

Gross Domestic Product (GDP) *per capita* and geographical distribution of ophthalmologists in Brazil

Produto Interno Bruto (PIB) per capita e a distribuição geográfica dos oftalmologistas no Brasil

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ABSTRACT

Purpose: To assess the number of ophthalmologists in Brazil, their regional distribution, ophthalmologist/habitant ratio, and the relation between ophthalmologist and State Gross Domestic Product (GDP) *per capita* to aid public health policies.

Methods: An ecologic study was conducted. Data were obtained from the "Census 2011 Brazilian Ophthalmology Council", from "Demographic Census of Brazilian Institute of Geography and Statistics (IBGE) 2010 and from "Brazilian Regional Accounts, 2005-2009"- Ministry of Planning, Budget and Management - IBGE.

Results: The number of ophthalmologists in Brazil is 15,719. Considering the performance in more than one municipality, the number of ophthalmologists in service is 17,992, that is, one ophthalmologist for 10,601; the ophthalmologist/site ratio vary among the States from a minimum of 1/51,437 (Amapá) to a maximum of 1/4,279 (Distrito Federal). There is a correlation among State GDP *per capita* and the number of ophthalmologists/habitant: the higher the GDP *per capita*, the larger is the number of ophthalmologists acting in the State ($p < 0.0001$).

Conclusion: According to this study, there is no lack of Ophthalmologists in the country, but a distribution imbalance which leads to professional shortage in particular places. A higher concentration of ophthalmologists/inhabitants was noticed in States which the economic growth is higher, expressed by the GDP *per capita*.

Keywords: Health manpower/statistics & numerical data; Ophthalmologists; Human resources administration; Physician distribution/statistics & numerical data; Gross domestic product; Census; Brazil

RESUMO

Objetivo: Analisar o número de médicos que exercem a Oftalmologia no Brasil, sua distribuição regional; relação oftalmologista por habitante e Produto Interno Bruto (PIB) Estadual *per capita*, para auxiliar as políticas de saúde pública.

Métodos: Foi realizado um estudo ecológico. Os dados foram obtidos do "Censo 2011 - Conselho Brasileiro de Oftalmologia", do "Censo Demográfico do Instituto Brasileiro de Geografia e Estatística (IBGE) 2010 e do "Contas Regionais do Brasil, 2005-2009"- Ministério do Planejamento, Orçamento e Gestão - Instituto Brasileiro de Geografia e Estatística - IBGE.

Resultados: O número de oftalmologistas no Brasil é de 15.719. Considerando a atuação em mais de um município, o número de oftalmologistas em atendimento é de 17.992, isto é um oftalmologista para 10.601; as relações oftalmologista/local de atendimento, variam entre os Estados desde um mínimo de 1/51.437 (Amapá) e a um máximo de 1/4.279 (Distrito Federal). Há uma correlação entre PIB Estadual *per capita* e número de oftalmologistas/habitante: quanto maior o PIB *per capita*, maior o número de oftalmologistas atuando no Estado ($p < 0,0001$).

Conclusão: Nas condições deste estudo, observou-se que não há falta de Oftalmologistas no território Nacional e sim, uma desigualdade de distribuição que conduz a focos de escassez de profissionais em determinadas localidades. Verificou-se uma concentração de oftalmologista/habitantes em Estados cujo crescimento econômico é maior, expresso pelo PIB *per capita*.

Descritores: Recursos humanos em saúde/estatísticas & dados numéricos; Oftalmologia; Administração de recursos humanos; Distribuição de médicos/estatísticas & dados numéricos; Produto interno bruto; Censos; Brasil

INTRODUCTION

The Social Security, comprised of Health, social security and assistance, was conceived in the Constitution of 1988 and allowed the implementation of the National Health System (SUS)⁽¹⁾, which the main principle is health as universal right. The SUS guidelines are: equality, universality and integrality. The equity, although not present in the terms, has become one of the main references to formulate public policies, arguing the inequalities in the health area.

There are several challenges in the health sector and they mainly involve the universality and equity principles, considering the occurrence of population groups with no access to any type of service, in all regions of Brazil⁽²⁾.

Actually, health service provision to remote and poor regions is an issue in almost all countries worldwide, as well as inadequate geographical distribution of service providers specially physicians⁽³⁻⁷⁾.

