Cost of Medical Treatment for Primary Open-Angle Glaucoma in Relation to Patients' Income and Its Impact on the Prognosis of the Disease, in Bouaké University Hospital

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Abstract

Introduction: Medical treatment for POAG is continuous and lifelong treatment. The aim of this study was to evaluate the relationship between the cost of this treatment and patients' income and the impact of this relationship on treatment compliance. **Materials and Methods:** Prospective cross-sectional study with a descriptive aim covering sociodemographic data, average incomes, and direct and indirect costs of treatment of 57 patients followed for POAG during the period from January 1, 2012, to December 31, 2016 (5 years). **Results:** The patients were aged 25 to 77 years (mean = 54.4 years) with a male predominance (sex ratio = 1.5). Retirees were the most represented (26.32%), followed by workers in the informal sector (14.04%) and housewives (12.28%). Patients who had an annual income less than or equal to 900,000 CFA francs (€1370.83) per year represented 56.14% and those who did not have health coverage represented 57.89%. The treatment was monotherapy (64.91%), dual therapy (31.58%) or triple therapy (3.05%) and the average ratio of "annual cost of treatment to annual income" was 0.56 with for maximum 2.23 and 0.02 as minimum. Patients who considered the cost of treatment unbearable for their income represented 78.95%. **Conclusion:** Prevention of blindness due to glaucoma requires early detection but also the establishment of health coverage mechanisms to improve compliance with medical treatment. In addition, consideration should be given to the development of glaucoma surgery in our country, the indication of which could be the first intention in certain patients, considering for those patients, the geographical and financial accessibility of medical treatment.

1. Introduction

Open-angle glaucoma is a group of chronic progressive optic neuropathies which have the common characteristic of morphological changes in the head of the optic nerve and are correlated with the progressive destruction of retinal nerve fibers in the absence of other ocular diseases or congenital pathologies [1]. Primary open-angle glaucoma (POAG) is the most common clinical form and represents the second cause of blindness in developed countries and affects 1 to 2% of the population over 40 years old. Its prevalence is 0.93% and increases, from the age of 70, by 1% every 5 years (3% at 75 years, 4% at 80 years) [2]. The major risk of POAG is blindness, which can be avoided or delayed if patients are systematically screened and treated early. The medical treatment of POAG aims to lower intraocular pressure (IOP) through the single or multiple daily administration of one or more eye drops, according to a specific schedule. This treatment is for life, it must be maintained until the last breath of the glaucomatous patient. Furthermore, it is sometimes associated with the treatment of other chronic pathologies due to the age of the patients, many of whom have comorbidities [3] [4]. Such treatment will require the regular purchase of medications, periodic check-up consultations and additional monitoring examinations. In addition to the costs generated by these activities, we must add those linked to frequent trips to a specialized center sometimes outside the patient's area of residence and sometimes, in our African context, accompanied by one or more people by traveling back and forth from his rural area to the urban center where the ophthalmology department is located. These costs, spread over time and reported per unit of time, allow us to define the average cost of medical treatment over a certain duration of treatment. Relating the average cost of treatment to the patient's income over a certain period therefore makes it possible to measure the impact of this cost on the patient's resources [5] and to deduce consequences on treatment compliance and prognosis of the disease in the long term. The aim of this work was to contribute to an improvement in the management of primary open-angle glaucoma in low-income countries, through a reflection on therapeutic regimens adapted to socio-economic and health conditions similar to ours, in Ivory Coast.

