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Direct Cost of Primary Open Angle Glaucoma Management

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Abstract

Background: There are few studies on the cost of glaucoma management in developing country, especially in Togo, there are no data on the cost of POAG management. **Aims**: To determine the annual direct cost of the management of POAG, to evaluate the annual economic weight of the management of POAG and to determine the factors associated with the annual economic weight of the management. **Methods**: We conducted a retrospective and descriptive study over a period of 12 months from January 1 to December 31, 2019 based on the records of patients followed for POAG in AFIA Eye Clinic in Lomé-Togo. The annual direct cost was defined by the sum of the costs of consultations, explorations and treatments. We defined the direct cost per patient and per year and related to the average annual income. It was said to be catastrophic at 20% or more of the estimated annual income. Chi 2 and Fisher tested the comparison of proportions. We conducted univariate and multivariate logistic regression to search correlations. **Results**: During the study period, 150 patient records were included. The average age was 47.24 ± 17.09 years and the sex ratio was 0.82. The cost of the diagnosis was 112.18 ± 22.26 €. The average cost of consultations was 19.46 ± 11.35 € and that of explorations was 92.71 ± 10.91 €. The annual cost of treatment per patient was 165.52 ± 110.16 €. The annual global direct cost of POAG management per patient was 277.69 ± 132.42 €. Compared to the annual income of 1166.29 €, the economic weight of the glaucoma management was 23.8%. This direct cost was catastrophic for 32.1% of patients in the study (44/150 of people with no care). Compared to the guaranteed inter-professional minimum wage (SMIG) of 640.30 €, the economic direct cost weight was 43.3%. Risk factors significantly associated with the direct cost were age over 40 (OR = 1.05 and p = 0.032), liberal profession (OR = 4.72 and p = 0.04), the absence

of health insurance (OR = 6.68 and p = 0.017) and the use carbonic anhydrase inhibitors (OR = 7.4 and p = 0.012) and prostaglandin analogues (OR of 38.2 and p < 0.001). **Conclusion**: This first study on the direct cost of POAG management in Lomé showed that the economic burden glaucoma represents for the patient, his family and society. The data from this study will allow health decision-makers to adopt strategies to mitigate the effects of glaucoma on the economy.

Keywords

Glaucoma, Direct Cost, Management, Lomé, Togo

1. Introduction

Primary open-angle glaucoma (POAG) is a chronic, progressive, potentially blinding, irreversible eye disease causing optic nerve rim and retinal nerve fiber layers loss with related visual field defects. Angle appearance is normal, and the major risk factors included the level of intraocular pressure and older age. Visual disabilities are usually prevented by early diagnosis and treatment (European Glaucoma Society, 2021) [1]. Treatment of POAG typically involves the use of hypotonic drugs, regular follow-ups including visual field analysis or optical coherence tomography to monitor drug effectiveness and disease progression (Varma, 2011) [2]. In 2020, glaucoma was estimated to occur in 79.6 million people worldwide (Varma, 2011) [2]. Recommended management of glaucoma typically includes the use of medications to reduce intraocular pressure (IOP) and regular participation in follow-up hospital visits, including visual field analysis or optical coherence tomography to monitor drug effectiveness and disease progression (Cakiner-Egilmez 2015) [3]. In several countries, especially developed ones, there are data on the costs associated with diseases, making it possible to measure the economic impact on populations in order to guide health policies. In the United States of America, the cost of therapeutic management of glaucoma is estimated at $2.5 billion per year, direct costs at $1.9 billion and indirect costs at $0.6 billion (Traverso, 2005) [4]. The burden of glaucoma treatment is largely supported by the government or medical insurance in developed countries; this information is unknown in developing countries because there are few studies on the cost of glaucoma in these countries (Nayak 2015, Smith 2018) [5] [6]. Sub-Saharan Africa was the most affected population in the world with the highest ratio of glaucoma to the adult population, estimated at 4.32% of the population in 2010 (Varma, 2011) [2]. Developing countries are constrained by insufficient information for the population, as well as insufficient resources and staff for eye care. Also, there is little understanding or consensus on which glaucoma detection and treatment strategies are likely to be the most cost-effective in terms of the greatest number of years of vision gained on a sustainable cost basis. This leads to a disproportionate allocation of blindness and

