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ORIGINAL ARTICLE

The Burden of Stroke in the Southeast Region of Brazil in 2019: an Estimate Based on Secondary Data from the Brazilian United Health System

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Abstract

Background: Stroke is one of the main causes of morbidity and mortality in the Southeast Region of Brazil, and it is impacted by socioeconomic conditions and the age of the population in the region.

Objectives: The objective of this study was to estimate the burden of stroke in the adult population, for both sexes, in different age groups, in the Southeast Region of Brazil, in the year 2019.

Methods: This descriptive study was conducted with secondary data on stroke, obtained from the Department of Informatics of the Brazilian Unified Health System (DATASUS) and the Brazilian Institute of Geography and Statistics (IBGE), to calculate years of life lost (YLL), years lived with disability (YLD), and disability-adjusted life years (DALY).

Results: In the year 2019, in the Southeast Region of Brazil, a total of 713,132 DALY were estimated, 80% from YLD and 20% from YLL. The highest values were from the state of São Paulo, as it is the most populous state; in the female sex, due to the greater number of female inhabitants; and in the age group between 40 and 59 years. However, when adjusted to a rate of 100,000 inhabitants, the greatest impact was for the male sex in the state of Minas Gerais, mainly in the age group between 70 and 79 years.

Conclusions: YLD were more relevant in the composition of DALY, due to higher stroke morbidity than mortality, and high stroke DALY burdens impact the economically active population in this region.

Keywords: Disability-Adjusted Life Years; Disease Burden; Stroke; Public Health, Health Services Statistics; Epidemiology

Introduction

Cardiovascular diseases account for the highest morbidity and mortality in Brazil, with a high demand in access to the services of the Brazilian Unified Health System (SUS) and major economic and social impacts due to premature deaths and years lived with disability (YLD).[1,2] Among cardiovascular diseases, stroke is the fifth leading cause of death worldwide and one of the main causes of living with disability. Stroke is related to the presence of arterial hypertension, diabetes, obesity, physical inactivity, and advanced age, and it may occur due to rupture or obstruction of a cerebral blood vessel.[3]

In 2018, most of the deaths registered in Brazil (27%) occurred due to diseases of the circulatory system (Chapter IX of the Tenth Revision of the International Classification of Diseases and Related Health Problems [ICD 10]), with stroke being the second cause of mortality of vascular origin (13,000 deaths) throughout the Southeast Region of Brazil, impacting the number of years of life lost (YLL).[4]

Even though stroke accounts for a large number of deaths in different age groups in Brazil, the majority of patients survive stroke; however, they return to social life with physical and functional limitations, which increase government spending on treatments and social security benefits, impacting the number of YLD.[5,6]

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Central Illustration: The Burden of Stroke in the Southeast Region of Brazil in 2019: an Estimate Based on Secondary Data from the Brazilian United Health System