2. Materials and Method

This is a prospective cross-sectional study with a descriptive aim which took place in the ophthalmology department of the Bouaké University Hospital. It covered the period from January 1, 2012, to December 31, 2016 (5 years) and the

survey was carried out from April 24 to June 24, 2017, *i.e.*, a duration of 2 months. Included in the study were patients aged 18 and over, followed for primary open-angle glaucoma confirmed by a visual field and under medical treatment for at least 6 months. The data were collected on an anonymous individual survey form (questionnaire). The collection was made from information contained in the patients' medical files which was completed by the patients themselves by telephone interview. In fact, patients were contacted using the telephone number written in the medical file. An appointment was made with each of them and after a verbal consent agreement, the survey was carried out using an anonymous questionnaire completed remotely by the investigator. The direct costs linked to the purchase of medicines and the carrying out of additional confirmatory or monitoring examinations were calculated based on the identification of medicines and examinations. Indeed, we have noted the prices as mentioned in the therapeutic guide of the general mutual of civil servants and agents of the State of Côte d'Ivoire (MUGEFCI) which is updated every year, for what concerns medicines and the rating grid for medical, biology and radiology procedures in use in Ivory Coast. Indirect costs such as those linked to travel and stays in the city of Bouaké for patients who do not live there were estimated by the patients themselves. Data analysis was carried out using EPI info version 7 software.

3. Results

The sample was composed of 57 patients whose average age was 54.4 years with an extreme of 25 and 77 years. The male gender was predominant with a sex ratio of 1.5. Retirees were the socio-professional category most observed with 26.32% (Table 1). More than half of the patients were married, *i.e.*, 57.89% (Table 2). Regarding socio-economic characteristics, patients who had an average monthly income less than 100,000f CFA*/month (<152€) were in the majority with a proportion of 55.56% and more than half of the patients (56.14%) had an annual income less than or equal to 900,000 francs CFA (€1370.83) per year (Table 3). Furthermore, 49.12% of patients had between 5 and 10 dependents and according to 28% of patients, they themselves represented a burden on their families (Figure 1). Regarding the purchase of anti-glaucoma medications, 57.9% did not have health coverage. They bought their treatment themselves or were helped by their spouse or another family member. With 50.88%, monotherapy with a beta-blocker was the most frequently used treatment (Table 4). For their regular follow-up, the first automated visual field check was carried out by 87.72% of the patients. This rate dropped to 20% for those who had carried out a second visual field check. Concerning the performance of other additional examinations (OCT, pachymetry, etc.), 96.49% of patients had done none (n = 55). Two patients had each performed an OCT (3.50%). Regarding treatment compliance, patients under treatment for at least 3 years represented 49.12% (n = 28). Those who claimed to have good compliance were 43 (75.43%). Glaucoma sufferers

who spent between 200,000 and 400,000 CFA francs (€304 - 609) per year for their treatment were in the majority with 71.93% (Table 5). The cost of treatment was considered unbearable for 78.95% of patients and was cited as the main cause of poor compliance. Despite this cost, patients who said they were satisfied with their treatment represented 56.14%. Those who were not satisfied represented 32%, and 5.26% had no opinion. Regarding surgical treatment, when patients were informed of the existence of such treatment, those who were in favor represented 82.46%. The 17.54% who were against it cited the probably high cost of this treatment as a reason.

Table 1. Distribution of patients according to occupation.

Occupation	Numbers	Percentages (%)
Retired	15	26.32
Informal Sector Workers	8	14.04
Teachers (primary and secondary)	7	12.28
Housewife	7	12.28
Student	2	3.51
Others*	5	8,77
Commercial and financial sector	4	7.02
Religious	4	7.02
Paramedics	3	5.26
Military	2	3.51
Total	57	100.00

Others* = Electricity Company Agent, Town Hall Agent, Cook Assistant, Meteorologist, Secretary.

Table 2. Distribution of patients according to marital status.

Marital status	Numbers	Percentages (%)
Bachelor	18	31.58
Divorced	1	1.75
Married	33	57.89
Widower/widow	5	8.77
Total	57	100.00

Table 3. Distribution of glaucoma patients according to median annual income.

