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ORIGINAL ARTICLE

Regional inequalities in the supply of ophthalmologists and the volume of cataract surgeries between the public and private health sectors in Brazil

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ABSTRACT | Purpose: This study aimed to evaluate disparities in the distribution of ophthalmologists and the volume of cataract surgeries across Brazil, considering public and private health sectors and the country's federative units. **Methods:** Data on ophthalmologists were obtained from the National Medical Residency Commission and the *Associação Médica Brasileira*. Information on cataract surgeries performed through the Unified Health System was collected from the DATASUS database, while data on procedures covered by private health plans were retrieved from the National Supplementary Health Agency. Population estimates from the 2024 Demographic Census of the Brazilian Institute of Geography and Statistics were used to calculate physician density and surgery rates per 100,000 inhabitants. Associations between the number of ophthalmologists and cataract surgery volume were analyzed using Spearman's correlation coefficient. **Results:** Brazil has 16,784 ophthalmologists, representing 8.96 specialists per 100,000 inhabitants. Marked disparities were observed: large cities (>500,000 inhabitants) had 18.75 ophthalmologists per 100,000 residents, whereas municipalities with <50,000 inhabitants had fewer than one. Across federative units, physician density ranged from 19.18 per 100,000 in the Federal District to 4.22 in Maranhão. In 2024, cataract surgery rates varied widely, from 1,012.61 per 100,000 inhabitants in the Southeast to 435.00 in the North. Nationally, Unified Health System performed 736.30 surgeries per 100,000 inhabitants, compared with 1,276.79 in the private sector. On average, each ophthalmologist performed 96.92 cataract surgeries annually. **Conclusion:** Significant inequalities persist in the geographic distribution of ophthalmologists and in cataract surgery provision, with higher surgical volumes concentrated in the private sector. Targeted policies are required to address regional disparities and improve the equity and efficiency of cataract care delivery in Brazil.

Keywords: Ophthalmologists/supply & distribution; Ophthalmologists/statistics & numerical data; Cataract extraction; Health services accessibility/statistics & numerical data; Healthcare disparities; Health policy; Public health systems; Insurance, Health; Brazil/epidemiology

INTRODUCTION

Cataract is the leading cause of blindness worldwide, with a prevalence among individuals aged 40 year and older ranging from 11.8% to 18.8%[1]. Globally, more than 20 million cataract surgeries are performed annually[2]. Beyond visual impairment, cataracts substantially reduce quality of life by limiting mobility and autonomy, while increasing the risks of falls, depression, and social isolation. This burden generates significant social and economic costs for both individuals and healthcare systems[3,4].

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The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request, subject to justified conditions.

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Advances in biometry, intraocular lens (IOL) technology, and surgical techniques have resulted in excellent outcomes, with high levels of postoperative visual recovery and patient satisfaction[5]. However, surgical accuracy and safety remain critical concerns in several countries[5].

In Brazil, 34.6% of individuals aged 60 year or older have been diagnosed with cataracts in one or both eyes. Nevertheless, considerable regional disparities persist in timely access to surgical treatment[6].

This descriptive and exploratory study aims to identify inequalities in the volume of cataract surgeries and in the availability of ophthalmologists across Brazilian federative units as well as between the public and private health sectors.

METHODS

The volume of cataract surgeries performed in Brazil in 2023 and 2024 was obtained from two official data sources: DATASUS[7], which records procedures within the universal public healthcare system (SUS), and the National Supplementary Health Agency (ANS), which compiles procedures and payments reported by private health insurance operators[8].

Secondary data on ophthalmologists were collected through cross-referencing and analysis of databases from the National Medical Residency Commission/ Ministry of Education (CNRM/MEC) and the Brazilian Medical Association (AMB).

To calculate physician and surgery rates per 100,000 inhabitants, population data were derived from the 2024 update of the Demographic Census by the Brazilian Institute of Geography and Statistics (IBGE)[9]. Information on the number of health insurance beneficiaries was obtained from the ANS database, using the quarterly average[10]. The population denominator for SUS rates was determined by subtracting the number of people with private health insurance from the total population.

