DOI 10.5935/0034-7280.20200050

Financial impact on glaucoma surgical treatment

Impacto financeiro no tratamento cirúrgico do glaucoma

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ABSTRACT

Objective: *The second leading cause of blindness worldwide, glaucoma, occasionally requires surgical procedure for control. Given that Brazil has an Unified Health System (SUS) and a political-economic crisis in 2016, we aim to evaluate the financial impact on the therapeutic decision of glaucoma in the last 6 years in Brazil, and to consider the current discussion about early interventionist indication in its therapeutic algorithm.* ***Methods:*** *Ecological study of the Brazilian population, based on the SUS Hospital Information System, evaluating the temporal behavior of SUS surgical procedures on glaucoma treatment, and dollar variation as influencing the temporal trend on the procedures. Simple Linear Regression analysis was performed, with statistical significance of P <0.05.* ***Results:*** *Between 2013 and 2018, 24888 individuals were hospitalized for glaucoma, male prevalence (51.68%), whites (32.57%) and elderly (57.84%). Southeast (45.61%) and Northeast (26.36%) Regions with the largest number of hospitalizations, and Trabeculectomy (84.18%) being the main procedure performed. There was an association of trabeculectomy and valve implantation, individually and linked, with dollar values in the Midwest (β = 1.103 with P = 0.007 for Trabeculectomies and β = 1.105 with P = 0.012 for both procedures) and South (β). = 16,727 and P = 0,006 for Implants), and association between increased Implants in the South region and greater coverage in primary care (β = 0.64 and P = 0.009).* ***Conclusion:*** *Non-dollar interference was observed, and increased procedures in the South and Midwest. The results corroborate an interventionist tendency and may be represented, possible, by the use of procedures provided by the SUS in an early manner.*

Keywords: *Costs and cost analysis; Filtering surgery; Glaucoma; Glaucoma drainage implants; Prosthesis implantation; Brazil*

RESUMO

Objetivo: Segunda maior causa de cegueira mundial, o glaucoma, ocasionalmente necessita de procedimento cirúrgico para controle. Tendo o Brasil um Sistema Único de Saúde (SUS), e crise político-econômica em 2016, objetiva-se avaliar o impacto financeiro na decisão terapêutica do glaucoma nos últimos 6 anos no Brasil, e considerar atual discussão sobre indicação de procedimentos intervencionistas precocemente no seu algoritmo terapêutico. **Métodos:** Estudo ecológico da população brasileira, com base no Sistema de Informações Hospitalares do SUS, avaliando comportamento temporal dos procedimentos cirúrgicos do SUS para tratamento do glaucoma, e variação do dólar como influenciador da tendência temporal sobre os procedimentos. Realizada a análise de Regressão Linear Simples, com significância estatística de P<0.05. **Resultados:** Entre 2013 e 2018 foram internados 24888 indivíduos por glaucoma, prevalência do sexo masculino (51.68%), brancos (32,57%) e idosos (57.84%). Regiões Sudeste (45.61%) e Nordeste (26.36%) com maior número de internações, sendo a Trabeculectomia (84,18%) principal procedimento realizado. Houve associação da Trabeculectomia e Implante de Válvula, individualmente e atrelados, com os valores do dólar nas regiões Centro-Oeste (β= 1,103 com P= 0,007 para Trabeculectomias e β= 1,105 com P=0,012 para ambos os procedimentos) e Sul (β= 16,727 e P= 0,006 para os Implantes), e associação entre aumento de Implantes na região Sul e maior cobertura na atenção básica (β= 0.64 e P= 0.009). **Conclusão:** Observou-se não interferência do dólar, e aumento dos procedimentos na região Sul e Centro-Oeste. Os resultados corroboram tendência intervencionista, podendo ser representada pelo possível uso dos procedimentos disponibilizados pelo SUS de forma precoce.

Descritores: Custos e análise de custo; Cirurgia filtrante; Glaucoma; Implantes para drenagem de glaucoma; Implantação de prótese; Brasil

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Study carried out at Goiânia Eye Institute, Goiânia City, GO, Brazil.