Even when the ratio physician/inhabitant is adequate, physicians' distribution tends to be concentrated in certain regions, leading to an undesirable result from the public health point of view and from the organizational principle of decentralization^(8,9).

Even in developed countries, these professionals are usually concentrated in larger cities, leaving small cities, rural areas, remote communities and poorer regions unattended^(3,7). In the United States, approximately 54 millions of people live in communities and regions with lack of health professionals, with no access to basic care due to economic, geographical and cultural barriers⁽¹⁰⁾.

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The main factors highlighted in the literature of utmost importance in the physician location choice are: place where the physician was graduated and/or completed the medical residence; States with higher Gross Domestic Product (GDP) *per capita*; continued medical education and work market opportunity available for the partner^(9,11-14).

In Brazil, governmental interventions were performed to set the physicians in the midland in the 60's, with "Projeto Rondon" (*Rondon Project*), "Programa de Interiorização das Ações de Saúde e Saneamento (PIASS) (*Program for Internalization of Health and Sanitation*)", "Programa de Interiorização do SUS" (PISUS) (*Program for Internalization of Unique Health System - SUS*)" and "Programa de Interiorização do Trabalho em Saúde (PITS) (*Program for Internalization of Health Work*)"⁽¹⁵⁾.

However, the poor physicians' distribution remains and affects mainly the North and Northeast regions of the country⁽¹⁶⁾.

There is no data available on the geographical distribution by medical specialty in each Brazilian regions and its relation with the number of inhabitants.

The Brazilian Ophthalmology Council had already performed a census in 2000, 12 years ago. Its information was very valuable, but in 2011 it was necessary to outline a new overview to assess, plan and guide physicians, health managers, and parliament members in public policies formulation and decisions on private and public investments.

The present paper assessed the number of ophthalmologists in Brazil, its regional distribution; Ophthalmologist per inhabitant and State GDP *per capita* ratio, to aid new priority projects in health area in order to achieve better access conditions for ophthalmologic services.

METHODS

The present study considered "ophthalmologists" the physicians who work in the ophthalmology specialty apart from holding a specialist title provided by CBO/Brazilian Medical Association and/or conclusion of Medical Residency in Ophthalmology accredited by the National Committee of Medical Residency (Ministry of Education) with registers at Regional Councils of Medicine.

An ecological study was conducted crossing the quantitative data obtained from registers published in the "Census 2011 of the Brazilian Ophthalmology Council"⁽¹⁷⁾, "Demographic Census 2010" of the Brazilian Institute of Geography and Statistics (IBGE)⁽¹⁸⁾ and the publication on GDP *per capita* from "Brazilian Regional Accounts" (IBGE)⁽¹⁹⁾.

According to the "Census 2011 of the Brazilian Ophthalmology Council", the number of ophthalmologists in Brazil is 15,719, however, the number of ophthalmologists acting in more than one municipality (duly registered and paying annuity in each Regional Council of Medicine) was identified as 2,273⁽¹⁷⁾.

For the purpose of covering all the population assistance, ophthalmologists acting in more than one municipality were considered according to the number of municipalities assisted, which rendered a total of 17,992 ophthalmologists⁽¹⁷⁾.

The variables recorded by each Brazilian State from these publications were: 1) number of ophthalmologists; 2) number of inhabitants; 3) Gross Domestic Product (GDP) *per capita*.

The number of inhabitants per ophthalmologist was calculated in each Brazilian State.

Pearson's (*r*) coefficient of correlation was estimated between inhabitants/ophthalmologist and GDP *per capita* by the regression technique, using the Minitab[®] statistical software version 16.1.

The significance level was adopted as 5% ($\alpha=0,05$).

RESULTS

Table 1 shows the ophthalmologist/inhabitant ratio by State and region according to the Ophthalmology Census 2011 and Demographic Census from Brazilian Institute of Geography and Statics (IBGE) 2010.

In table 2 it is shown the Gross Domestic Product (GDP) *per capita*, according to Regions and the States in 2009.

In figure 1 it is possible to notice the ophthalmologist/inhabitants ratio and the Gross Domestic Product *per capita* according to States.

DISCUSSION

Inadequate distribution of health professionals (doctors and nurses) is an old and permanent worldwide phenomenon; and each country has been trying to minimize the problem according to their reality and political and economic needs^(3-8,20).