Cataract surgery rates per ophthalmologist were also calculated according to the federative units of Brazil.

The Spearman correlation coefficient was applied to assess the association between the number of ophthalmologists and the number of cataract surgeries. This was performed in two ways: using the absolute number of surgeries and using surgery rates per 100,000 inhabitants. Statistical analyses were conducted with IBM SPSS software, version 24.0 (Chicago, Illinois), with the significance level set at 5%.

RESULTS

In 2024, there were 16,784 practicing ophthalmologists in Brazil. However, there were 19,054 specialist registrations, as 2,270 individuals (13.5%) were registered with more than one Regional Medical Council and may work in more than one state. The majority of specialists were male (56.3%), with a mean age of 48 years, and 55.9% resided in the country's state capitals.

The distribution of ophthalmologists across Brazil was highly uneven, with 18 federative units below the national average of 8.96 specialists per 100,000 inhabitants (Figure 1). The Federal District had the highest concentration (19.18), followed by São Paulo (11.25) and Espírito Santo (10.97). In contrast, Amazonas (3.60), Pará (3.77), and Maranhão (4.22) recorded the lowest ratios. Among municipalities, the 48 cities with populations of 500,000 or more had 18.75 ophthalmologists per 100,000 inhabitants, while the 3,823 municipalities with fewer than 50,000 residents had fewer than one per 100,000.

At the national level, cataract surgery rates were 779.07 procedures per 100,000 inhabitants in 2023 and 868.69 in 2024 (Tables 1 and 2). In 2024, the SUS accounted for 64% of all cataract surgeries, corresponding to 736.30 procedures per 100,000 inhabitants who relied exclusively on the public system. In 2023, SUS was responsible for 60% of surgeries, with a rate of 607.10 per 100,000 inhabitants. In absolute terms, the public sector performed 984,009 surgeries in 2023 and 1,181,837 in 2024, representing a 20% increase.

In the private sector, among individuals covered by health insurance (approximately one-quarter of the population), the rate was 1,276.79 surgeries per 100,000 insured individuals in 2024, accounting for 36% of the national total. In 2023, private health plans performed 40% of all cataract surgeries, with a rate of 1,340.89 per 100,000 insured individuals. In absolute numbers, the private sector conducted 665,244 surgeries in 2023 and 664,861 in 2024, showing stability with a slight decrease of 0.1%.

In 2024, private health plans performed 73.4% more cataract surgeries per 100,000 inhabitants than SUS, compared with a difference of 121% in 2023. Regional variation was substantial: In 2024, the Southeast registered 1,012.61 surgeries per 100,000 inhabitants, while the North had only 435.04. Across all regions, the private sector performed more procedures than