The authors declare no conflict of interest

Received for publication 2/2/2020 - Accepted for publication 7/7/2020

Introduction

According to the latest data made available by the World Health Organization, [1] glaucoma is one of the leading causes of blindness worldwide (12.3%) - it is only second to cataracts (47.8%) - and the main cause of irreversible blindness cases in Brazil and worldwide. [2] According to estimates, there will be 79.6 million individuals with open- and closed-angle glaucoma in 2020.[3]

Despite the technological and scientific advancements in glaucoma diagnosis and treatment, its delayed diagnosis or inadequate disease management, either by the physician or due to poor access to the health system, can worsen patients' conditions and lead to permanent injuries, regardless of the available treatments. [4-6] Public treatment is made available for glaucoma patients through the Brazilian Unified Health System (SUS – Sistema Único de Saúde), which is one the largest national health systems in the world [7], despite the lack of public funding, misallocation of resources and other shortcomings observed in its services.[8,9]

Glaucoma treatment often starts with clinical therapy based on antiglaucomatous eye drops. However, invasive procedures are recommended when this therapy is no longer effective in controlling intraocular pressure. [10]

The approach to glaucomatous patients is not satisfactorily performed, since 89% of diagnosed cases present disease progression. [11] Even patients subjected to clinical treatment, in clinical trials, presented disease progression: 34% of untreated patients and 20% of treated patients followed-up for 24 months presented disease progression. [12] One of the reasons for such an outcome may lie on poor therapeutic adherence, which ranged from 4.6% to 80%, as well as on non-persistence to treatment for 12 months, whose rate ranged from 50% to 75%.

Trabeculectomy is one of the invasive procedures used to treat glaucoma; this fistulizing surgery has the advantage of reducing pressure fluctuations to enable intraocular pressure stability. [13] However, it may lead to several complications - such as infections, postoperative hypotonia and scarred bleb [14] - capable of limiting its long-term effectiveness.

Valve implantation surgery is another form of invasive treatment available for glaucoma patients at SUS; it is often used to treat refractory glaucoma, as well as after trabeculectomy, or after any other surgery that has failed to control the intraocular pressure. [15,16] However, it is worth emphasizing that the surgical manipulation of the conjunctiva to place the drainage device may render future trabeculectomy unfeasible in case of implantation failure. [17]

Trabeculectomy and tube implantations are often indicated at a much later stage in glaucoma treatment due to their potential to lead to severe short- and long-term complications. [16,18,19]

There are less invasive procedures available nowadays, such as the "microinvasive or minimally invasive glaucoma surgery" (MIGS). Although these procedures do not have a strict definition, they are featured by minimal external dissection, short operative time, good safety profile and rapid recovery. [20] In addition, they optimize the safety of surgical interventions applied to glaucoma patients, [21] which enables using them early in the therapeutic paradigm and in non-refractory glaucoma cases. [22,23]

Instead of competing with traditional filtering surgeries, MIGSs are an alternative to excessive drug therapy, since they mitigate therapeutic issues attributed to medication, such as adverse effects, poor therapeutic adherence and low quality of life. [21-23]

Based on the Brazilian public health reality observed at SUS and on procedures made available by it, it is necessary taking into consideration the cost with the adopted procedure rather than just analyzing patients' clinical conditions to enable therapeutic decisions between trabeculectomy and implant, since the need for the implantable device can burden the public system, and it may delay the authorization and performance of higher cost procedures.

The price of the implantable device has increased in the last few years; consequently, so did the cost with tube-shunt surgery, which went from R$ 499.20 in 2013 to R$ 873.61 in 2018 [24] – this period corresponds to the appreciation of the US dollar against the Brazilian Real [25], which reached its peak in 2016. The recorded increase in the aforementioned price was triggered by the political-economic crisis that took place in Brazil in 2016, which led to the biggest accumulated GDP drop in the Brazilian history (more than 7%), as well as to an exchange rate shock that devaluated the Brazilian currency by 50% against the US dollar, with variation from 2.63 R$/US to 4.05 R$/US$. [25] In addition, unemployment rate increased from less than 7% in 2014 to over 13% in 2016. [26]

Based on the similar efficacy between trabeculectomy and tube-shunt surgery [20], which are therapeutic options available at SUS and the public system's alternative to MIGS, as well as on the current debate about the recommendation of interventionist procedures to both early and refractory cases, the aim of the current study was to evaluate the financial impact - at hospital level - on therapeutic decisions concerning glaucoma patients in Brazil, in the last 6 years.

