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Cerebrovascular disease in Brazil from 1990 to 2015: Global Burden of Disease 2015

Doença cerebrovascular no Brasil de 1990 a 2015: Global Burden of Disease 2015

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ABSTRACT: ***Objective:*** To verify the time trends of mortality rates, years of lost life (YLL), and years lived with disability (YLD) caused by cerebrovascular disease in Brazil between 1990 and 2015. ***Methods:*** The estimates from the Global Burden of Diseases 2015 were used to analyze the magnitude and trends of mortality rates and disability-adjusted life years (DALY) for cerebrovascular disease (ICD-10: I-60-69) in the 27 units of the Federation between 1990 and 2015. The states were analyzed by the social development index (SDI), based on average income per person, educational attainment at 15 years- old and total fertility rate. ***Results:*** Despite the increase in the absolute number of deaths due to cerebrovascular disease, the proportion of deaths below 70 years of age has been halved between 1990 and 2015. The acceleration of the reduction was higher among women; and increased from 1990 to 2005, when compared to the period from 2005 to 2015. The risk of death has been halved across the country, but states in the lower SDI tertile had less significant reductions (-1.23 and -1.84% a year) compared to the middle tertile (-1.94 and - 2.22%) and the upper tertile (-2.85 and -2.82%) for men and women, respectively. The years lived with disability also presented a reduction among states, but less expressively. ***Conclusion:*** Despite the reduction of age-adjusted mortality rates throughout the country, cerebrovascular disease still presents a high disease burden, especially in states with lower socioeconomic development.

Keywords: Social inequality. Stroke. Hypertension. Primary Prevention. Mortality.

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RESUMO: ***Objetivo:*** Verificar as tendências temporais das taxas de mortalidade, dos anos de vida perdidos (*years of life lost* — YLL) e dos anos de vida perdidos devido à incapacidade (*years lost due to disability* — YLD) motivadas pela doença cerebrovascular no Brasil entre 1990 e 2015. ***Métodos:*** Utilizou-se as informações do *Global Burden of Diseases 2015* (GBD 2015) para analisar a magnitude e as tendências das taxas de mortalidade e dos anos de vida ajustados por incapacidade (DALY — *disability-adjusted life years*) nas 27 unidades da Federação, entre 1990 e 2015, pela doença cerebrovascular (CID-10: I-60-69). Os estados brasileiros foram analisados pelo índice de desenvolvimento social (IDS), composto por renda *per capita*, proporção de escolaridade formal aos 15 anos e taxa de fecundidade. ***Resultados:*** Apesar do aumento do número absoluto de mortes pela doença cerebrovascular, a proporção de mortes abaixo dos 70 anos de idade reduziu pela metade entre 1990 e 2015. A aceleração da queda foi maior entre as mulheres, e mais acentuada no período de 1990 e 2005 do que de 2005 a 2015. O risco de morte reduziu-se à metade em todo o país; porém, os estados no tercil inferior tiveram reduções menos expressivas para homens e mulheres (respectivamente, -1,23 e -1,84% ao ano), comparados aos no tercil médio (-1,94 e -2,22%) e no tercil superior (-2,85 e -2,82%). Os anos perdidos por incapacidade também apresentam redução entre os estados, mas de forma menos expressiva. ***Conclusão:*** Apesar da redução das taxas ajustadas por idade em todo o país, a doença cerebrovascular ainda apresenta alta carga de doença, principalmente nos estados com menor desenvolvimento socioeconômico.

Palavras-chave: Desigualdade social. Acidente Vascular Cerebral. Hipertensão arterial. Prevenção primária. Mortalidade.

INTRODUCTION

Among chronic non-communicable diseases, those of the circulatory system are the main cause of mortality worldwide, including Brazil, which has one of the highest rates in South America[1-3]. Among cardiovascular diseases (CVD), cerebrovascular disease has specific characteristics within the Brazilian reality, being one of the most neglected diseases in the country. It also has high incidence and mortality, which determines a slowed epidemiological transition compared to countries with similar socioeconomic development[4,5]. In the 1960s and 1970s, cerebrovascular mortality rates in the city of São Paulo were among the highest within Western cities and countries[6,7]. In the early 1980s, the reduction in cerebrovascular mortality rates was first noticed in the city and in the state of São Paulo[7,8]. This reduction was later observed throughout the country, with marked inequalities between regions. The poorest regions, with the highest mortality rates, presented the greatest reduction — despite still remaining with the highest rates[9-12].