In Brazil, one of the challenges for the consolidation of the National Health System (SUS) is the geographic distribution of physicians. This distribution influences the social welfare, since doctors are considered the main providers of health services.

According to Póvoa and Andrade⁽⁹⁾, the distribution of doctors resulting from the individual location choice does not always coincide with the distribution deemed appropriate, and even though the total supply of doctors in a country has an appropriate relationship physician/inhabitant, the distribution of these professionals tend to be concentrated in certain regions, generating a socially undesirable result.

Geographic concentration of professional and services prevents the accomplishment of the principles governing the National Health System regarding the universalization, integrality and decentralization itself⁽⁸⁾.

Inequality occurs not only between regions of Brazil^(21,22), but also between urban and rural areas, as well as between capital and other cities of the same State⁽²³⁾.

According to the report of the research "Brazil's Medical Demographics - 2011", conducted by the Federal Council of Medicine (CFM) and the Regional Medicine Council of the State of São Paulo (CREMESP)⁽²⁴⁾, when comparing Brazilian with international data, there are different "Brazils": country Brazil, less developed, approaching concentration rates of African doctors, and Brazil from the major centers, showing a proportion of physicians far above the European average⁽²⁴⁾.

According to this report, in absolute numbers, Brazil has the fifth largest population of physicians in the world with 371,788 physicians. Therefore, it is not correct to say that there is a general lack of physicians in Brazil, but inequality of distribution that leads to shortage of professionals in certain localities, and in certain medical specialties⁽²⁴⁾.

In Brazil, there are few studies on the distribution of medical specialties, although it is understandable that only societies who know themselves can design and build their future.

In Ophthalmology, one of the first studies on the geographic distribution of ophthalmologists was held in São Paulo in 1984⁽²⁵⁾, it found the index of one ophthalmologist per 17,687 inhabitants, but in 439 municipalities there were no ophthalmologists, indicating an irregular distribution.

The Ophthalmologic Census 2011⁽¹⁷⁾ also found an uneven distribution, considering the vast national territory: in Amapá, for example, it found one ophthalmologist per 51,437 inhabitants, and in the Federal District, one ophthalmologist per 4,279 inhabitants.

Although there is an imbalance in the distribution of ophthalmologists in Brazilian states, according to the Census of Ophthalmology 2011 there is no evidence of insufficiency of that professional in Brazil; the opposite result was described by Resnikoff et al.⁽²⁶⁾ who found an insufficient number of ophthalmologists in practice in the world, based on information obtained by the "International Council of Ophthalmology". This discrepancy of information was generated by the difference of the methodology applied. Resnikoff et al.⁽²⁶⁾ data were based on information provided by the National Societies of Ophthalmology, that not always have in its records all the physicians who practice ophthalmology in their countries.

For a population of approximately 190.7 million inhabitants, there are in Brazil 15,719 ophthalmologists, i.e., one ophthalmologist for

Table 1. Ophthalmologist/inhabitant ratio by state and region; Ophthalmology census 2011 and demographic census from Brazilian Institute of Geography and Statics (IBGE) 2010

Region	State	Population	Ophthalmologist	Ophthalmologists/inhabitants
North	TO	1.383.453	65	1/21.284
	AM	3.480.937	147	1/23.680
	RO	1.560.501	65	1/24.008
	RR	451.227	16	1/28.201
	PA	7.588.078	243	1/31.226
	AC	732.793	19	1/38.568
	AP	668.689	13	1/51.437
Total North region		15.865.678	568	1/27.932
Northeast	PE	8.796.032	651	1/13.512
	BA	14.021.432	1.036	1/13.534
	PB	3.766.834	225	1/16.741
	RN	3.168.133	203	1/15.606
	CE	8.448.055	537	1/15.732
	SE	2.068.031	116	1/17.828
	PI	3.119.015	163	1/19.135
	AL	3.120.922	164	1/19.030
	MA	6.569.683	145	1/45.308
Total Northeast region		53.078.137	3240	1/16.382
Southeast	SP	41.252.160	5.727	1/7.203
	RJ	15.993.583	2.111	1/7.576
	ES	3.512.672	359	1/9.784
	MG	19.595.309	1.929	1/10.158
Total Southeast region		80.353.724	10.126	1/7.935
South	PR	10.439.601	1.036	1/10.077
	SC	6.249.682	610	1/10.245
	RS	10.695.532	992	1/10.782
Total South region		27.384.815	2.638	1/10.381
Midwest	DF	2.562.963	599	1/4.279
	GO	6.004.045	474	1/12.667
	MS	2.449.341	186	1/13.169
	MT	3.033.991	161	1/18.845
Total Midwest region		14.050.340	1.420	1/9.895
Brazil		190.732.694	17.992*	1/10.601