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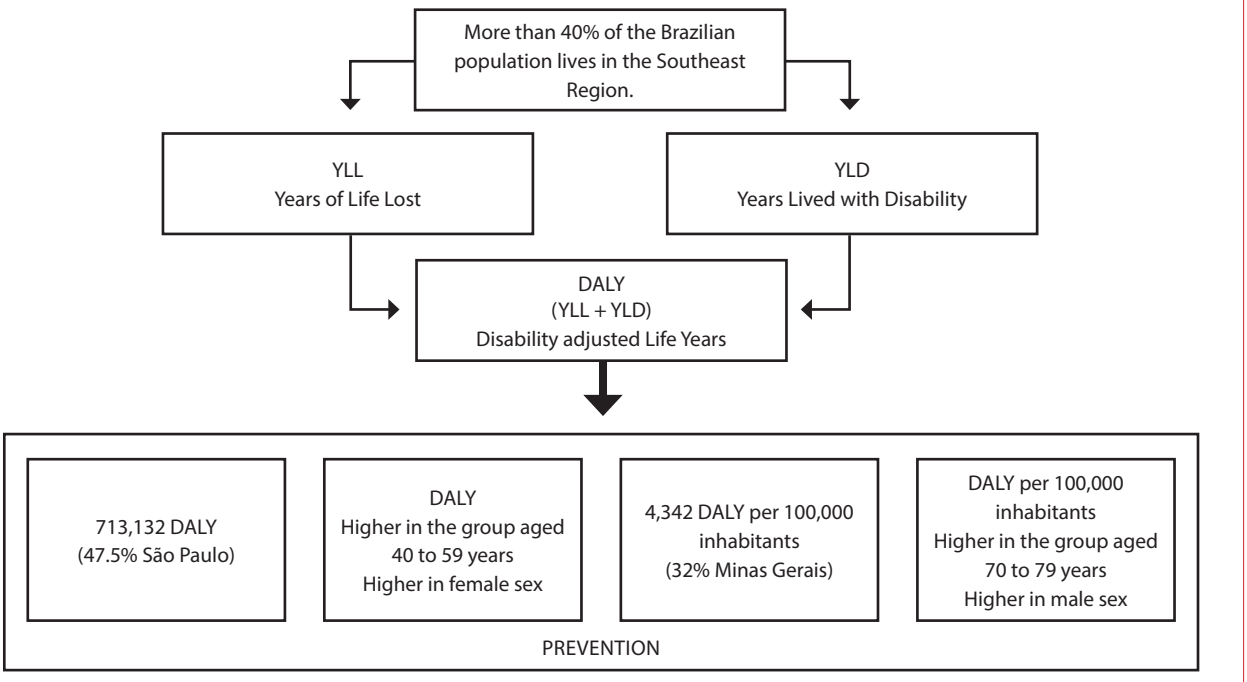

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In an attempt to express the burden of a disease in society, the World Health Organization (WHO), in 1990, developed an indicator that estimates the number of disability-adjusted life years (DALY), which is obtained by adding the number of years lost due to early mortality to the years of life lived with disability or impairment (DALY = YLL + YLD).[7,8]

Currently, in higher-income countries, mortality, incidence, and DALY rates have stabilized, due to primary and secondary prevention actions; however, the worldwide burden of stroke is still expanding, mainly due to population aging and to low income in countries with lower socioeconomic development.[9]

Given the large numbers of mortality and survival of patients, the socioeconomic impact that the disease generates in society and the importance of monitoring and developing indicators of stroke burden (DALY), the objective of this study was to estimate the burden of stroke in the population adult, over 18 years of age, for both sexes, in different age groups, in the Southeast Region of Brazil, in the year 2019.

Methods

A descriptive analysis of stroke was carried out in the most populous region of Brazil, the Southeast, which comprises the federative units of Espírito Santo, Minas Gerais, Rio de Janeiro, and São Paulo, using secondary data from the Hospital Information System (SIH/SUS) and the Mortality Information System (SIM/SUS), both belonging to the Department of Informatics of the Brazilian Unified Health System (DATASUS), as well as from the Brazilian Institute of Geography and Statistics (IBGE), for the year 2019.

Data regarding mortality were obtained from SIM/SIH, and data regarding the number of stroke cases were obtained from SIH/SUS using the TabWin program, available for free download from DATASUS, for the year 2019. It is important to highlight that data from the SIH only encompass strokes registered in public hospitals or hospitals affiliated with the SUS, without recording admissions to private hospitals, whereas data from SIM encompass all deaths due to stroke, regardless of whether they occurred in public or private hospitals, or even at home. Data referring to both mortality and the number of cases were organized by sex and age over 18 years, considering only code I-64 of the ICD 10 (stroke, not specified as hemorrhagic or ischemic), eliminating the insertion of other codes such as I-63 (cerebral infarction) and I-69 (sequelae of cerebrovascular diseases), which would include other

pathologies in addition to stroke and could, therefore, interfere with the DALY results.

To compose indices with the population of each Brazilian federative unit, the estimated adult population for each federative unit in the year 2019 was organized by sex and detailed age (18 to 130 years), obtained from the IBGE.[10] For analysis of results, data from SIM, SIH, and estimated population were organized by age group (18 to 39, 40 to 59, 60 to 69, 70 to 79, and 80 years and above).