One of the main aspects of cerebrovascular mortality is that the reduction of the risk of death by the disease is much more unequal, according to social and economic indicators, in macro-regions, states or city districts than other chronic non-communicable diseases[14-16]. In the city of São Paulo, between 1996 and 2011, the decline in death rates due to stroke was much more significant in affluent districts compared to less affluent districts[16].

The initiative of the Global Burden of Disease (GBD) 2015 Study Group is an opportunity to verify the mortality and pattern of cerebrovascular disease in Brazil by states of the

Federation, including information on disabilities. In addition, it allows to test the hypothesis that cerebrovascular disease is directly related to the lower social and economic development.

METHODS

Descriptive study, with secondary data on the burden of disease estimated for Brazil by GBD 2015, coordinated by the Institute for Health Metrics and Evaluation (IHME)[17]. As the GBD methodology includes updating procedures and conceptual principles since its first publication, the burden of disease estimate was performed according to the IHME method applied in 2015. The GBD 2015 allowed the data, hitherto submitted by countries, to be broken down by federal units — in Brazil, by states. Data analysis generated indicators of mortality and years of life lost (YLL) which, summed to the information on morbidity and the number of years lived with disability (YLDs) provided the measure of the global burden of disease: the disability-adjusted life years (DALYs), whose definition is described in a methodological article[18]. The GBD 2015 created the socioeconomic development index (SDI) for all evaluated places, by calculating per capita income, formal education at 15 years of age and fertility rate. For descriptive purposes, the 27 units of the Federation were divided into tertiles according to SDI: lower, middle, and upper.

DATA SOURCE

For Brazil, the main source of information used in the mortality analysis was the Mortality Information System (acronym in Portuguese - SIM) database of the Ministry of Health, adjusted by other national and international sources. Methods for correcting underreporting of mortality and ill-defined causes were used, as referred to in the 18th Chapter of the 10th Revision of the International Classification of Diseases (ICD-10), "Symptoms, signs and abnormal findings of clinical and laboratory tests, not elsewhere classified." Previously published modeling was applied for the redistribution of diseases with less useful diagnoses, the "garbage codes" for target diseases[19,20]. A specific software — DisMod-MR — was used for data processing. It is a tool that generates consistent estimates of incidence, prevalence, duration of disease remission, and excess risk of death for each disease. It is available at: http://vizhub.healthdata.org/irank/arrow.php, accessed in May 2015. The ICD-10 referral codes for cerebrovascular disease were I-60 to I-69.

STATISTICAL ANALYSIS

Data for GBD 2015 were obtained from the database https:// vizhub.healthdata.org/collaborators/, in December 2016. The difference between YLL, YLD, DALYs, and adjusted

mortality rates among Brazilian states, according to SDI, was investigated with non-parametric tests in SPSS 23.0 software: Kruskal-Wallis; Jonckheere-Terpstra, and median test, all adapted for „n" samples and with a stepwise step-down test.

ETHICAL ASPECTS

The study was waived by the Research Ethics Committee because it exclusively uses large national databases of secondary data of public domain, without nominal identification. The ethical principles contained in the Resolution of the National Health Council (CNS) n. 466 of December 12, 2012 were observed.

RESULTS

Table 1 shows the evolution of cerebrovascular disease burden in Brazil in 1990, 2005 and 2015. The number of deaths increased, but early mortality before the age of 70 years had a significant reduction for both sexes, mainly in women. Age-adjusted YLL also showed significant reduction for both sexes; the absolute values in 2015 were half those calculated

Table 1. Description of the burden of cerebrovascular disease in Brazil, by sex, in the years 1990, 2005, and 2015.