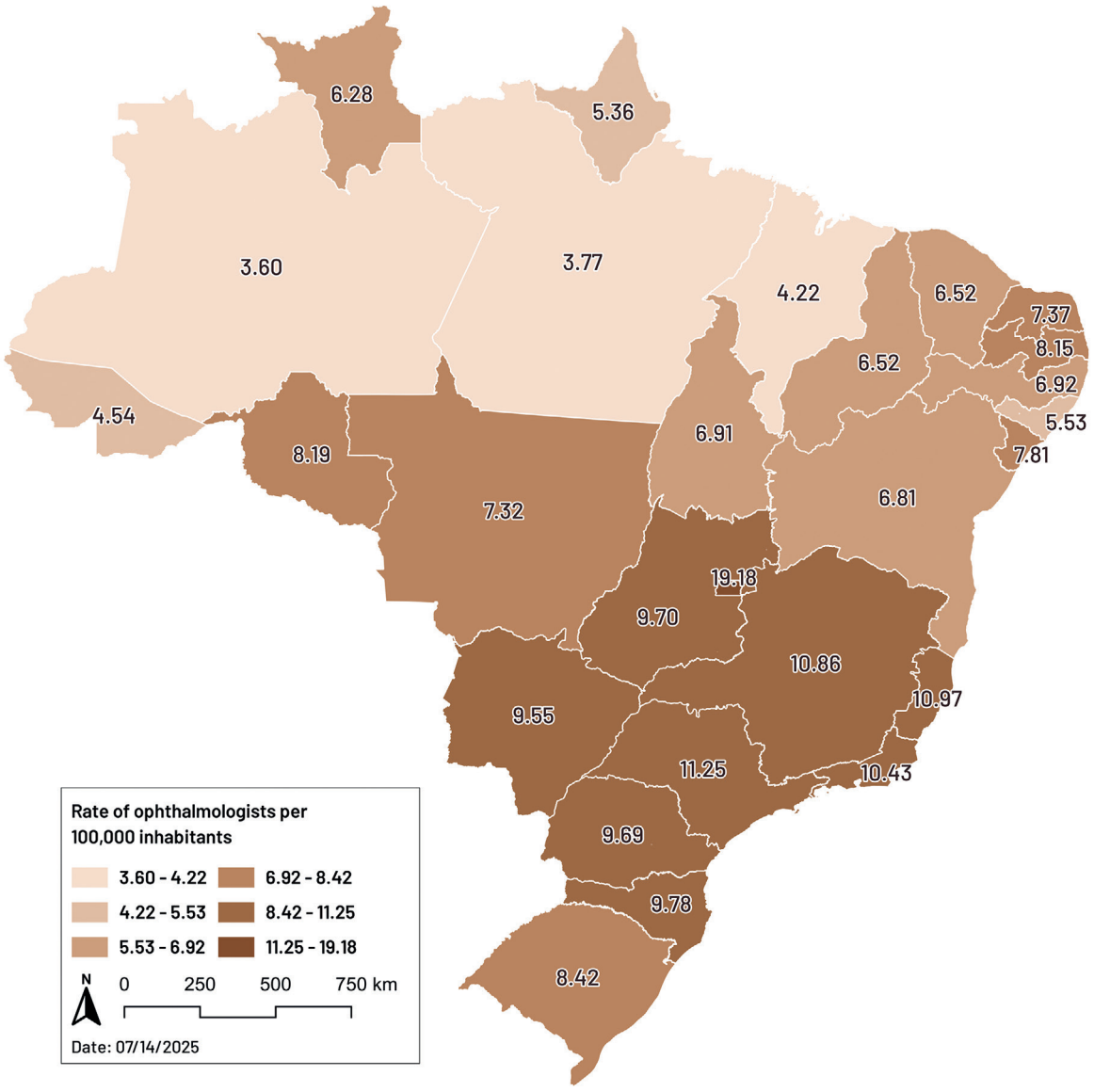

Figure 1. Distribution of ophthalmologists per 100,000 inhabitants by major geographic regions and federative units in Brazil, 2024.

Table 1. Cataract surgery volume in Brazil by major geographic region and health sector (SUS and private plans), 2023 and 2024

	2023			2024		
	Rate per 100,000 inhabitants			Rate per 100,000 inhabitants		
Regions	SUS*	Private Sector	Total	SUS*	Private Sector	Total
North	326.12	513.25	344.51	372.00	957.37	435.04
Northeast	613.47	1,488.27	720.46	745.08	1,277.69	814.05
Southeast	727.73	1,281.89	916.69	892.35	1,237.30	1,012.61
South	630.60	1,727.05	885.64	729.13	1,735.94	971.43
Central-West	367.90	1,193.00	538.58	485.58	907.41	591.42
Brazil	607.10	1,340.89	779.07	736.30	1,276.79	868.69

Source: Data adapted from IBGE, CNRM, AMB, DATASUS, and ANS.
*The rate per 100,000 inhabitants for SUS was calculated using the Brazilian population size, excluding individuals covered by private health plans or insurance.

