presented significant variation of frequency according to the types of glaucoma analyzed, being influenced by social trends of late seek for care by the male patients, whereas female patients are more diagnosed for going earlier to the Ophthalmology services.

In addition, although there is no unanimous response to the increased risk of glaucoma in patients with DM and SAH, numerous studies have indicated a higher detection of SAH in glaucomatous patients than DM. Therefore, what was observed by the present study precisely illustrates this superiority, with the number of hypertensive individuals identified almost 10x the number of diabetic ones in the patients analyzed, which reinforces the cause and effect relation pointed out. However, as it is a correlation that still faces controversies including recent research, more studies should be encouraged, and the correct control of these diseases should remain one of the pillars of public health in Brazil and the world, being it a risk factor for glaucoma or not.

Another important point is that pharmacological associations were the most commonly used methods to control IOP in the patients studied, which reveals a similar management to that adopted in other parts of Brazil and the world. Therefore, this communication makes the treatment homogeneous, and allows the efficacy of the first lines of therapy to be sufficient, reducing the number of cases progressing to invasive procedures.

Given these considerations, the present study suggests that the interior of the Western Amazon, more precisely the west of Pará, presents results close to the Brazilian and international context, with some divergences warning to the need for broader and more elucidative studies, especially regarding the region chosen by this research. The scarcity of similar studies, therefore, made a more reliable comparison of the findings unfeasible, with the results of research in other regions of the country and the world being used as a discussion parameter, giving the present study a pioneering and encouraging character for the elucidation of the characteristics related to glaucoma.

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