	1990	2005	2015	1990	2005	2015
	Men			Women		
Number of deaths	52,610	58,489	73,487	48,771	56,774	70,591
Early mortality (<70 years of age) (%)	55.7	45.9	39.7	47.1	37.5	30.5
YLL (x 1.000 inhab.)	3,477.0	2,104.4	1,707.6	2,441.0	1,462.1	1,125.8
YLD (x 1.000 inhab.)	87.4	60.5	54.1	71.7	49.7	44.0
DALY (x 1.000 inhab.)	3,564.4	2,164.9	1,761.7	2,512.7	1,511.8	1,169.8
YLD/DALY	2.45	2.79	3.07	2.86	3.29	3.76
Prevalence						
number of cases	208,604	234,940	297,841	205,583	234,996	295,174
age adjusted rate (x 100.000 inhab.)	575.0	398.1	355.7	470.2	324.7	288.4

YLL: *years of life lost*; YLD: *years lived with disability*; DALY: *disability-adjusted life years*.

for 1990. The age-adjusted YLDs also showed a reduction, but the proportion of the YLD component of DALY showed a small increase among men, from 2.45% in 1990 to 3.07% in 2015, and among women, from 2.86% in 1990 to 3.07% in 2015. During this 25-year period, there was a drop in prevalence rates; however, the number of prevalent cases — that is, of people with cerebrovascular disease — has increased significantly.

Table 2 presents YLLs, YLDs, and DALYs for cerebrovascular disease by state, divided into SDI tertiles, calculated for 2015. The differences across tertiles were statistically significant using comparative methods, showing a very strong association between cerebrovascular disease burden and social and economic indicators.

DALYs due to cerebrovascular disease also showed a significant change in 25 years of observation. Excess DALYs among men remained at approximately 44% in the first 20 years, increasing to 51% in 2015 due to differences in YLL — YLD remained 20% higher in male

Table 2. Description of years of life lost, years lived with disability and disability-adjusted life years as a result of cerebrovascular disease in 2015 per unit of the Brazilian Federation.

State (SDI)	Men			Women		
	YLL[1] (x1.000)	YLD[2] (x1.000)	DALY[3] (x1.000)	YLL[4] (x1.000)	YLD[5] (x1.000)	DALY[6] (x1.000)
Maranhão (0.502)	2853.0	69.4	2922.4	1985.1	59.0	2044.1
Piauí (0.503)	2415.0	63.0	2478.1	1621.5	52.1	1673.6
Alagoas (0.512)	2511.7	67.5	2579.3	1651.1	56.3	1707.3
Paraíba (0.535)	2296.7	60.1	2356.8	1417.6	49.1	1466.7
Ceará (0.548)	2186.7	58.3	2245.0	1332.7	47.9	1380.6
Acre (0.556)	1814.3	56.9	1871.3	1342.1	50.2	1392.3
Bahia (0.559)	1993.5	57.2	2050.7	1456.9	50.2	1507.1
Sergipe (0.571)	2070.4	59.1	2129.5	1369.1	48.6	1417.7
Rio Grande do Norte (0.575)	1533.7	49.0	1582.7	930.5	40.1	970.7
Lower SDI	**2186.7**	**59.1**	**2245.0**	**1417.6**	**50.2**	**1466.7**
Pernambuco (0.585)	1997.6	58.9	2056.5	1313.9	48.4	1362.3
Pará (0.587)	2112.9	59.2	2172.1	1480.5	50.6	1531.1
Tocantins (0.601)	2265.7	60.1	2325.8	1651.9	53.7	1705.6
Rondônia (0.604)	1740.1	53.2	1793.3	1228.3	45.3	1273.6
Goiás (0.633)	1544.0	48.7	1592.7	1070.9	40.5	1111.5
Amazonas (0.636)	1771.4	52.8	1824.2	1253.5	44.1	1297.6

Continue...

Table 2. Continuation.