To calculate YLL due to stroke, the study used the Complete Mortality Table for males and females for the year 2019,[10] which makes it possible to identify the standardized life expectancy and the number of deaths during the same year, extracted from DATASUS.[4] For each year lost, a discount rate of 3% was applied to each year of future life lost, following WHO guidelines.[11]

In calculating YLD, the number of stroke survivors was considered, estimated by the number of cases, subtracted from the number of deaths during the same period, in addition to the standardized life expectancy for males and females and the weight of disability caused by stroke, evaluated at 0.588, in accordance with the 2019 Global Burden of Disease.[11]

Finally, to obtain the DALY, the sum of YLL and YLD was calculated and, in order to observe the impact on the population of each federative unit, DALY rates per 100,000 inhabitants were calculated. The data obtained from DATASUS and IBGE and the calculation of indicators of stroke burden (YLL, YLD, and DALY) were tabulated in Excel® spreadsheets.

This study was developed as part of the postgraduate program in Public Health of the Federal University of Juiz de Fora (UFJF), and evaluation by the Research Ethics Committee was waived, because it uses data from official health information systems in the public domain, following the principles of Brazilian National Health Council Resolution number 466, of December 12, 2012.

Results

YLD varied between 75% (Rio de Janeiro) and 82% (Minas Gerais) in the composition of each DALY, indicating a greater impact due to patient survival than premature death, for both sexes and all federative units. Both YLD and YLL were higher for the population of both sexes in the economically active age group between 40 and 59 years old (217,419 YLD and 47,506 YLL), and they were lower between 18 and 39 years for YLD and 80 years or older for YLL. When sex was compared, the female sex was observed to have a predominance for YLD and the male sex for YLL (Table 1).

Table 2 displays the DALY for each Brazilian federative unit, distributed by sex and age group. The state of São Paulo had 339,020 DALY (47.5%), followed by Minas Gerais (217,036 DALY, 30.5%), Rio de Janeiro (130,940 DALY, 18.5%) and Espírito Santo (26,136 DALY, 3.5%). In the analysis by sex, there was a predominance of DALY for the female sex in the young population between 18 and 39 years old and over 70 years old, impacting most the states of Espírito Santo and Minas Gerais; in contrast, the male population showed higher DALY between 40 and 69 years old and greater difference in relation to females in the age group between 60 and 69 years old (19,870 DALY), impacting most the states of Rio de Janeiro and São Paulo. For both sex and federative unit, the age group between 40 and 59 years old generated the highest number of DALY (135,075 DALY for males and 129,850 for females), totaling 264,925 DALY. When analyzed proportionally at a rate per 100,000 inhabitants, the highest values were found in Minas Gerais (1,398 DALY), followed by Rio de Janeiro (1,047 DALY), São Paulo (1,009 DALY), and Espírito Santo (888 DALY).

Graph 1 displays the distribution of DALY according to federative unit, age group, and sex. The highest DALY values for the 4 federative units and both sexes are located in the age group between 40 and 59 years old, followed by a gradual decrease, until reaching the lowest values in the age group 80 years or older.

When analyzing the DALY per 100,000 inhabitants, the rates increased starting from 18 years of age to the age group between 70 and 79 years old, when they reached their peak and subsequently decreased. These same rates were greater for males from the age group between 40 and 49 years for the 4 federative units analyzed (Graph 2).

The Central Figure summarizes the main results found in this study.