*= the census 2011 found 15,719 ophthalmologists in Brazil. This discrepancy between the total of ophthalmologists found and the total in the States is due to the fact that a part of the ophthalmologists works in more than one place.

every 12,134 inhabitants. But 15% of Brazilian ophthalmologists that work in more than one municipality increase the quota for 17,992 doctors, representing one ophthalmologist for every 10,601 inhabitants (Table 1).

According to the WHO (World Health Organization)⁽²⁷⁾, which considers satisfactory the ratio of one physician for 20,000 inhabitants, for North America and Occidental Europe, the number of ophthalmologist/inhabitants in Brazil (1/10,601) is above the recommended (Table 1).

Despite potential criticism of the number required for the proper care ophthalmologist/ inhabitant ratio recommended by WHO⁽²⁷⁾, in the present study this percentage was adopted because there is no better references in medical literature.

Nineteen Brazilian States present ophthalmologist/inhabitants ratio below 1/20,000; eight States (all States from the North and Northeast region) present an ophthalmologist/inhabitants ratio beyond 1/20,000; being in Amapá 1/51,437 inhabitants and in Maranhão 1/45,308 inhabitants (Table 1).

In this study, it is possible to notice that the concentration of ophthalmologists in certain regions is directly related to GDP per capita in the region, as shown in figure 1.

The Gross Domestic Product is the main measure of economic growth in a region. Its measurement is made from the sum of the value of all goods and services produced in the region in a given period⁽²⁸⁾.

In 2009, according to IBGE⁽¹⁹⁾, eight units of the Federation had a GDP per capita above the national average, which was R\$ 1,6917.66;

Table 2. Gross Domestic Product per capita, according to Brazilian Regions and its States - 2009; Regional Accounts of Brazil (IBGE)

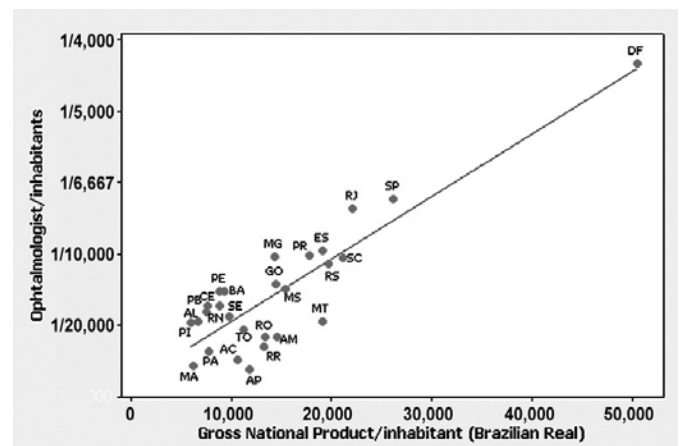
Region	State	Gross Domestic Product per capita (R\$)
North	TO	11.277,70
	AM	13.270,47
	RO	13.455,56
	RR	13.270,47
	PA	7.859,19
	AC	10.687,45
	AP	11.816,60
	Total North region	
Northeast	PE	8.901,93
	BA	9.364,71
	PB	7.617,71
	RN	8.893,90
	CE	7.686,62
	SE	9.787,25
	PI	6.051,10
	AL	6.728,21
MA	6.259,43	
Total Northeast region		8.167,75
Southeast	SP	26.202,22
	RJ	22.102,98
	ES	19.145,17
	MG	14.328,62
Total Southeast region		22.147,22
South	PR	17.779,11
	SC	21.214,53
	RS	19.778,39
Total South region		19.324,64
Midwest	DF	50.438,46
	GO	14.446,68
	MS	15.406,96
	MT	19.087,30
Total Midwest region		22.364,63
Brazil		16.917,66

Source: IBGE, State Statistic Agencies, State Secretariats and Manaus Free-trade Zone Authority-SUFRAMA, and Population and Social Indicators Coordination.