Median annual income (Franc CFA*)	Numbers	Percentages (%)
300,000	21	36.84
900,000	11	19.30
2,100,000	10	17.54
4,500,000	13	22.81
9,000,000	2	3.51
Total	57	100.00

CFA* = African Financial Community (Ivorian currency); 1 CFA francs = 0.0015 Euro, in fixed parity.

Table 4. Distribution of glaucoma patients according to therapeutic modalities.

	Families of molecules	Numbers	Percentages (%)
Monotherapy	Prostaglandin analogue	8	14.04
	Beta blockers	29	50.88
Fixed therapeutic combinations	CAI* + Beta blockers (Dorzolamide + Timolol)	6	10.53
	PA** + Beta blockers (Travoprost + Timolol)	2	3.51
Non fixed therapeutic combinations	PA + CAI + Beta blockers	1	1.75
	CAI + Beta blockers	4	7.02
	PA + Beta blockers	4	7.02
	CAI + Parasympathomimetics	2	3.51
	PA + CAI + Parasympathomimetics	1	1.75
	TOTAL	57	100.00

CAI*: carbonic anhydrase inhibitor; PA**: prostaglandin analogue.

Table 5. Distribution of the glaucoma patients according to the annual coast of the medical treatment of the disease.

Annual coast of the medical treatment (FCFA*)	Numbers	Frequency (%)
<100,000	1	1.75
100.000 - 199.000	8	14.04
200.000 - 299.000	25	43.86
300.000 - 399.000	16	28.07
400.000 - 499.000	5	8.77
>500.000	2	3.51
Total	57	100.00

CFA* = Communauté Financière Africaine (African Financial Community). The "Francs CFA" is the Ivorian currency; 1 francs CFA = 0.0015 Euro, in fixed parity.
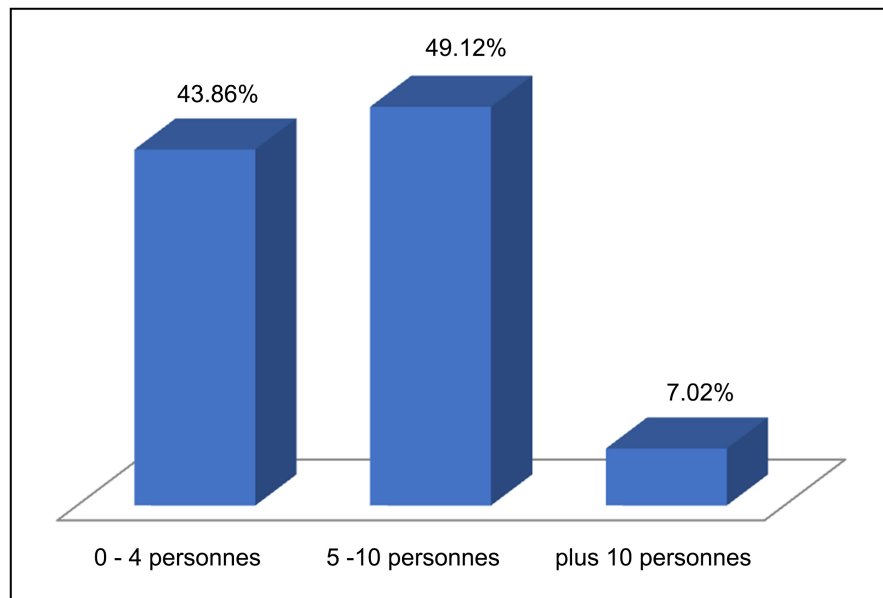
Figure 1. Distribution of patients according to the number of dependents.