Methods

Ecological study conducted with the Brazilian population in order to evaluate the epidemiological profile of hospitalizations due to glaucoma in the Brazilian Unified Health System (SUS), as well as to identify the temporal behavior of surgical procedures adopted to treat the disease from 2013 to 2018, by associating them with US dollar fluctuations and with Primary Care coverage. Epidemiological profile was based on the calculation of hospitalization rates whose basic cause was described as Glaucoma (ICD-10 H.40) in Hospital Admission Orders (HAO). These HAOs were stratified by sex, race/color and age group; data were collected in SUS's Hospital Information System (SIH/SUS - Sistema de Informações Hospitalares do SUS).

The object of the current study was defined as the procedures most often performed by SUS to correct glaucoma, namely: Trabeculectomy (04.05.05.032-1) and Anti-Glaucomatous Prosthesis Implant (04.05.05.013-5). Next, the number of procedures (SIH/SUS) was tabulated, both together and in separate, according to the investigated years and to Brazilian regions. Subsequently, procedure rates were calculated based on the quotient between the number of procedures and the resident population (according to sex- and age-group-based population projections recorded for Federation Units by the Brazilian Institute of Geography and Statistics - IBGE), multiplied by 100 thousand inhabitants.

The Ministry of Health's Primary Care e-Manager website (https://egestorab.saude.gov.br/) was used to evaluate the monthly primary care (PC) coverage in each region throughout the investigated years in order to enable calculating the mean annual coverage per region. In addition, the annual dollar variation – i.e., the annual mean value of the currency made available by Ipeadata (http://www.ipeadata.gov.br/) - was set as the factor influencing

the time trend to carry out the procedures.

Simple Linear Regression analysis was carried out to find the association between the performance of the investigated procedures and Primary Care coverage, or the annual value of the dollar. It resulted in the slope coefficient β of the line. Statistical significance was set at $P < 0.05$.

Data were tabulated in the TabWin software and calculations were carried out in Excel software. All analyses were carried out in Stata statistical package v. 14.0.

Results

The total of 24,888 individuals were hospitalized due to glaucoma from 2013 to 2018; 51.68% of them were men and 48.32% were women. Of these, 9,298 did not have information about parameter "race/color". Based on Table 1, most patients were Caucasian (white) (32.57%); they were followed by mixed ethnic ancestry (brown) individuals (22.65%). Elderly individuals (57.84% of cases) were the main population hospitalized due to Glaucoma; they were followed by adult individuals (34.06% of cases). The largest number of hospitalizations per region was observed in the Southeastern region (45.61%), which was followed by the Northeastern region (26.36%).

Table 2 shows both corrective procedures; 18,792 of them were notified, 47.52% were performed in the Southeastern region and 26.80%, in the Northeastern region (the two main highlighted regions). Trabeculectomy was the main procedure performed in separate (84.18%).

Based on the comparison of equivalent periods in the past to the herein investigated period, which was divided into triennia, the number of procedures increased, as shown in Figure 1. The first triennium (2009-2011) presented mean annual variation

Table 1
Epidemiological and demographic profile of hospitalizations due to Glaucoma in the Brazilian Unified Health System

Variable	n	%
Sex		
Female	12,027	48.32
Male	12,861	51.68
Age group		
0-14 years (children)	1,726	6.94
15-19 years (teenagers)	289	1.16
20-59 years (adults)	8,477	34.06
60 years or older (elderly)	14,396	57.84
Race / Color		
Caucasian	8,105	32.57
African-descendant	1,532	6.15
Mixed ethnic ancestry	5,637	22.65
Asian-descendant	314	1.26
Indigenous	2	0.01
No information	9,298	37.36
Region		
Central-Western	2,004	8.05
Northeastern	6,560	26.36
Northern	265	1.07
Southeastern	11,352	45.61
Southern	4,707	18.91

Source: Tabulation and calculations carried out by the au

Table 2
Absolute and relative frequency of procedures such as trabeculectomy, antiglaucomatous prosthesis implantation, and both procedures, in Brazil and in its regions.

