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Mortality among Brazilian adolescents and young adults between 1990 to 2019: an analysis of the Global Burden of Disease study

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Abstract *Mortality indicators for Brazilians aged between 10 and 24 years old were analyzed. Data were obtained from the Global Burden of Disease (GBD) 2019 Study, and absolute numbers, proportion of deaths and specific mortality rates from 1990 to 2019 were analyzed, according to age group (10 to 14, 15 to 19 and 20 to 24 years), sex and causes of death for Brazil, regions and Brazilian states. There was a reduction of 11.8% in the mortality rates of individuals aged between 10 and 24 years in the investigated period. In 2019, there were 13,459 deaths among women, corresponding to a reduction of 30.8% in the period. Among men there were 39,362 deaths, a reduction of only 6.2%. There was an increase in mortality rates in the North and Northeast and a reduction in the Southeast and South states. In 2019, the leading cause of death among women was traffic injuries, followed by interpersonal violence, maternal deaths and suicide. For men, interpersonal violence was the leading cause of death, especially in the Northeast, followed by traffic injuries, suicide and drowning. Police executions moved from 77th to 6th place. This study revealed inequalities in the mortality of adolescents and young adults according to sex, causes of death, regions and Brazilian states.*

Key words *Mortality, Adolescent, Young adult, Health status disparities, External causes*

Introduction

The World Health Organization estimates that, in 2019, more than 1.5 million teenagers and young adults, between 10 and 24 years of age, died around the world, approximately 5,000 deaths per day[1]. In most countries a reduction in mortality rate has been observed among this age group individuals, except for the group of males aged 15 to 19 years in the Eastern Mediterranean region and the Americas[2]. African countries show the highest rates of disability-adjusted life year (DALY), while developed countries show the lowest ones.

Most deaths of individuals aged 10 to 24 years are caused by violence, suicide, and traffic injuries (external causes), mental illness, alcohol abuse, negative outcomes related to maternal and contraceptive health, and infectious diseases[1-4], reflecting the lack of public policies for prevention and protection[3,5]. Mortality among teenagers and young adults compromises the future and points to government's and society's negligence in assuring a quality of life for this age group[6-9].

In Brazil, the high proportion of deaths due to external causes in this population segment stands out. In 2016, approximately half of the 56 thousands of deaths due to homicide occurred among young people aged 15 to 29 years, 77% of whom were black[10,11]. Differentials in the risk of death of young people in the country are also explained by household and living conditions in municipalities and states; in Brazil, those poor young people living in more developed areas are at higher risk of dying[12].

The 2030 Sustainable Development Agenda includes teenagers among its priorities, and many objectives include actions aimed at this group: poverty eradication, gender equality, access to safe drinking water and sanitation, and peace and justice, thus making it important to monitor advances[13,14]. In Brazil, there is a scarcity of long-term time series analysis of teenage and young adults mortality rates. Investigating the pattern of mortality in this age group is an action of great relevance for the understanding of the phenomenon and the development and reorientation of intersectoral public policies driven to this population segment. Taking this fact into consideration, the current work seeks to analyze the mortality rates of adolescents and young adults aged 10 to 24 years, according to sex and cause of death for Brazil and its states, between 1990 and 2019.

Methods

The terminology "adolescents" and "young adults" was used to refer to people between 10 and 24 years of age, an age group which includes the beginning of adolescence (10 to 14 years old), the middle (15 to 19 years old), and the young adult age (20 to 24 years old)[15].

Secondary data from the study "Global Burden of Disease 2019" (GBD 2019), conducted by the Institute for Health Metrics and Evaluation (IHME), was analyzed. GBD data capture premature deaths and disability due to more than 350 diseases and injuries in 195 countries by age and sex since 1990, making it possible to compare different populations over time[16]. These data have been adjusted, enabling a comparison among all the countries, as well as subnational estimates[17,18].

The GBD study uses the Mortality Information System (SIM, in Portuguese), from the Brazilian Ministry of Health, as the main source of mortality data. This database is submitted to adjustments based on other national and international sources. In the case of mortality, statistical handling of data was conducted to improve the quality of information. As part of this handling, it is performed "garbage code" – causes which should not be considered the basic cause of death, as well as poorly defined causes - redistribution, and the correction for the unnotified or under-reported deaths[19]. The GBD 2019 follows the International Statistical Classification of Diseases and Health Related Problems (CID) 9 and 10 to define the cause groups. These were described previously[17,20] and are thoroughly revised in each edition of the GBD 2019 study in order to include new sources of data and new evidence[11,19,20].

The IHME uses the 95% uncertainty intervals (95% UI) defined between 2.5 and 97.5% of the estimated values. All the estimates are calculated 1,000 times to obtain the 95% UI. The 95% UI include uncertainties from all the sources and steps of modeling, like the variability of sampling size, among others.

The GBD 2019 organizes the underlying cause of death in a four-level hierarchy. Level 1 stratifies the diseases in 3 major groups: 1) communicable, maternal, neonatal, and nutritional diseases; 2) non-communicable diseases; and 3) injuries. Levels 2, 3 and 4 detail the group 1, disaggregating it in 21, 168 and 369 diseases, respectively.

This study analyzed the number and the proportion of deaths, and mortality rates for the total population of adolescents and young adults, between 10 and 24 years of age in Brazil and its states from1990 to 2019, and the percentage of change between these two estimates was presented. This study also presented the time series of the number of deaths and mortality rates between 1990 and 2019, according to the age groups (10 to 14 years of age, 15 to 19 years of age, and 20 to 24 years of age) and sex, and the percentage variation of mortality rates between the two years, also according to sex and the age groups. The mortality rates due to the causes of death according to Brazil, its states, and sex, were also presented. The causes were separated into levels 2, 3 or 4 of the hierarchy, according to their variation for Brazil, its regions, its states, age groups, and over time. The Global Burden of Disease in Brasil (GBD Brazil) study was approved by the Research Ethics Committee from Universidade Federal de Minas Gerais (UFMG).