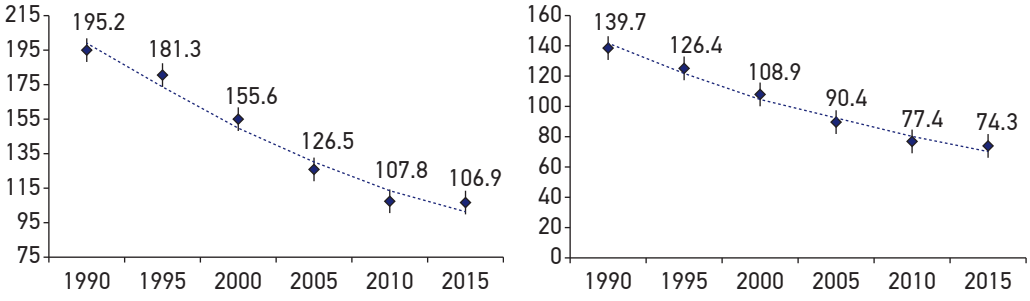
State (SDI)	Men			Women		
	YLL[1] (x1.000)	YLD[2] (x1.000)	DALY[3] (x1.000)	YLL[4] (x1.000)	YLD[5] (x1.000)	DALY[6] (x1.000)
Roraima (0.638)	1439.2	47.7	1486.9	1014.7	40.9	1055.5
Amapá (0.642)	1998.8	55.8	2054.6	1328.8	44.0	1372.8
Mato Grosso Sul (0.651)	1778.4	57.7	1836.1	1127.6	45.9	1173.4
Middle SDI	**1778.4**	**55.8**	**1836.1**	**1253.5**	**45.3**	**1297.6**
Minas Gerais (0.660)	1636.2	58.1	1694.3	1059.5	45.5	1105.0
Mato Grosso (0.660)	1796.0	53.3	1849.3	1172.0	43.3	1215.3
Paraná (0.675)	1765.1	55.6	1820.7	1084.9	42.8	1127.7
Espírito Santo (0.685)	1787.0	57.6	1844.6	1133.4	45.8	1179.2
Santa Catarina (0.715)	1367.8	48.8	1416.6	923.5	40.0	963.5
Rio Grande do Sul (0.726)	1531.5	51.3	1582.8	1039.8	42.8	1082.6
Rio de Janeiro (0.753)	1671.6	54.5	1726.1	1125.0	45.3	1170.3
São Paulo (0.757)	1342.4	47.7	1390.1	862.2	38.0	900.2
Distrito Federal (0.855)	1149.4	45.8	1195.3	734.5	37.3	771.8
Upper SDI	**43,274**	**1636.2**	**53.3**	**1059.5**	**42.8**	**1105.0**

1. Kruskal-Wallis (KW) Test: p = 0,03; Jonckheere-Terpstra (JT) Test: p < 0,001; median test: p = 0,04.
2. KW: p = 0,018; JT: p < 0,004; median: p = 0,06.
3. KW: p = 0,004; JT: p < 0,000; median: p = 0,004.
4. KW: p = 0,02; JT: p < 0,001; median: p = 0,01.
5. KW: p = 0,006; JT: p < 0,001; median: p = 0,004.
6. KW: p = 0,002; JT: p < 0,000; median: p = 0,001.

YLL: *years of life lost*; YLD: *years lived with disability*; DALY: *disability-adjusted life years*; SDI: Social Development Index.

populatin than in female population. The evolution of YLL and YLD during this period is presented in Figure 1, revealing that there is a reduction of both indicators for both men and women, but that the proportion of YLD has increased discretely, especially among the female sex.

From 1990 to 2015, the risk of death from cerebrovascular disease in Brazil fell for men (-2.41% a year) and women (-2.51% a year). However, the annual reduction in mortality rates adjusted for age — for both sexes — decelerated in the period from 2005 to 2015 in relation to the previous period, from 1990 to 2005. Table 3 shows the evolution of mortality rates adjusted by age by Brazilian states classified by socioeconomic index for men. The decline in cerebrovascular mortality rates was observed in all states, differing according to socioeconomic status — the reduction is always greater between 1990 and 2005



Men: annual reduction 1990-2005 = -2.89%; 2005-2015 = -1.68%.
Women: annual reduction 1990-2005 = -2.8%; 2005-2015 = -1.96%.

Figure 1. Temporal trend of age-adjusted mortality rates in Brazil between 1990 and 2015.

Table 3. Age-adjusted cerebrovascular mortality rates (x 100,000 inhab.) in men among Brazilian states, classified into three strata according to the Social Development Index.