causes a decrease in productivity and care costs, thus limiting the economic resources of our societies (Smith, 2018) [6]. As the increase in the severity of the disease increases the financial burden, it is important to know how much each patient spends on the treatment of their disease and to accurately measure the impact on their monthly income in our country (Varma, 2011) [2]. Regarding glaucoma in Togo, there are no data on the cost of its management and its impact on the general population. Studies carried out in countries bordering Togo, notably Benin (Sounouvou 2015) [7] and Ghana (Ocansey, 2016) [8] did not take into account the cost of OCT. The present study was initiated with the general objective of determining the direct cost of the management of primary open-angle glaucoma in Lomé.

2. Methods

Type of study: We conducted a retrospective and descriptive study over a period of 12 months from January 1 to December 31, 2019.

Setting and study population: Our study took place in AFIA Eye Clinic in Lomé, the capital of Togo. Togo is a West African country located between the 6th and 11th degree of North latitude; limited to the north by Burkina-Faso, to the east by Benin, to the west by Ghana and to the south by the Atlantic Ocean. Its area is 56,600 km^2 with a population estimated at around 8.6 million in 2020, with a distribution of 49.30% men and 50.70% women. The density is 152 inhabitants per km^2 (Koubogbé 2015) [9]. The target population of this study consists of patients of all ages with a complete medical file regularly followed for POAG in AFIA Eye Clinic in Lomé. We have included in this study all records of patients followed up at least 6 months for POAG in which all required information was available.

Study variables: The variables studied were sociodemographic data (age, sex, profession, monthly income), the glaucoma stage, types of treatment, direct annual cost of care (consultation, explorations, treatment), and economic weight. The glaucoma stage was determined using the Glaucoma Staging system based on visual field Mead deviation score (Mills, 2006) [10]. The annual direct cost was defined by the sum of the costs of consultations, explorations (IOP, Central Corneal Thickness, automated visual field and optical coherence tomography) and treatments (medical, physical or surgical and adjuvant). The costs of consultations, explorations, surgery and Laser were obtained from the database of Eye Clinic, and these of medicines were obtained in pharmacies. We defined the direct cost per patient and per year and related to the average annual income. The National Institute of Statistics, Economic, and Demographic Studies (INSEED) estimated the annual income (Koupogbé, 2015) [9]. It was said to be catastrophic at 20% or more of the estimated annual income.

Data collection tool: We collected the data on a pre-established tested and validated survey form with 20 items (Appendix).

Data analysis: We performed statistical analysis using R 4.0.3 software (R Core Team, Vienna). Chi 2 and Fisher tested the comparison of proportions. We

conducted univariate and multivariate logistic regression to search correlations. After univariate analysis, sufficiently associated variables ($p < 0.2$) were introduced into a reduced model for bivariate analysis. Variables are considered significantly associated to cost if odd ratio > 1 and $p < 0.05$.

3. Results

During the study period, we retained 150 patient records. The average age of the patients was 47.24 ± 17.09 years with extremes of 7 and 80 years. There were 36 patients aged between 40 and 50 years, *i.e.* 24% of the sample. There was a female predominance with an M/F sex ratio of 0.82. Private sector employee constituted the most important socio-professional category with a workforce of 66, *i.e.* 44% of patients. Self-employed or liberal professions employees followed with a workforce of 32 *i.e.* 21.3% of the sample as shown in Figure 1. The annual income was estimated according to INSEED at 765026.00 CFA francs with extremes of 0 to 3667272.00 CFA francs *i.e.* €1163.44 with extremes of 0 to €5594.6. In 62.7% of cases, patients paid for their care directly and health insurance plan or by a third party carry costs in 37.8%.