Region	N. of procedures	%
	Trabeculectomy	
Northern	112	0.7
Northeastern	4,066	25.46
Southeastern	7,655	47.93
Southern	2,630	16.47
Central-Western	1,507	9.44
Brazil	15,970	100
	Antiglaucomatous prosthesis implantation	
Northern	34	1.20
Northeastern	971	34.41
Southeastern	1,275	45.18
Southern	304	10.77
Central-Western	238	8.43
Brazil	2,822	100
	Both procedures	
Northern	146	0.78
Northeastern	5,037	26.80
Southeastern	8,930	47.52
Southern	2,934	15.61
Central-Western	1,745	9.29
Brazil	18,792	100

Source: Tabulation and calculations carried out by the authors

Table 3
Association between rates recorded for Trabeculectomy, Antiglaucomatous Prosthesis Implantation and those recorded for both procedures, and US dollar price or Primary Care coverage, in Brazil and in its regions

Region	Dollar (β)	**P-**value	PC coverage	**P-**value
	Trabeculectomy			
Northern	8.761	0.201	0.354	0.328
Northeastern	0.793	0.376	0.022	0.384
Southeastern	1.018	0.133	0.046	0.083
Southern	1.015	0.126	0.044	0.070
Central-Western	1.103	0.007*	0.013	0.315
Brazil	1.202	0.132	0.045	0.089
	Antiglaucomatous Prosthesis Implantation			
Northern	-3.732	0.857	0.340	0.744
Northeastern	-2.267	0.531	-0.012	0.908
Southeastern	-9.303	0.208	-0.351	0.251
Southern	16.727	0.006*	0.643	0.009*
Central-Western	-6.781	0.281	-0.092	0.514
Brazil	-5.721	0.459	-0.161	0.554
	Both procedures			
Northern	6.61	0.299	0.247	0.459
Northeastern	0.595	0.499	0.020	0.425
Southeastern	0.93	0.183	0.042	0.121
Southern	0.998	0.103	0.043	0.056
Central-Western	1.105	0.012*	0.012	0.335
Brazil	1,108	0,173	0,042	0,118

Source: Tabulation and calculations carried out by the authors.
*< 0.05: Statistically significant

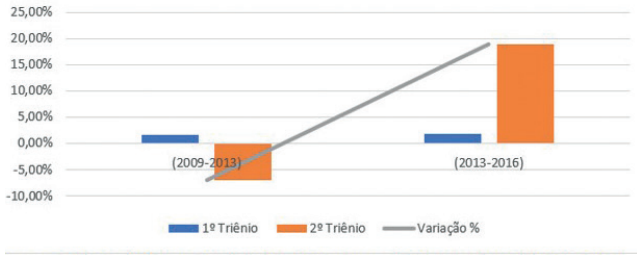

Figure 1: Mean annual variation in the number of surgical procedures performed per evaluated triennium

of 1.7%, whereas the second triennium (2011-2013) recorded mean annual variation of -7%. With respect to the number of procedures performed in equivalent periods in the present study, the first triennium (2013-2015) presented mean annual variation of 1.8%, and the second triennium (2016-2018) recorded mean annual variation of 19%.