State	1990	2005	2015	1990-2005	2005-2015	1990-2015
Maranhão	296.3	194.4	177.1	-2.81	-0.93	-2.06
Piauí	194.1	174.9	154.9	-0.69	-1.22	-0.90
Alagoas	240.2	170.8	155.6	-2.27	-0.93	-1.74
Paraíba	179.0	145.8	141.5	-1.36	-0.30	-0.94
Ceará	172.9	151.3	140.1	-0.89	-0.77	-0.84
Acre	152.1	118.6	113.0	-1.66	-0.49	-1.19
Bahia	169.2	134.4	124.6	-1.54	-0.76	-1.23
Sergipe	202.4	147.7	134.1	-2.10	-0.97	-1.65
Rio Grande do Norte	136.9	104.5	99.6	-1.80	-0.48	-1.27
Lower SDI	**179.0**	**147.7**	**140.1**	**-1.66**	**-0.77**	**-1.23**
Pernambuco	198.2	140.6	122.0	-2.29	-1.43	-1.94
Pará	189.7	150.3	135.0	-1.55	-1.08	-1.36
Tocantins	174.4	148.4	142.0	-1.08	-0.44	-0.82
Rondônia	212.6	135.1	113.2	-3.02	-1.76	-2.52
Goiás	182.5	104.4	96.5	-3.73	-0.78	-2.55
Amazonas	164.6	126.7	114.8	-1.74	-0.99	-1.44
Roraima	153.4	113.9	92.1	-1.99	-2.13	-2.04

Continue...

Table 3. Continuation.

State	1990	2005	2015	1990-2005	2005-2015	1990-2015
Amapá	138.8	135.9	126.3	-0.14	-0.73	-0.38
Mato Grosso	161.2	135.9	113.0	-2.24	-1.48	-1.94
Middle SDI	**174.4**	**135.9**	**114.8**	**-1.99**	**-1.08**	**-1.94**
Minas Gerais	197.8	116.6	98.6	-3.52	-1.68	-2.79
Mato Grosso do Sul	177.2	126.6	109.1	-1.14	-1.85	-1.42
Paraná	242.9	135.5	114.9	-3.89	-1.64	-2.99
Espírito Santo	240.7	145.6	113.9	-3.35	-2.46	-2.99
Santa Catarina	20.9	117.3	92.7	-3.85	-2.36	-3.25
Rio Grande do Sul	194.9	118.7	99.5	-3.31	-1.76	-2.69
Rio de Janeiro	223.6	125.0	100.0	-3.87	-2.23	-3.22
São Paulo	172.0	104.4	84.3	-3.33	-2.14	-2.85
Distrito Federal	144.2	107.0	78.9	-1.99	-3.05	-2.41
Upper SDI	**194.9**	**118.7**	**99.5**	**-3.35**	**-2.14**	**-2.85**

SDI: Social Development Index

than in the period from 2005 to 2015. During 25 years of observation, the annual fall of risk of death in the upper tertile of the SDI was more than twice that of the lower tertile. The most significant reductions occurred in the states with the highest socioeconomic status: Santa Catarina, Rio de Janeiro, Espírito Santo, Paraná, and São Paulo. The lowest impact, in turn, was observed in less developed states: Paraíba, Piauí, Ceará, Tocantins and Amapá. Table 4 presents the same situation of the evolution of cerebrovascular mortality rates among women. The analysis of the three SDI strata found that the reduction in the risk of death was higher in women than in men, and also showed that the reduction was more accelerated in the upper stratum than in the lower stratum.

The units of the Federation with the highest decline in cerebrovascular mortality rates were Santa Catarina, Rio de Janeiro, Paraná, Espírito Santo, and Distrito Federal, unlike Acre, Piauí, Tocantins, Maranhão, and Amapá, states in which the lowest decrease of these rates occurred.

The differences between some states is useful for understanding the epidemiological description. For comparison purposes, among women, rates in the state of Bahia were 34% higher than in Distrito Federal in 1990, 50% higher in 2005, and 70% higher in 2015. But in the same region, such as the Southeast, some differences have narrowed. For example, the difference in mortality rates in 1990 and 2005 was 40% higher in the state of Espírito Santo

Table 4. Age-adjusted cerebrovascular mortality rates (x 100,000 inhab.) in women among Brazilian states, classified into three strata according to the Social Development Index.