Discussion

In 2019, stroke remained the third leading cause of combined death and disability worldwide, associated with a large number of cases and an increased DALY burden.[12] Even with the trend towards an increased number of cases worldwide, the incidence, prevalence, most affected sex, age group, mortality rate, and DALY due to stroke may vary depending on the economic development and population characteristics of a region.[13]

Table 1 – YLD and YLL distributed by Brazilian federative unit and age group for the Southeast Region in the year 2019

		YLD						YLL					
FU	Sex	18 to 39 years	40 to 59 years	60 to 69 years	70 to 79 years	80 years or older	Total	18 to 39 years	40 to 59 years	60 to 69 years	70 to 79 years	80 years or older	Total
ES	Male	691	3357	3278	1700	587	9613	125	946	881	478	346	2777
	Female	1066	4078	2463	1869	892	10368	279	1123	713	778	485	3378
	Total	1757	7435	5741	3569	1479	19981	404	2069	1594	1257	831	6155
MG	Male	7393	32480	25250	16325	5204	86651	1350	6340	4989	3995	1991	18665
	Female	11760	33620	21387	16194	8253	91213	1625	6634	4498	4784	2966	20507
	Total	19153	66099	46637	32518	13457	177864	2975	12974	9487	8778	4958	39172
RJ	Male	3877	19906	15661	7735	1936	49115	997	5580	5218	3473	1303	16572
	Female	5263	18767	12827	8857	3509	49222	951	5044	4285	3769	1981	16031
	Total	9140	38673	28488	16592	5445	98337	1949	10625	9503	7242	3284	32603
SP	Male	12472	54043	41022	22348	6332	136217	2296	12422	10833	7103	3043	35697
	Female	17345	51169	33003	23102	10205	134824	2204	9416	8086	7914	4661	32280
	Total	29817	105212	74025	45450	16537	271042	4501	21838	18919	15016	7703	67978
Total	Male	24433	109786	85210	48107	14060	281596	4768	25289	21921	15049	6683	73710
	Female	35435	107633	69680	50022	22858	285628	5060	22217	17582	17245	10093	72197
	Total	59867	217419	154890	98129	36919	567225	9828	47506	39503	32293	16776	145907

Source: Authors. ES: Espírito Santo; FU: federative unit; MG: Minas Gerais; RJ: Rio de Janeiro; SP: São Paulo; YLD: years lived with disability; YLL: years of life lost.

In general, research indicates that stroke affects elderly people, the male sex, and populations of countries with limited socioeconomic conditions, which have higher morbidity than mortality rates.[14]

DALY values may also vary depending on the period analyzed; for example, in 2016, there were 5.5 million deaths and 116.4 million DALY due to stroke,[15] whereas, in 2019, there were 6.5 million deaths and 143 million DALY, with a prevalence of 101 million stroke cases worldwide, responsible for high mortality, but also for a large number of survivors living with sequelae.[12] Meanwhile, in 2016, there were 107,258 deaths due to stroke in Brazil, with the male population over 70 years of age being most affected.[16]

DALY are obtained by the sum of YLL and YLD, and the proportion of each of these factors will depend on the type of pathology under analysis, the sex, the study period, and the geographic location. In this study on stroke, YLD for both sexes was more representative in the composition of the DALY, varying between the federative units analyzed, from 75% for Rio de Janeiro to 82% for Minas Gerais. Even with little difference in DALY between sexes, YLD in the female sex were responsible for 80% of DALY, in agreement with research carried out in regions with greater socioeconomic development, where women had greater YLD.[17,18]

Another variable that could justify higher DALY in the female sex is their representation, since this population is larger than the male population, representing up to 60% of the population in Rio de Janeiro, 56% in São Paulo, and 54% in Minas Gerais and Espírito Santo.[4] In relation to YLL, the highest burden was related to the male sex (21% of the DALY), indicating that men lose many years of life due to premature death.[16] Corroborating these findings from the Southeast Region, another study in Santa Catarina, located in the South Region of Brazil,

Table 2 – DALY and rates per 100,000 inhabitants distributed by Brazilian federative unit and age group for the Southeast Region in the year 2019