Federal District, São Paulo, Rio de Janeiro, Santa Catarina, Rio Grande do Sul, Espírito Santo, Mato Grosso and Paraná ie, all states from the South Region, three in the Southeast Region and two from the Midwest (Table 2). According to the Census 2011 of the Brazilian Council of Ophthalmology⁽¹⁷⁾, these same regions stand out from others in relation to the number of ophthalmologists/ inhabitants: Southeast 1/7,935, South 1/10,381, and Midwest 1/9,895 (Table 1 and Figure 1).

The Federal District, with the highest GDP per capita in Brazil, R\$ 50,438,46 (Table 2), stood out over other states in physician per capita (1/4,279) (Table 1 and Figure 1).

Among the states with GDP per capita below the national average, stands out Piauí with R\$ 6,051.10 and one ophthalmologist per 19,135



Pearson's correlation coefficient, $r=0.877$ ($p<0.001$).

Figure 1. Ophthalmologist/inhabitants ratio and Gross Domestic Product per capita according to States - 2009; Ophthalmology Census 2011, Demographic Census of Brazilian Institute of Geography and Statistics (IBGE) 2010 and Regional Accounts of Brazil, IBGE.

inhabitants, Maranhão with R\$ 6,259.43 and one ophthalmologist per 45,308 inhabitants, Pará with R\$ 7,859.19 and one ophthalmologist per 31,226 inhabitants, Acre with R\$ 10,687.45 and one ophthalmologist per 38,568 inhabitants, and Amapá with R\$ 11,816.60 and one ophthalmologist per 51,437 inhabitants (Tables 1 and 2, Figure 1).

The existence of a relationship between the number of physicians and the economic development of a region is highlighted in the literature, suggesting that the choice of a location by physicians is influenced by differences in monetary gains among regions⁽⁹⁾.

According to the Medical Association of Minas Gerais, physicians are attracted to large cities where there is a greater economic development, good salaries and better quality of life⁽²⁹⁾.

Rimlinger and Steele⁽³⁰⁾ stated that if there is a regional equalization of income per capita, probably the inequality between the distribution of physician will decrease; and that the increase in the number of physicians itself is no guarantee of a better regional distribution, as an even higher increase may occur in areas where there is already a great supply.

A very important aspect, which was not possible to analyze in this study is the estimated number of young ophthalmologists entering the Brazilian market. In 2011, the Brazilian Medical Association/Brazilian Ophthalmology Council issued 327 Certificates of Experts. The number of Application made for obtaining the National Test of Title was 583.*

On the other hand, the National Commission of Medical Residency reports that 238 physicians concluded their residencies in Ophthalmology⁽³¹⁾.

Even considering that many physicians who practice ophthalmology may have double certification (Brazilian Medical Association / Brazilian Council of Ophthalmology and the National Commission of Medical Residence) and that many physicians have no medical specialty certification, we can assume that approximately 700 new professionals were inserted in the market.

Other relevant information is that there will be an increase in the number of young specialists who have completed their training in 2012, because both the Brazilian Council of Ophthalmology and the National Commission of Medical Residency accredited new services for specialist training in ophthalmology.

This growth will create a greater distortion in the ophthalmologist/patient ratio, as new doctors entering the specialty far outnumber the population growth.

* Official communication of the Brazilian Council of Ophthalmology-Learning Commission -31/05/2012.

On the National scenario, according the Federal Council of Medicine, there is a rapid growth in the number of physicians in the country. In 1980, there was 1.13 for each physician group of 1,000 inhabitants. This ratio rose to 1.48 in 1990 and to 1.71 in 2000, and reached 1.89 in 2009. In 2011, the rate reached 1.95 doctor per 1,000 inhabitants; in the period, the increase was 72.5%⁽²⁴⁾.

According to a study forecasting population conducted by WHO, Brazil is in the same situation of the U.S., Canada and other European countries which will not have, in 2015, a scenario of lack or insufficient number of physicians⁽³²⁾.

Today we have a large growth in the number of ophthalmologists and a better distribution in Brazil. The data presented here will help young colleagues in their professional decisions, and analyzed in conjunction with the new data from IBGE, will also serve as subvention for the accreditation of new courses of specialization.

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