State	1990	2005	2015	1990-2005	2005-2015	1990-2015
Maranhão	161.6	159.8	126.8	-0.08	-2.31	-0.97
Piauí	145.8	132.8	108.0	-0.62	-2.07	-1.20
Alagoas	195.6	127.5	105.7	-2.86	-1.87	-2.46
Paraíba	153.0	106.4	91.1	-2.42	-1.55	-2.07
Ceará	132.1	108.2	89.9	-1.33	-1.86	-1.54
Acre	120.0	103.3	87.9	-1.00	-1.61	-1.24
Bahia	148.8	111.3	94.0	-1.93	-1.69	-1.84
Sergipe	148.1	103.8	91.0	-2.37	-1.31	-1.95
Rio Grande do Norte	105.5	74.0	64.1	-2.36	-1.44	-1.99
Lower SDI	**148.1**	**108.2**	**91.1**	**-1.93**	**-1.69**	**-1.84**
Pernambuco	160.1	102.3	84.0	-2.98	-1.97	-2.58
Pará	154.5	120.0	98.9	-1.69	-1.93	-1.78
Tocantins	132.0	122.8	103.4	-0.48	-1.73	-0.98
Rondônia	151.1	92.5	81.0	-3.28	-1.33	-2.50
Goiás	140.2	80.6	70.5	-3.69	-1.33	-2.75
Amazonas	137.0	101.8	86.4	-1.98	-1.64	-1.84
Roraima	121.7	86.3	69.9	-2.29	-2.11	-2.22
Amapá	108.0	93.1	91.2	-0.99	-0.21	-0.68
Mato Grosso	120.7	94.1	76.7	-2.79	-1.97	-2.46
Middle SDI	**137.0**	**94.1**	**84.0**	**-2.29**	**-1.73**	**-2.22**
Minas Gerais	134.8	83.4	68.8	-3.20	-1.93	-2.69
Mato Grosso do Sul	135.5	89.2	73.2	-1.66	-2.04	-1.81
Paraná	161.8	91.8	75.3	-3.78	-1.98	-3.06
Espírito Santo	160.3	97.9	75.9	-3.29	-2.54	-2.99
Santa Catarina	152.7	85.0	67.0	-3.91	-2.38	-3.30
Rio Grande do Sul	141.3	87.4	73.7	-3.21	-1.70	-2.60
Rio de Janeiro	153.9	85.9	70.1	-3.89	-2.03	-3.14
São Paulo	113.9	69.4	58.0	-3.30	-1.80	-2.70
Distrito Federal	110.9	73.5	54.8	-2.74	-2.94	-2.82
Upper SDI	**141.3**	**85.9**	**70.1**	**-3.29**	**-2.03**	**-2.82**

SDI: Social Development Index

than in the state of São Paulo; but in 2015 this difference fell to an excess of 30% greater risk in women living in the state of Espírito Santo compared to those in the state of São Paulo.

DISCUSSION

The analysis of the indicators organized by the analytical logic applied by GBD 2015 showed that the burden of cerebrovascular disease presented significant changes between 1990 and 2015, such as reduction of the proportion of mortality below 70 years and reduced risk of death for both sexes, with a clear difference according to the SDI — a change also found for DALYs for men and women.

Unlike coronary disease, in which there are four major risk factors involved — dyslipidemia, hypertension, smoking, and diabetes — cerebrovascular disease has hypertension as the main risk factor, not only for cases of parenchymal hemorrhage, but also for cerebral ischemic events. For this reason, the identification, treatment, and control of arterial hypertension should be considered as main determinants for reducing mortality: first, for reducing the incidence of the disease; second, for altering the natural history of the disease, reducing lethality. However, in countries with historical series of mortality statistics that are more extensive, the reduction of mortality due to stroke precedes the introduction of antihypertensive drugs on a large scale[21]. Specifically in Brazil, there is another important risk factor in the genesis of cerebrovascular disease: heart disease, with a strong potential for embolisms, such as those resulting from chagasic myocarditis[22].