		DALY						DALY per 100,000 inhabitants					
FU	Sex	18 to 39 years	40 to 59 years	60 to 69 years	70 to 79 years	80 years or older	Total	18 to 39 years	40 to 59 years	60 to 69 years	70 to 79 years	80 years or older	Total
ES	Male	815	4304	4159	2178	934	12390	119	835	2671	3268	3026	851
	Female	1346	5201	3176	2647	1377	13747	203	995	1886	3116	2811	924
	Total	2161	9504	7335	4826	2310	26136	160	916	2263	3182	2894	888
MG	Male	8743	38820	30239	20319	7195	105316	252	1437	3590	4863	3710	1380
	Female	13385	40254	25885	20977	11219	111721	396	1445	2770	4082	3914	1415
	Total	22127	79073	56124	41297	18415	217036	323	1441	3159	4432	3832	1398
RJ	Male	4874	25486	20879	11208	3240	65687	189	1172	2957	3378	2314	1106
	Female	6215	23811	17111	12626	5490	65253	240	1017	1950	2634	1970	994
	Total	11089	49297	37990	23834	8730	130940	214	1092	2399	2938	2085	1047
SP	Male	14768	66466	51855	29451	9375	171915	201	1120	2861	3436	2641	1054
	Female	19550	60585	41089	31016	14866	167105	272	976	1941	2728	2397	968
	Total	34318	127050	92944	60466	24241	339020	236	1046	2365	3032	2486	1009
Total	Male	29200	135075	107132	63156	20744	355307	759	4563	12079	14944	11691	4391
	Female	40495	129850	87262	67267	32951	357825	1112	4434	8547	12560	11092	4300
	Total	69695	264925	194394	130423	53695	713132	933	4494	10186	13585	11296	4342

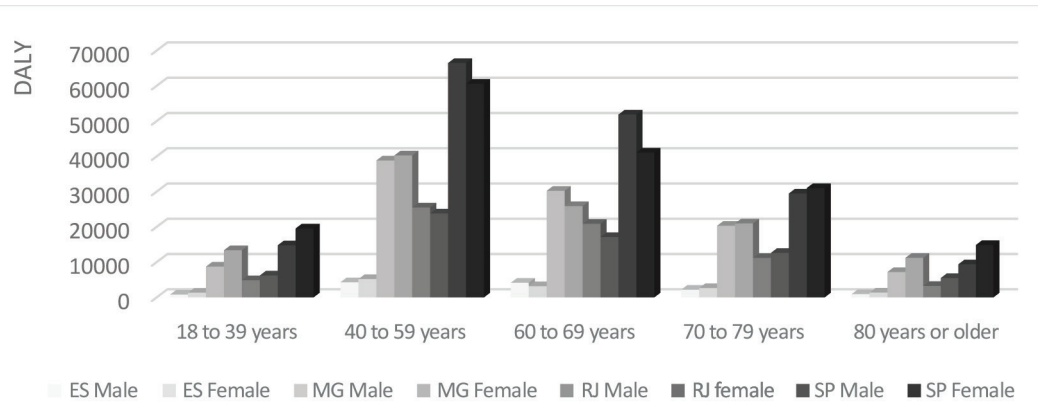
Source: Authors. DALY: disability-adjusted life years; ES: Espírito Santo; FU: federative unit; MG: Minas Gerais; RJ: Rio de Janeiro; SP: São Paulo.

found that cerebrovascular diseases represented the second leading cause of DALY, composed 82% of YLD and 18% of YLL.[19]