Table 2. Cataract surgeries performed in Brazil in 2024 by SUS and private health plans, by geographic regions and federative units (FU)

	2024						
	SUS		Private sector		Brazil (SUS+private sector)		%
FU	n	Rate per 100,000 inhabitants[a]/SUS	n	Rate per 100,000 inhabitants[a]/private plans	n	Rate per 100,000 inhabitants[a]/Total Brazil	SUS/Total Brazil
North region	61,972	372,00	19,247	957,37	81,219	435,04	76%
Rondônia	4,282	270,62	2,656	1,620,08	6,938	397,31	62%
Acre	3,336	399,39	228	502,79	3,564	404,71	94%
Amazonas	17,327	480,48	1,697	251,40	19,024	444,36	91%
Roraima	3,404	496,41	12	38,62	3,416	476,57	100%
Pará	29,208	376,42	13,055	1,442,81	42,263	487,78	69%
Amapá	1,901	257,07	74	116,79	1,975	246,00	96%
Tocantins	2,514	173,32	1,525	1,202,54	4,039	256,06	62%
Northeast region	370,422	745,08	94,500	1,277,69	464,922	814,05	80%
Maranhão	27,772	428,02	3,980	761,81	31,752	452,89	87%
Piauí	36,322	1,224,67	3,362	820,41	39,684	1,175,60	92%
Ceará	50,561	650,43	21,003	1,438,35	71,564	775,03	71%
Rio Grande do Norte	26,452	939,17	7,677	1,219,43	34,129	990,37	78%
Paraíba	26,872	730,16	9,637	2,073,51	36,509	880,79	74%
Pernambuco	59,298	732,48	20,108	1,393,00	79,406	832,43	75%
Alagoas	17,196	607,42	9,006	2,314,39	26,202	813,70	66%
Sergipe	13,539	693,54	7,770	2,292,51	21,309	930,09	64%
Bahia	112,410	857,26	11,957	688,04	124,367	837,46	90%
Southeast region	515,086	892,35	382,266	1,237,30	897,352	1,012,61	57%
Minas Gerais	125,196	807,69	107,745	1,850,58	232,941	1,092,46	54%
Espírito Santo	37,876	1,365,50	23,180	1,745,02	61,056	1,488,40	62%
Rio de Janeiro	98,905	846,37	45,261	817,88	144,166	837,22	69%
São Paulo	253,109	911,69	206,080	1,131,64	459,189	998,82	55%
South region	172,260	729,13	129,980	1,735,94	302,240	971,43	57%
Paraná	71,701	827,13	49,523	1,569,14	121,224	1,025,18	59%
Santa Catarina	56,471	889,53	37,847	2,213,27	94,318	1,170,42	60%
Rio Grande do Sul	44,088	512,15	42,610	1,625,40	86,698	772,03	51%
Central-West region	62,097	485,58	38,868	907,41	100,965	591,42	62%
Mato Grosso do Sul	13,960	629,59	16,389	2,394,06	30,349	1,045,83	46%
Mato Grosso	14,756	467,68	2,936	430,95	17,692	461,16	83%
Goiás	30,484	562,73	10,121	523,51	40,605	552,41	75%
Federal District	2,897	144,96	9,422	957,25	12,319	413,00	24%
Brazil	1,181,837	736,30	664,861	1,276,79	1,846,698	868,69	64%

Source: Data adapted from IBGE, CNRM, AMB, DATASUS, and ANS.
[a]The rate per 100,000 inhabitants was calculated based on the size of the Brazilian population.

the public sector. The greatest disparities occurred in the North, where private plans performed 157% more surgeries than SUS, and in the South, where the difference was 138%. In the Southeast, Northeast, and Central-West, the differences were 39%, 71%, and 87%, respectively.

When total cataract surgery production (SUS plus private) was considered, the federative units with the lowest rates per 100,000 inhabitants, far below the national average, were Amapá (246.00), Tocantins (256.06), Rondônia (397.31), Acre (404.71), Federal District (413.00), Amazonas (444.36), and Maranhão (452.59; Table 2). The low rate in the Federal District was particularly notable, given that it had the highest concentration of ophthalmologists. In several states, surgical production was concentrated in capital cities, such as Manaus.

In most federative units, surgery rates were higher among those with private health insurance than among SUS users. Exceptions included Amazonas, Roraima, Amapá, Piauí, and Bahia, where the public sector performed more procedures. In Rio de Janeiro, Mato Grosso, and Goiás, surgery rates were similar between the two sectors (Table 2).