Clinical and paraclinical aspects

Thirty-three (33) patients over 150 had arterial hypertension, *i.e.* 20.7%, and 17 patients, *i.e.* 11.3%, had a history of familial glaucoma. The mean of annual consultations was 1.72 ± 1.01 with extremes of 1 to 6. According to the stage of glaucoma, 71 patients *i.e.* 47.3% were at stage 1 (MD > −6 dB). The average number of IOP performed was 1.72 ± 1.01 and the average number of automated visual field and OCT examination of the optic disc were each 1.46 ± 0.47. All the patients were under hypotensive eye drops. Two (2) patients *i.e.* 1.33% had a trabeculectomy and 1 patient *i.e.* 0.67% had a laser treatment. The beta-blocker eye drops were used by 86 patients *i.e.* 48% followed by prostaglandin analogues eye drops by 60 patients *i.e.* 33.6% of cases. Table 1 shows the demographic and clinical data.

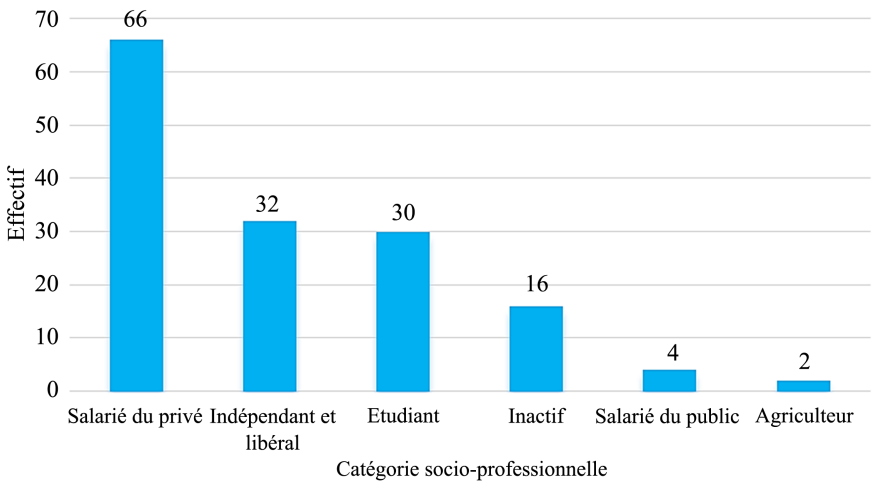

Figure 1. Patients repartition according to socio-professional categories.

Table 1. Socio-demographics and clinical characteristic of patients.

Mean age (years)	47.24 ± 17.09		
Sex-ratio (M/F)	0.82		
Average annual income (euro)	1163.44 [0 - 5594.6]		
		Frequency	Percentage
Glaucoma stage (MD* in dB**)			
	Stage 1-Early (MD > −6 dB)	71	47.3%
	Stage 2-Moderate (−12 < MD < −6)	42	28%
	Stage 3-Advanced (−20 < MD < −12)	36	24%
	Stage 4-Severe (MD < −20)	1	0.7%
Eye drops Treatment			
	Beta blockers	86	48%
	Prostaglandins	60	33.6%
	Carbonic anhydrase Inhibitors	26	14.6%
	Cholinergic Agents	5	2.8%
	Alpha-adrenergic agonists	2	1.1%
Laser			
	SLT Laser	1	0.6%
Surgery			
	Trabeculectomy	2	1.3%

* = Mean Deviation ** = Decibels.

Annual direct cost

The cost of the diagnosis was 73,582 ± 14,600 CFA francs *i.e.* 112.18 ± 22.26 €. The average cost of consultations was 12,767 ± 7444 CFA francs *i.e.* 19.46 ± 11.35 € and that of explorations was 60,815 ± 7156 CFA francs *i.e.* 92.71 ± 10.91 €. The cost of annual medical treatment per patient was 91,265 ± 65,478 CFA francs, *i.e.* 139.13 ± 99.82 € (Table 2). The cost of surgical treatment per patient was 533F CFA *i.e.* 0.81 €, that of the annual physical treatment per patient was 833F CFA *i.e.* 1.27 € and that of the adjuvant treatment per patient was 14,772 ± 22,583F CFA *i.e.* €139.13 ± €99.82. The annual cost of treatment per patient consists of the costs of medical treatment, laser, surgical treatment and adjuvant treatment. It was 108,571 ± 72,261 CFA francs *i.e.* 165.52 ± 110.16 €. The annual global direct cost of POAG management (consultations, functional explorations and treatments) per patient was 182,153 ± 86,861 CFA francs *i.e.* 277.69 ± 132.42 €. Table 3 shows the details of the costs.