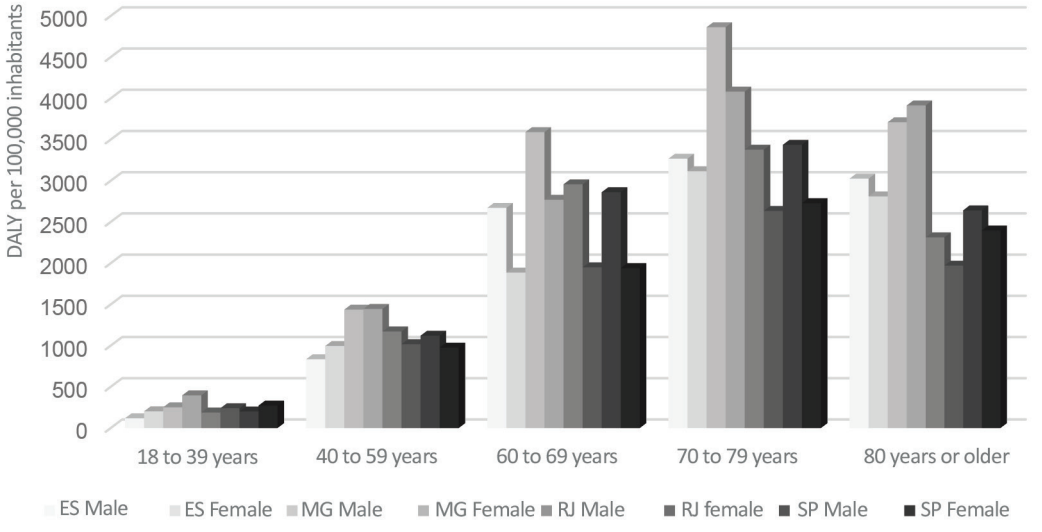
According to IBGE data, 42% of the inhabitants of Brazil live in the Southeast Region, and more than half of this population lives in the state of São Paulo.[10] According to the Brazilian National Health Survey on chronic diseases, 2.2 million people over 18 years of age reported a medical diagnosis of stroke in Brazil, with an estimated prevalence of more than 1 million cases of stroke in the Southeast Region alone.[20] The greater number of inhabitants in each of these states could justify the higher DALY for São Paulo, followed by Minas Gerais, Rio de Janeiro, and Espírito Santo.

Advanced age is also a factor that increases the number of stroke cases and the predisposition to more severe forms of stroke, not only impacting patients' routine lives but also increasing public spending.[21,22] In the Southeast Region, the population over 60 years of age is still small in proportion to the other age groups, varying between 13% for Espírito Santo and 16% for Rio de Janeiro, with a tendency to increase over the coming years.[10] Even with the elderly population still small, 53% of the DALY in these states are allocated to the population over 60 years of age. Even with a large part of the disease burden coming from respiratory and neoplastic diseases, cardiovascular diseases, particularly infarction and stroke, still lead these burdens in this elderly population, especially in low- and middle-income regions.[14]

Even though DALY are higher for the elderly population in the Southeast Region, there is still a large impact on the young population up to 59 years of age, suggesting that the region is undergoing a process of epidemiological transition, as the increase in the number of cases and DALY is largely due to population growth and aging, resulting in an increased prevalence



Graph 1 – DALY distributed by Brazilian federative unit and age group for the Southeast Region in the year 2019
Source: Authors. DALY: disability-adjusted life years; ES: Espírito Santo; MG: Minas Gerais; RJ: Rio de Janeiro; SP: São Paulo.



Graph 2 – DALY rates per 100,000 inhabitants, distributed by Brazilian federative unit and age group for the Southeast Region in the year 2019
Source: Authors. DALY: disability-adjusted life years; ES: Espírito Santo; MG: Minas Gerais; RJ: Rio de Janeiro; SP: São Paulo.

of stroke, despite the improvement in these patients' survival conditions.[15] As stated, regions with less economic development tend to generate great impacts on the younger population still involved in productive activity,[14,16] and, in line with this reasoning, the highest DALY load was related to the population between 40 and 59 years old, indicating a great loss of productivity for both sexes, when they are still economically active.[16]

Faced with changes in the population profile and patterns of development, studies predict an increase in the number of stroke cases with a 17% reduction in mortality, but with a 27% increase in survivors.[23] In this perspective of the changing age pyramid and development of the Southeast Region, an increase in DALY is still to be expected, with reflections on health actions that can be carried out to minimize the impact of the stroke burden.