The proportion of surgeries performed by SUS relative to the total production varied widely. It exceeded 90% in Acre, Bahia, Piauí, Amapá, Roraima, and Amazonas but fell below 50% in the Federal District and Mato Grosso do Sul. In 2024, surgical productivity per ophthalmologist also varied significantly, ranging from an average of 180.38 procedures per year in Piauí and 147.20 in Alagoas to only 21.54 in the Federal District and 37.06 in Tocantins (Figure 2).

Finally, calculation of the Spearman correlation coefficient (Table 3) revealed a strong correlation between the number of cataract surgeries and the number of ophthalmologists. However, when adjusted for population, this association weakened, suggesting that additional factors may influence surgical output. These likely include professional and behavioral aspects of ophthalmologists as well as structural characteristics

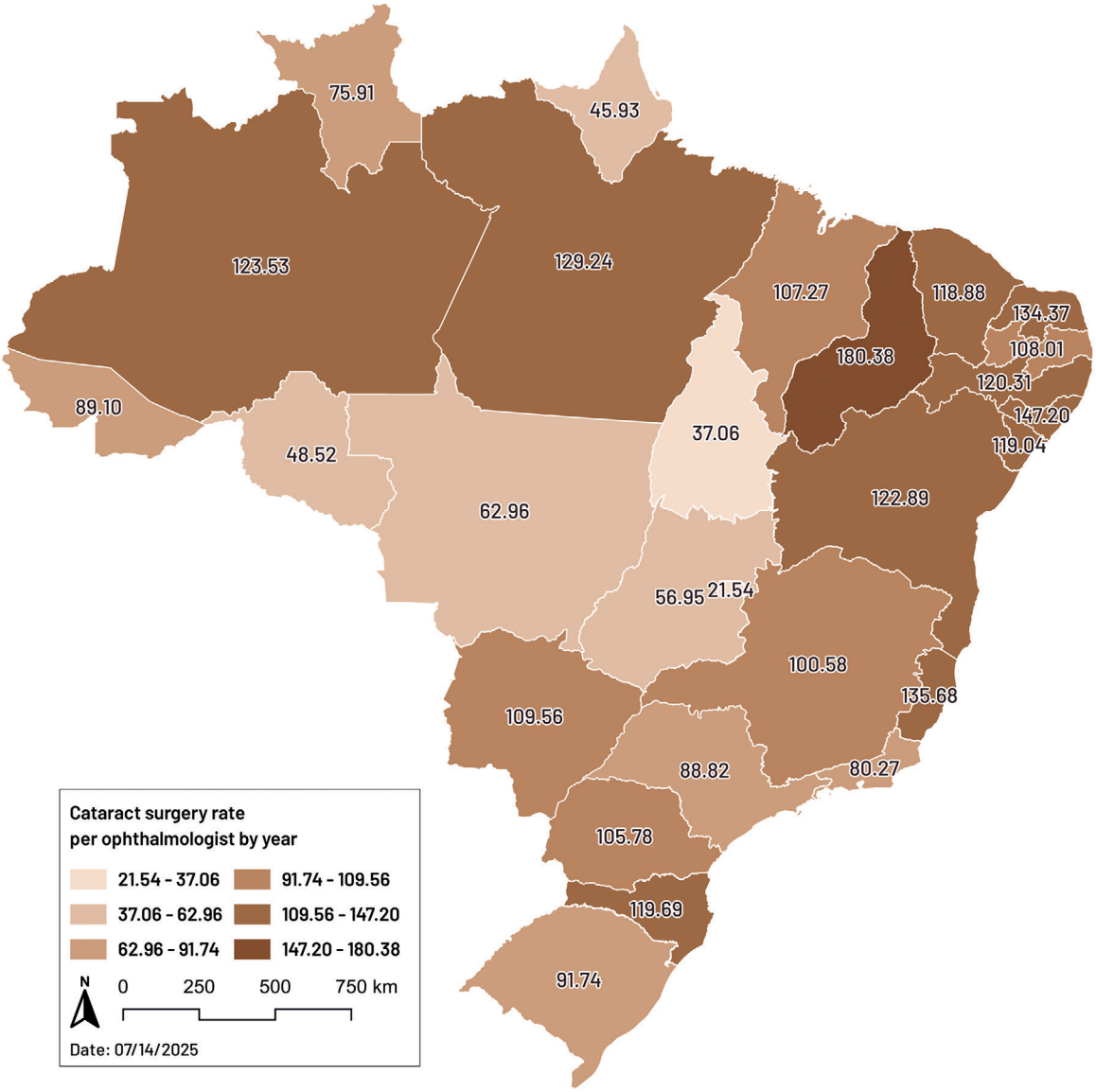

Figure 2. Cataract surgery rate per ophthalmologist by federative unit in Brazil, 2024.

Table 3. Spearman correlation coefficient between the supply of ophthalmologists and the absolute number and rate of cataract surgeries per 100,000 inhabitants in Brazil, 2024

Surgeries		Ophthalmologists
Number of cataract surgeries	r_s	0.924
	p-value	<0.001
Cataract surgery rate per 100,000 inhabitants	r_s	0.543
	p-value	0.003

Source: Data adapted from IBGE, CNRM, AMB, DATASUS, and ANS.

of the healthcare system, such as service accessibility, diagnostic capacity, the organization of local and regional care networks, and referral pathways.

DISCUSSION

This study underscores the value of combining secondary data from administrative records on healthcare production and payments generated by SUS managers and private health operators.

As with physicians in general and other medical specialties[11], ophthalmologists are more concentrated in the South and Southeast, a pattern also observed in other Latin American healthcare systems[12].

Although SUS performs the largest absolute number of cataract surgeries, population-adjusted rates show that private health plans provide significantly more procedures. These findings help explain the long waiting times for cataract surgery within SUS[13] and may inform the design of public policies, such as the *Agora Tem Especialistas* program launched by the federal government in 2025[14].

Over the 2 years analyzed, SUS increased its cataract surgery output, consistent with previous reports[15,16]. This growth has been linked to greater federal funding, contracting of private ophthalmology clinics by public administrators, allocation of congressional amendments, and implementation of surgical task forces[15,16].