Table 2. Type of eye drops and their cost.

	Percentage	Annual cost (Euro)
Beta blockers	64.2	65.39 ± 46.90
Prostaglandins	44.8	45.97 ± 32.98
Carbonic anhydrase Inhibitors	19.4	20.43 ± 14.66
Cholinergic Agents	1.5	2.04 ± 1.47
Alpha-adrenergic agonists	3.7	3.06 ± 2.20
Total	-	139.13 ± 98.21

Table 3. Summary of the direct costs of POAG management.

	Cost in euro	Percentage
Diagnosis	**112.18 ± 22.6**	**40.4**
Consultation	19.46 ± 11.35	
Exploration	92.71 ± 10.91	
Treatment	**165.52 ± 110.16**	**59.6**
Medical	139.13 ± 99.82	
Surgical	0.81 ± 0.0	
Laser	1.27 ± 0.0	
Adjuvant	24.31 ± 34.45	
Total	**277.69 ± 132.42**	**100.0**

Economic support weight

The INSEED's estimating annual income at 765,026 CFA francs *i.e.* €1166.29 and the overall annual cost of care at 182,153 ± 86,861 CFA francs *i.e.* €277.69 ± 132.42, the economic weight of the glaucoma management was 23.8% ± 11.4%. This care was catastrophic for 32.1% of patients in the study (44/150 of people with no care). This direct cost, compared to the guaranteed inter-professional minimum wage (SMIG) of 420,000 CFA francs/year, *i.e.* €640.30 had a weight of 43.3% ± 20.7%.

Factors associated with catastrophic costs.

Table 4 shows the risk factors associated with the direct costs. They are: age over 60 (OR = 1.05 and p = 0.032), exercising a liberal profession (OR = 4.72 and p = 0.04), the absence of health insurance (OR = 6.68 and p = 0.017) and the use of eye drops such as carbonic anhydrase inhibitors (OR = 7.4 and p = 0.012) and prostaglandin analogues (OR of 38.2 and p < 0.001). Factors such as Age below 40 years, history of High blood pressure, genre, being an employee, use of beta-blockers eye drops, are not associated with catastrophic cost (p = 0.05).

Table 4. Associated factors to catastrophic costs.

	Odd ratio (OR)	p	Significance
Age > 60 years	1.05	0.032	Yes
Carbonic Acid inhibitors	7.4	0.012	Yes
Prostaglandins	38.2	<0.001	Yes
Self-employee	4.72	0.04	Yes
No health Insurance	6.68	0.017	Yes
Beta-Blockers	0.6	0.15	No
Employee	0.2	0.25	No
High Blood Pressure	0.5	0.37	No
Number of eye drops	0.8	0.08	No
Health insurance	0.3	0.18	No
Genre	0.6	0.28	No
Glaucoma Stage	0.9	0.35	No

4. Discussion

We showed by our study that the annual global direct cost of POAG management per patient was 182,153 ± 86,861 CFA francs *i.e.* 277.69 ± 132.42 €. This cost represented 32.1% of the average annual income and 43.3% of the SMIG. The cost was influenced by age > 40 years ($p = 0.032$), the absence of health insurance ($p = 0.017$), being self-employee ($p = 0.04$) and the use of inhibitors of carbonic anhydrase or prostaglandin analogues ($p < 0.001$).