Discussion

Glaucoma type, its prognosis and prevalence rates can change depending on the investigated population. African-descendant individuals are the most prevalent among primary open-angle glaucoma patients. They present the most severe cases[27], whereas primary closed-angle glaucoma is more prevalent among Chinese and Eskimo individuals.[28]

The population investigated in the present study comprises glaucoma patients subjected to invasive procedures often performed at advanced-stage and refractory glaucoma cases.[19] Most patients (32.57%) declared to be white, similar to a study conducted in Brazil, according to which, 74.5% of patients with glaucoma declared themselves white. Such a finding explains the higher surgical rate recorded for the total number of procedures carried out in white individuals, despite the fact that African-descendants are the ones proportionally presenting the most severe cases. In addition, 37.36% of hospitalized patients did not present race/color information, likely due to poor filling of this yet neglected variable. [29,30] According to epidemiological studies, values higher than 30% are classified as poor filling. [31,32]

It is essential emphasizing that trabeculectomy and tube-shunt surgery represented the surgical therapeutic options provided by SUS among all interventional procedures performed in the investigated period. They were the only notifiable forms of intervention, since MIGSs are not covered by the Brazilian public health system, although they are lesser invasive and lead to lesser complications. [20]

Based on the analysis of the number of surgical procedures performed in the same triennial periods in the past, it was possible seeing that the first triennium (2009-2011) recorded mean annual variation of 1.7%, whereas the second triennium (2011-2013) presented mean variation of -7%. As for the herein investigated period, the first triennium (2013-2015) recorded mean annual variation of 1.8%, whereas the second triennium (2016-2018) presented mean annual variation of 19% – this number was notably higher than that recorded for other periods evaluated under the same circumstances.

Most surgical procedures were performed in the Southeastern and Northeastern regions, which are the most populous regions in the country. [33] These regions present the largest absolute number of glaucoma patients and, consequently, the largest number of conducted procedures. Despite the large number of primary care institutions in these regions, [34] there was no association between the absolute number of institutions and variation in the number of procedures performed within the investigated period, different from outcomes recorded for the Southern region, where these two variables presented positive association.

Unlike the expected, the Southern region presented increased number of tube-shunt procedures, despite a certain time when this procedure represented greater burden, since its cost increased from R$ 499.20 (in 2013) to R$ 873.61 (in 2018). This period-of-time corresponded to the appreciation of the US dollar against the Brazilian Real [25] – US dollar price increased by 57% in this time. [24] The Southern region has shown increased number of tube-shunt surgeries, whereas the Central-Western region showed increased number of trabeculectomies. Thus, currency price variations did not overall affect the number of medical procedures performed in Brazil, since they increased in the Southern and Central-Western regions.

It is consensus that the clinical treatment applied to glaucoma cases is effective, as evidenced by the Early Manifest Glaucoma Trial; [35] however, despite the mean reduction by 25% in intraocular pressure, disease-progression rate reached 60% in treated patients, and this finding shows that the clinical treatment helps, but not enough. Such facts further corroborate the current trend observed among Glaucomatologists to perform interventional procedures, to the detriment of exclusively clinical treatments with poor therapeutic adherence, [36,37] in order to enable greater intraocular pressure control, to reduce eye-drop use and, consequently, to improve patients' quality of life.

According to these Glaucomatologists "Intervention in Glaucoma cases is more of a proactive than reactive procedure based on advanced diagnostic methods to actively determine patients at high risk, to be more aggressive in the adopted treatment and to early intervene in disease process." [38]

When it comes to SUS, the interventionist trend could be represented by increased number of available procedures, such as trabeculectomy and tube-shunt surgery. These therapies were originally recommended for advanced and/or refractory glaucoma cases; they can be used as early intervention alternative in the Brazilian public health system.

References

1. Resnikoff S, Pascolini D, Etya'ále D, Kocur I, Pararajasegaram R, Pokharel GP, et al. Global data on visual impairment in the year 2002. Bull World Health Organ. 2004;82(11):844–51.
2. Guedes R, Guedes V, Chaoubah A. Cost-effectiveness in glaucoma. Concepts, results and current perspective. Rev Bras Oftalmol. 2016;75(4):336–41.
3. Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol. 2006;90(3):262–7.
4. Travassos C, Viacava F, Fernandes C, Almeida M. Desigualdades geográficas e sociais na utilização de serviços de saúde no Brasil. Cienc Saude Colet. 2000;5(1):133–49.
5. Kerrigan-Baumrind LA, Quigley HA, Pease ME, Kerrigan DF, Mitchell RS. Number of ganglion cells in glaucoma eyes compared with threshold visual field tests in the same persons. Invest Ophthalmol Vis Sci. 2000;41:741–8.
6. Kass MA, Heuer DK, Higginbotham EJ, Johnson CA, Keltner JL, Miller JP, et al. The Ocular Hypertension Treatment Study: a randomized trial determines that topical ocular hypotensive medication delays or prevents the onset of primary open-angle glaucoma. Arch Ophthalmol. 2002;120(6):701–13.