Despite the increased number of strokes and DALY worldwide, mainly due to changes in the age pyramid and patterns of economic development, standardized

rates have tended to decrease, as diagnoses, treatments, and access to health systems have become more widely available.[15] Even though DALY were higher for the female sex, in the analysis standardized per 100,000 inhabitants, male sex had a greater impact in all age groups 40 years and over, in agreement with data from the 2016 Global Burden of Disease, in which men and people 70 years and older were more at risk of developing a stroke, explained by eating habits and lifestyle.[16]

Unlike the results of this study, even though there was a reduction in the burden of stroke between 1990 and 2015, the number of DALY for cerebrovascular diseases adjusted per 1,000 inhabitants was higher for the states of Espírito Santo, Rio de Janeiro, Minas Gerais, and São Paulo, driven by higher values of YLL.[24]

Among the risk factors that can increase the stroke burden, hypertension remains the main modifiable risk factor; nonetheless, easy access to processed food products has also led high body mass index to be incorporated into the new risk factors, joining smoking, alcoholism, diabetes, and sedentary lifestyle.[12,13,17,25,26]

Regarding non-modifiable risks, population aging continues to be the main risk factor for stroke and the increased number of DALY, becoming a challenge to public policies that need to simultaneously promote awareness and protect the population from modifiable risk factors, but also understand the dynamics of change in the age pyramid, with a tendency toward increased DALY in the Southeast Region.

The DALY indicator was questioned in its conception in the 1990s for attempting to measure the burden of disability, mortality, and quality of life of survivors of a given disease, but it is currently incorporated as an indicator of morbidity and mortality and a parameter in the health area to analyze the impact of different diseases in different regions and population groups. However, three factors may limit a more detailed understanding of the burden of stroke in the Southeast Region. First, the descriptive analysis of DALY in the year 2019, without elaborating a historical series regarding the impact of the DALY during previous years, limits the comprehension of the trends with greater accuracy, although much of the literature indicates an increase in the number of DALY due to population aging and economic development conditions.

A second issue that should be taken into account is that the study objective was to assess the burden of stroke in the most populous region of Brazil. Nonetheless, the national literature is scarce, limiting comparisons with other Brazilian regions or even with the Southeast Region itself, which makes this research more relevant in terms of originality. Finally, this study is based on secondary data from the SUS, which could lead to underestimated results in relation to DALY due to stroke in the Southeast Region; even though all the records of deaths due to stroke in this region are covered by the SIM/SUS, records of hospitalizations from the private network were not considered, since the SIH/SUS only records strokes in the public SUS network, thus underestimating the burden of stroke in this region.

As suggestions to minimize the burden of stroke in this region, there should be integration between social, economic, and health policies that could improve the relationship between an individual's age, modifiable risk factors, and increased family income, with the aim of preventing stroke and reducing its burden. Health actions could be directed from early childhood on, with education, guidelines, and campaigns that minimize consumption of industrialized or high-calorie products, excessive use of table salt in family meals, and consumption of alcohol and tobacco. Associated with these factors, regular physical activity should be encouraged with public policies for access to squares, fields, and areas near bodies of water, with lighting and security for the practice of aerobic sports to combat hypertension as well.[13,15,17,27]

These silent risk factors, when associated with population aging, cause health spending and socioeconomic damage, in which the disease burden is more related to morbidity than mortality and for which long-term care costs end up surpassing health expenditures. In addition to health promotion and protection, centers specializing in stroke diagnosis and treatment could minimize mortality and reduce the burden of disability, facilitating the recovery and reintegration of patients into society.[14] Allied to these health strategies, economic policies that improve the population's living conditions and financial independence would act as catalysts for improving quality of life and reducing DALY.[28,29]

Conclusions

It is important to evaluate the burden of stroke in order to measure the impact on the population in terms of premature deaths and lives lived with physical and social limitations. This study found that the highest DALY were related to the most populous federative units, and that, when compared to sex, there was a slight

predominance for females due to longer survival (YLD). DALY were higher in the elderly population, but the age group between 40 and 59 years old was the most impacted, possibly interfering with family income; however, when adjusted per 100,000 inhabitants, the male sex became more predominant in the Southeast Region of Brazil. It is worth emphasizing that increased life expectancy and population aging tend to further increase the burden of stroke in this region.

Author Contributions

Conception and design of the research, analysis and interpretation of the data, statistical analysis, writing of the manuscript, critical revision of the manuscript for intellectual content: Dos Reis MF, Chaoubah A; acquisition of data: Dos Reis MF.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

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