The average age of our sample was 47.24 ± 17.09 years. In Nigeria, Adio *et al.* [11] reported an average age close to ours, *i.e.* 52.7 years. Our results differ from those of Sounouvou [7] in Benin, where the mean age was 56.3 ± 14.6 years and of Ocansey [8] in Ghana for whom the mean age was 65 ± 14.8 years. In general, the average age of onset of POAG varies between samples. However, this average age is around 40 in most countries [8]. Employees were the most represented socio-professional category with 44% of patients, followed by independent or liberal professions, 21.3%. Murdoch *et al.* [12] found 53% of employees and Sounouvou *et al.* reported 28.2% [7] of employees. We could explain these results that employees most often have health insurance and therefore have the possibility of affording healthcare more than other patients who do not benefit from health insurance.

The costs of diagnosis and treatment were respectively 73,582 ± 14,600 F CFA (112.18 ± 22.26 €) and 108,571 ± 72,261 F CFA (165.52 ± 110.16 €) which gives a cost of total direct cost of 182,153 ± 86,861 CFA francs (277.69 ± 132.42 €), *i.e.* 23.1% of the average income. For Sounouvou *et al.* in Benin [7], the average cost of diagnosis was 52,149 CFA francs (€79.50), that of treatment 140,113 CFA francs (€213.60), giving an overall direct cost of 192,262 CFA francs (€293.11)

representing 52.7% of average income. Adio *et al.* in Nigeria [11] found an annual cost of 625,540 CFA francs (€953.64), including the direct and indirect costs of care but representing 49.8% of average income.

In our study, the annual direct cost of 182,153 ± 86,861 CFA francs (277.69 ± 132.42 €), is 43.3%, of the minimum wage (420,000 CFA francs/year or 640.30 €), this cost is catastrophic for patients who had to face family and living burdens. The direct cost of care was paid directly by 62.7% of patients, 28.7% by health insurance and 8.7% by relatives. Murdoch [12] found support by the patient in 44% of cases, by health insurance in 34.8% and the rest by caregivers. Adio *et al.* [11] reported that 73.3% of their patients paid their own medical expenses compared to 13.3% paid by the family. These high rates of self-care might relate to the low rate of health insurance coverage.

Age over 40 years (OR = 1.05 and p = 0.032) was associated with catastrophic cost of glaucoma management. Nayak *et al.* [5] in India found a significant difference in cost for patients over 60 years old and those under 40 years old (p = 0.016). Ocansey [8] found that patients under 40 used 2.4% of their income. The patients over 60 use 22.6% of theirs for the management of their glaucoma. The insidious, chronic, progressive and asymptomatic nature of POAG leads to greater consumption of medical and financial resources at an advanced age and stage of the disease, this to slow its progression [13].

The self-employed or liberal profession (farmer, housewife, etc.) linked to the catastrophic cost (OR = 4.72; p = 0.04) compared to employees. Self-employed profession patients suffer a significant financial loss because they do not benefit from health insurance. Ocansey [8] and Murdoch [12] did not find an association between the overall cost and the use of health insurance because all the patients in their studies benefit of health insurance.

The use of prostaglandin analogues increases the direct cost by 38.2 times and carbonic anhydrase inhibitors also influence the total cost by 7.4 times. Ocansey [8] also found that the use of prostaglandins increased the overall cost by 12.03 times. This is evident by the high cost of these molecules in the management of glaucoma. Early diagnosis and adequate treatment could reduce personal and societal economic burdens related to POAG [2]. Undertaking a one-time surgical treatment rather than long-term drugs or the introduction of controlled generics could also considerably reduce the costs of treatment.

The limitations of this study lie in its retrospective nature and the middle size of our sample which may be sources of bias. Nevertheless, socio-professional classes are relatively representative that can allow this study to be generalize.

5. Conclusion

This first study on the direct cost of POAG management in Lomé showed that the economic burden glaucoma represents for the patient, his family and society. The data from this study will allow health decision-makers to adopt strategies to mitigate the effects of glaucoma on the economy.

Conflicts of Interest

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

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Abbreviations and Symbols

POAG: Primary Open Angle Glaucoma

€: Euro

INSEED: The National Institute of Statistics, Economic, and Demographic Studies

SMIG: Guaranteed inter-professional minimum wage