7. Macinko J, Harris MJ, Rocha MG. Brazil's National Program for Improving Primary Care Access and Quality (PMAQ): fulfilling the potential of the world's largest payment for performance system in primary care. J Ambul Care Manage. 2017;40(2 Suppl 2 Supplement, The Brazilian National Program for Improving Primary Care Access and Quality (PMAQ)):S4–11.
8. Massuda A, Hone T, Leles FA, de Castro MC, Atun R. The Brazilian health system at crossroads: progress, crisis and resilience. BMJ Glob Health. 2018;3(4):e000829.
9. Rodrigues VS, Boas GD, Bastos MO. O impacto das instituições financeiras internacionais nas políticas de saúde no Brasil. Anais. 7º. Seminário da Frente Nacional Contra a Privatização da Saúde. Maceió (AL), 27 a 29 Out 2017. [Saúde em Tempos de Retrocessos e Retirada de Direitos].
10. Inga Samaniego J, Mantari Laureano J, Chávez Ávila F, Charca Mamani S. Beneficios y riesgos de dispositivos de drenaje para tratamiento de glaucoma. Rev Cuba Oftalmol. 2017 ;30(2):1–2.
11. Heijl A, Buchholz P, Norrgren G, Bengtsson B. Rates of visual field progression in clinical glaucoma care. Acta Ophthalmol. 2013;91(5):406–12.
12. Garway-Heath DF, Crabb DP, Bunce C, Lascaratos G, Amalfitano F, Anand N, et al. Latanoprost for open-angle glaucoma (UKGTS): a randomised, multicentre, placebo-controlled trial. Lancet. 2015;385(9975):1295–304.
13. Klink T, Praetorius S, Leippi S, Klink J, Grehn FJ. Diurnal and nocturnal intraocular pressure fluctuations after trabeculectomy. Ophthalmologica. 2012;227(3):160–5.
14. Heuer DK, Parrish RK 2nd, Gressel MG, Hodapp E, Palmberg PF, Anderson DR. 5-fluorouracil and glaucoma filtering surgery. II. A pilot study. Ophthalmology. 1984;91(4):384–94.
15. Jones E, Clarke J, Khaw PT. Recent advances in trabeculectomy technique. Curr Opin Ophthalmol. 2005;16(2):107–13.
16. Higa FS, Melo LA Jr, Tavares IM, Tito IR, Mello PA. Resultados do implante de Susanna em glaucoma refratário. Rev Bras Oftalmol. 2004;63(4):223–9.
17. Joshi AB, Parrish RK 2nd, Feuer WF. 2002 survey of the American Glaucoma Society: practice preferences for glaucoma surgery and antifibrotic use. J Glaucoma. 2005;14(2):172–4.
18. Ventura MP, Omi CA, Júnior ER, Tavares IM, Júnior LA. Primeiro Consenso de Cirurgia de Glaucoma. São Paulo: Sociedade Brasileira de Glaucoma. 2017. p.55-65.
19. Gedde SJ, Schiffman JC, Feuer WJ, Herndon LW, Brandt JD, Budenz DL; Tube versus Trabeculectomy Study Group. Treatment outcomes in the Tube Versus Trabeculectomy (TVT) study after five years of follow-up. Am J Ophthalmol. 2012;153(5):789–803.e2.
20. Manasses DT, Au L. The new era of glaucoma micro-stent surgery. Ophthalmol Ther. 2016;5(2):135–46.
21. Saheb H, Ahmed II. Micro-invasive glaucoma surgery: current perspectives and future directions. Curr Opin Ophthalmol. 2012;23(2):96–104.
22. Ahmed II. MIGS and the FDA: what's in a Name? Ophthalmology. 2015;122(9):1737–9.
23. Guedes RA. Cirurgias micro-invasivas do glaucoma. Vale a pena? Rev Bras Oftalmol. 2019;78(4):217–8.