4. Discussion

The average age of the patients was 54.4 ± 15.9 with a range of 25 and 77 years. These results are consistent with those of Moukouri *et al.* in Cameroon [6] which found an average age of 51.4 years. Authors like BRON and Ouertani found higher average ages which were 64 and 68 years respectively in France and Tunisia [7] [8]. These results could be explained by the prevalence of glaucoma which increases with age and the fact that it is a risk factor. Furthermore, the average age of patients in the African melanoderma environment could also mean an earlier appearance of POAG in melanoderma subjects. The male gender was in the majority with a ratio of 1.5. The male predominance was found in most African studies, notably those of Ahnoux in Ivory Coast [9] and Sounouvou in Benin [10] with respective proportions of 59.4% and 57.6% men. However, other authors such as Demailly [11] in France and Mac Donald [12] in Canada noted an equal distribution between the sexes in a respective study. This difference could be explained by men's greater accessibility to medical care in the African context due to greater autonomy, particularly on the financial level [10], whereas in developed countries, insurance systems and health coverage has reduced this inequality. This male predominance would then be a selection bias because gender would not be a risk factor for the disease, given the discordant data from numerous studies on the subject. However, would this male predominance not be an indicator of the epidemiological profile of the disease in relation to gender, in the African context south of the Sahara [13]? Retirees and people working in the so-called informal sector were the most represented with 26.32% and 14.04% of patients respectively (Table 1). If the former have regular income in the form of retirement pensions, the latter most often have irregular income. These data reveal that a large proportion of patients with POAG are people with low income

due to their socio-professional situations, or even poor people. This is confirmed through the analysis of the average income of patients, on the one hand, and their family responsibilities on the other. Indeed, more than half of the patients (56.14%) had an income less than or equal to 900,000 CFA francs (€1370.83) per year (Table 3). These data agree with those of the IMF which estimated in 2015 the GDP per capita in Ivory Coast at 729,644 CFA francs (€1112.33) even though the African average was €2962.57 and the world average was €12612.64 in 2014 [14]. Added to this was the fact that more than half of the patients (57.89%) did not benefit from health coverage. This situation is therefore indicative of the economic precariousness in which most of these patients lived. Furthermore, regarding family responsibilities, almost half of the patients had between 5 and 10 dependents (49.12%) and among the 43.86% who had 0 to 4 dependents (n = 25) and among the latter, 7 patients claimed to be a burden on their families. As for treatment, most patients (64.91%) benefited from monotherapy. The same observation was made by Sounouvou [10] and Ouattara [13] who found respectively 59.4% and 54.16% of people benefiting from monotherapy. Monotherapies with a beta blocker were the most frequently used (50.88%), probably due to their relatively low costs since the advent of generics [15] [16]. This would tend to support the assertion that Beta-blocker is the "Swiss army knife" of the African glaucomatologist [17]. For medical monitoring, the automated visual field (AVF) control was requested, but 12.28% of patients were unable to carry it out due to the cost which they considered high and due to its difficult geographical accessibility. in our context. Indeed, the closest visual field was in the town of Yamoussoukro, 100 kilometers from the town of Bouaké. This would also justify that almost all (80%) of the patients did not perform more than 2 visual fields during the various checks they carried out and that apart from the visual field, no other complementary examination had been carried out. accomplished. Disease monitoring was therefore much more based on tonometric monitoring and ophthalmoscopic analysis of the optic disc. Patients who did not reside in the city of Bouaké were therefore required to travel from their places of residence accompanied by stays with relatives (arrival the day before the appointment and departure the next day), some being accompanied by a relative. All the direct and indirect costs (purchase of medicines, carrying out additional examinations, travel and stays for monitoring, etc.) evaluated for each patient indicated that 71.93% (n = 41) spent between 200,000 - 400,000 CFA francs per patient (304 - 609 € per year) in relation to their treatment. The average ratio of annual treatment cost to annual income was 0.56 with a maximum of 2.23 and a minimum of 0.02. This implies that on average, patients spent more than half of their income on expenses related to their glaucoma treatment, but that in some cases, these expenses exceeded more than twice the patients' income. More than 3 out of 4 patients (78.95%) considered the cost of treatment unbearable while 21.05% considered it bearable. But the latter were patients with high incomes who had an economic situation which allowed them to buy their medicines and carry out