Access to cataract diagnosis and treatment varies both across and within countries[17,18]. With a national rate of 868.7 surgeries per 100,000 inhabitants, Brazil trails behind France (1,493.0)[19], Belgium (1,416.0)[19], Germany (1,153.7)[19], Japan (1,148.0)[20], and the United Kingdom (956.2)[19] but surpasses China (220.5)[21] and Mexico (147.5)[22], where the reported rates may, to some extent, underestimate the actual surgical volume.

Surgical productivity per ophthalmologist varies widely across regions and among professionals. This heterogeneity should be considered when planning specialist training and defining the number of procedures to be offered through SUS.

Further research is warranted to clarify the factors driving these disparities. They may relate to structural issues, such as healthcare financing and system organization, or to patient-level determinants, including income, social conditions, and geographic location. Other potential factors include the availability of ophthalmologists qualified or willing to perform surgeries within SUS and the pricing and reimbursement structures for cataract procedures and intraocular lenses.

Strategies to address these inequities include coordinating initiatives and resources across government levels, reallocating private-sector capacity to public services, standardizing practices and pricing, and engaging ophthalmologists through fair remuneration and adequate working conditions. Cataract surgery could thereby serve as a model case for demonstrating the viability of Brazil's constitutionally mandated universal public healthcare system.

This study has limitations. There are no data on whether ophthalmologists are available to perform surgeries. Surgical records in DATASUS, which rely on reporting from municipal and state health departments, may contain inaccuracies, as may service production data submitted to ANS by private insurance operators. Additionally, procedures paid directly by private patients were not captured.

In conclusion, this study presents new empirical evidence of overlapping geographic and structural inequalities in Brazil, as observed in the supply of ophthalmologists and the volume of cataract surgeries performed across regions, federative units, and healthcare sectors. By delaying timely access to surgical treatment, these disparities force patients to live longer with visual impairment, reducing quality of life and increasing the burden of preventable blindness. Urgent measures are therefore required to overcome inequalities in access to cataract surgery and ophthalmologists in Brazil.

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