24. SIGTAP - Sistema de Gerenciamento da Tabela de Procedimentos, Medicamentos e OPM do SUS – Competência 2013/2018 [Internet]. Brasília (DF): Ministério da Saúde; 2018. [citado 2020 Jun 6]. Disponível em: http://sigtap.datasus.gov.br/tabela-unificada/app/sec/inicio.jsp
25. Rossi P, Mello G. Choque recessivo e a maior crise da história: A economia brasileira em marcha à ré. Campinas (SP): Centro de Estudos de Conjuntura e Política Econômica - IE/UNICAM; 2017. [Nota do Cecon, IE/UNICAMP, 2017].
26. Reis MC. Como as condições do mercado de trabalho influenciam as transições do desemprego para o emprego? Nota Técnica. Mercado de Trabalho. 2017;63:40-5.
27. Sommer A, Tielsch JM, Katz J, Quigley HA, Gottsch JD, Javitt J, et al. Relationship between intraocular pressure and primary open angle glaucoma among white and black Americans. The Baltimore Eye Survey. Arch Ophthalmol. 1991;109(8):1090–5.
28. Congdon N, Wang F, Tielsch JM. Issues in the epidemiology and population-based screening of primary angle-closure glaucoma. Surv Ophthalmol. 1992;36(6):411–23.
29. Araújo EM, Costa MD, Hogan VK, Araújo TM, Dias AB, Oliveira LO. A utilização da variável raça/cor em Saúde Pública: possibilidades e limites. Interface Comunicacao Saude Educ. 2009;13(31):383–94.
30. Braz RM, Oliveira PD, Reis AT, Machado NM. Avaliação da completude da variável raça/cor nos sistemas nacionais de informação em saúde para aferição da equidade étnico-racial em indicadores usados pelo Índice de Desempenho do Sistema Único de Saúde. Saúde Debate. 2013;37(99):554–62.
31. Souza R, Batista LE, Werneck J, Lopes F. Saúde da população negra. Coleção Negras e Negros: Pesquisas e Debates. São paulo: ABPN-Associação Brasileira de Pesquisadores Negros; 1ª.ed. De Petrus et Alii Editora Ltda. 2012. p.34-62.
32. Almeida MF, Alencar GP, Novaes HM, Ortiz LP. Sistemas de informação e mortalidade perinatal: conceitos e condições de uso em estudos epidemiológicos. Rev Bras Epidemiol. 2006;9(1):56–68.
33. Instituto Brasileiro de Geografia e Estatística (IBGE). Características da população e dos domicílios: resultados do universo. Censo demográfico 2010. Brasília (DF): IBGE; 2011.
34. Brasil. Ministério da Saúde. Informação e Gestão da Atenção Básica [Internet]. Brasília (DF): Ministério da Saúde; 2017. [citado 2019 Out 1]. Disponível em: <https://egestorab.saude.gov.br/>.
35. Heijl A, Leske MC, Bengtsson B, Hyman L, Bengtsson B, Hussein M; Early Manifest Glaucoma Trial Group. Reduction of intraocular pressure and glaucoma progression: results from the Early Manifest Glaucoma Trial. Arch Ophthalmol. 2002;120(10):1268–79.
36. Ribeiro MV, Ribeiro LE, Ribeiro ÊA, Ferreira CV, Barbosa FT. Avaliação da adesão aos colírios em pacientes com glaucoma através da Escala de Morisky de 8 itens: um estudo transversal. Rev Bras Oftalmol. 2016;75(6):432–7.
37. Buscacio ES, Colombini GN. Estudo sobre os fatores relacionados a interrupção do tratamento do glaucoma. Rev Bras Oftalmol. 2011;70(6):371–7.
38. Ahmed I. Glaucoma and MIGs. Paper presented at: SECO; February 20-24, 2019; New Orleans.

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