their checks without this having a strong impact on their lifestyles. Married patients accounted for 57.89% (Table 2). Marriage is seen in our African context as a factor of stability on an emotional, family but especially financial level. Mutual support within the married couple allows spouses to feel secure. However, it could also be seen as a burden. In a large proportion of couples, only one of the spouses carried out an income-generating activity, sometimes with financial difficulties due to the imbalance between the often very low income and the sometimes very significant expenses. Patients who had between 5 and 10 people in their care were the most represented with 49.12% (Figure 1) this could probably be explained by cultural habits and family support in Africa, where families are sometimes very large. Among the 43.86% of patients who had between 0 and 4 dependents, more than half (28%) had no dependent but were rather a burden on their family. One of the reasons would be the economic precariousness in our developing countries, but also because of the advanced age of these patients who no longer have any income and who are sometimes blind. Many of these patients are unassisted and sometimes rely on family members when they can help them. Our results were consistent with those of Ouattara who demonstrated that among glaucoma patients who had an income-generating activity, a proportion of 66.66% of patients had no health coverage [13]. The absence or low health coverage in most developing countries could be a poor prognosis factor for chronic diseases such as POAG. Among patients who did not have health coverage, 24.1% purchased their medications personally while 15.79% needed help from their spouse or another family member to purchase them. This family solidarity, understood as both material and moral support for these people, supposes a link between people with common interests or a feeling of collective belonging. But how far can this solidarity go in a general context of "high cost of living" decried almost everywhere in Africa?

Patients under treatment for more than 3 years represented 48.21% and those who claimed to have good compliance with treatment represented 75%. Does this rate reflect reality, when we know that Ouattara *et al.* [13] in a study on the impact of medical treatment of primary open angle glaucoma on the quality of life of patients noted an interruption rate of 41.67%? However, the cost of treatment was the main cause of poor compliance according to 25% of patients. Our results are lower than those of Wane [18] and Rakkaa [19] who found 38.7% and 39% poor compliance in their respective studies. The figures in our series below could be explained by probably more effective awareness raising. Although the compliance rate was high in our series, only 56.14% of patients were satisfied with the treatment. This shows all the reflection that must be carried out around medical treatment which, in addition to being expensive and inaccessible for many patients, poses a problem of satisfaction, particularly among patients who initially did not complain of any symptoms until the day an ophthalmologist diagnosed them with glaucoma [13]. When surgical treatment was proposed as an alternative to medical treatment, most patients (82.46%) were in favor of this

possibility. However, those who were against this treatment (17.54%) cited the probably high cost of this treatment as a reason. Other alternatives to classic filtering surgery such as that trabeculectomy have demonstrated their effectiveness. These include selective laser trabeculoplasty (SLT) but in the context of low-income countries that are sometimes under-equipped, should we not promote surgery as first intention and at lower cost for certain categories of patients to avoid blindness due to glaucoma? Multicenter studies would make it possible to define the indications.

5. Conclusion

Primary open-angle glaucoma is a chronic, very blinding disease with an insidious progression, most often affecting people over the age of 40 and requiring lifelong medical treatment. The aim of our work was to analyze the impact of the cost of this treatment on patients' income and its consequences on the prognosis of the disease in a low-income country like ours. The low income of most patients and their low rate of social security coverage highlight the financial precariousness in which they could live. Given the sometimes very high cost of medical treatment compared to the income of many patients, this can constitute an obstacle to good compliance with treatment. The blindness that would be the consequence of such poor observance would add to the burden of global blindness and more specifically that of our country. Prevention of blindness due to glaucoma therefore requires early detection but also the establishment of health coverage mechanisms to improve compliance with medical treatment. In addition, consideration should be given to the development of glaucoma surgery in our country, the indication of which could be the first intention in certain patients, considering for those patients, the geographical and financial accessibility of medical treatment.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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