However, the greatest magnitude of cerebrovascular disease is not found in states with a high prevalence of Chagas Disease, such as Goiás, Minas Gerais, and Bahia. In fact, there is a direct relation of cerebrovascular disease with the worst indicators of social and economic development, as already observed in other evaluations of the disease in Brazil. Social differentiation would not only induce a higher incidence of cerebrovascular disease: even in conditions of appropriate medical care to the acute event, subsequent mortality is related to socioeconomic indicators, such as a lower level of formal education, which represented a risk factor for worse survival at long term, as demonstrated in the Stroke Mortality and Morbidity Study (EMMA) in São Paulo[23].

Owing to an absolute determinant — poverty — or other, relative — social inequality — the data presented here do not allow conclusion. However, Vincens and Stafström estimated that social inequality would be an independent risk factor for cerebrovascular mortality, with an 18% reduction in mortality rates associated with the drop of 10 points on the Gini scale of social inequality[15]. In addition to the impact of both poverty and social inequality on the magnitude of cerebrovascular disease, this study corroborates more localized assessments, showing that the reduction in cerebrovascular mortality was unequal among states, being always more incisive in the federative units with better socioeconomic indicators.

The data presented show that the decline in mortality rates and YLLs was more pronounced between 1990 and 2005 than in the subsequent decade. The most plausible explanation is

that the initial reduction in cerebrovascular mortality rates in Brazil — very high in relation to other countries[6,7] — was accelerated because it required simple actions — both in reducing risk factors and in medical care.

The reduction not only of the YLLs, but also of the YLDs, during the period 1990 to 2015 (Table 2), enables us to observe reduction for both lethality and disease incidence. This hypothesis is based on information from Joinville, Santa Catarina, where there was a reduction in the lethality concomitant with the reduction in incidence — a much greater number of cases of hemorrhage than of cerebral ischemia[24,25]. However, when the National Health Survey 2013 evaluated the prevalence of cerebrovascular disease, there was an inverse relationship with the level of formal education, an association that increased when the presence of motor sequelae due to this disease was analyzed separately[26].

Finally, in another evaluation of GBD 2015, arterial hypertension, the most relevant risk factor for cerebrovascular disease, was identified as the main factor in terms of all-cause mortality and morbidity[27]. In addition, in the cohort of Bambuí, in the state of Minas Gerais, the incidence of hypertension was significantly higher among the poor and those with less formal education, independently of factors related to ethnicity and/or genetic ancestry[28]. Thus, actions directly linked to the detection, treatment, and control of arterial hypertension are shown as the way to reduce the magnitude and regional differences of cerebrovascular disease, as it has already occurred in other countries[29].

However, the reduction in cerebrovascular mortality was more effective in states where the risk of death was relatively lower — precisely those with better socioeconomic indicators. This is not surprising as it was almost universally observed by Julian Hart in 1971, who described as „the inverse care law" — that is, the benefits apply first to those who least need to be benefited[30].

Studies based on official mortality statistics always present limitations inherent in the process of obtaining primary information. In the case of Brazil, the historical differences in coverage of the mortality system and the unequal proportion of ill-defined causes of death are limiting factors that have recently been corrected with the improvement of the entire system[31]. If corrections did not capture real regional differences, they could distort relative trends between regions.

Reprocessing by IHME to include these constraints, which are still in the initial testing phase, will lead to improvement in subsequent years. In particular, for cerebrovascular disease, problems of classificatory origin prevent discrimination of the most common types: parenchymal hemorrhage and ischemic event of any origin — atherosclerotic, embolism of cardiac or other artery origin, and injury of small vessels. This is due to the exaggerated use of the I-64 code („stroke, not specified as hemorrhagic or ischemic")[32,33]. It was not possible to adequately compare mortality by cerebrovascular and cardiac causes in the states from the analysis of the impact of the Family Health Strategy Programs[34] and Popular Pharmacy Program[35]. These two actions could potentially explain the effects on mortality reduction as well as differences between states.

CONCLUSIONS

Over a 25-year period, the description of the cerebrovascular disease, without distinction of clinical presentation, showed a significant reduction in mortality for men and women, mainly in the period from 1990 to 2005 compared to 2005 to 2015. Despite the reduction across the country of age-adjusted rates, the states with the best social and economic indicators were more favored than those with the worst indicators and the highest mortality rates.

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