Results

Table 1 shows the number of deaths and mortality rates per 100,000 inhabitants in Brazil and its states. In Brazil, in 1990, in the 10 to 24 age range, 51,796 deaths (rate of 111.1/100,000; uncertainty interval – 95% UI 109.4 – 113./100,000) were reported. In 2019, 49,253 deaths (rate of 98/100,000; 95% UI 94.8-1001,4/100,000) were reported, representing a reduction of 11.8% during the period. In the same year, the highest rates occurred in the states of Ceará (142.9/100,000), Pernambuco (139.3/100,000), Rio Grande do Norte (136.6/100,000), Espírito Santo (136.1/100,000), and Sergipe (133.5/100,000). The biggest reductions between 1990 and 2019 by state were reported in the states of São Paulo (-48%), Rio de Janeiro (-33.5%), Distrito Federal (-29%), and Roraima (-25.8%). The highest percentages of increase occurred in the states of Rio Grande do Norte (+86.5%), Ceará (+74%), Paraíba (+50.7%), Piauí (+38.5%), Sergipe (+37.1%), and Alagoas (+24.8%).

Figure 1 shows the variation of mortality rates in females aged 10 and 24 years, between 1990 and 2019, by state (Figure 1A). In 1990 it was observed a mortality rate of 57.6/100,000 inhabitants (13,459 deaths), while in 2019, there was a rate of 39.9/100,000 inhabitants (9,891 deaths). A reduction of approximately 30.0% during the period analyzed was found in the rates for Brazil and in the majority of the states (data not shown).

According to Figure 1, 38,310 deaths were reported among males (rate of 165.1/100,000) in 1990 (Figure 1B). In 2019, there were 39,362 deaths (rate of 154.9/100,000), with a reduction of only 6.2% and with great disparity among the states. A reduction was found in the states of São Paulo (-54%), Distrito Federal (-28%), Rio de Janeiro (-33%), Rondônia (-23%), and Roraima (-22%). In all the other states, an increase or stability was reported. The biggest increases occurred in the states of Rio Grande do Norte (+122%), Paraíba (+70.9%), Alagoas (+43%), Espírito Santo (+38%), Amapá (+34%), Pernambuco (+33%), Ceará (+106%), and Sergipe (+57%).

Figure 2 shows the time series for the absolute number of deaths (Figure 2A) and mortality rates (Figure 2B) per 100,000 inhabitants, for the age groups of 10 to 14, 15 to 19, and 20 to 24 years, by sex, from 1990 to 2019. Among males, 10 to 14 years of age, the number of deaths varied from 5,913 (68,0/100,000; 95% UI, 65.8 - 70.4) in 1990, to 3,248 (39.2/100,000; 95% UI, 36.1-42.4) in 2019, with a 42.4% reduction within the period. In the age group of 15 to 19 years, the number of deaths remained stable: 13,252 (174.5/100,000; 95% UI, 170.5- 178.8) in 1990 and 14,303 (171.5/100,000; 95% UI, 163.2-179.8) in 2019. In the age group of 20 to 24 years, there was an increase in the absolute number and reduction of 10% in the rate during the period: 19,145 deaths (277.1/100,000; 95% UI 272.3-282.3) in 1990, and 21,811 (248.4/100,000; 95% UI, 240.5 - 257.7) in 2019.

Among women a reduction was observed in all age groups. For the age group of 10 to 14 years, a 37.4% reduction was observed during the period: 3,413 (39.7/100,000) in 1990 and 1,991 (24.8/100,000) in 2019. For the age group of 15 to 19 years, the reduction was 29%: 4,471 (58.1/100,000) in 1990 and 3,347 (41.3/100,000) in 2019. For the age group of 20 to 24 years, a 33.4% reduction was observed: 5,575 (78.7/100,000; 95% UI, 77.1 - 80.4) in 1990 and 4,553 deaths (52.4/100,000; 95% UI, 50.1- 54.9) in 2019.

As shown in Figure 3, the time series indicated: for males, a decline among the 10 to 14 years of age group and an increase among the 15 to 19 years of age group until 2017. A reduction for the 20 to 24 years of age group was observed between 1990 and 2005, and then an increase in the North, Northeast, and Midwest regions until 2017, followed by a decline. In the South region, an oscillation was observed throughout the entire period. In the Southeast region, there was a

Table 1. Number of deaths and mortality rates among individuals of 10 to 24 years of age, both sexes, respective 95% Uncertainty Intervals and percentage variation of the indicators for Brazil and for each state, 1990 and 2019.

Brazil and states	Number of Deaths						Mortality rate (for 100,000 inhabitants)						PV
	1990			2019			1990			2019			
		95% UI			95% UI			95% UI			95% UI		
	n	LL	UL	n	LL	UL	Tx	LL	UL	Tx	LL	UL	
Brazil	51.769	50.945	52.633	49.253	47.627	50.913	111,1	109,4	113,0	98,0	94,8	101,4	-11,8
Acre	163	157	169	281	258	304	111,9	107,8	116,1	101,2	92,9	109,5	-9,6
Alagoas	884	841	927	1.219	1.086	1.365	100,9	96,0	105,8	125,9	112,2	141,0	24,8
Amapá	100	97	103	305	286	327	103,0	99,5	106,6	118,5	110,9	126,7	15,0
Amazonas	754	708	810	1.183	1.080	1.296	103,6	97,3	111,2	96,4	87,9	105,6	-7,0
Bahia	3.747	3.434	4.099	3.190	2.754	3.645	91,0	83,3	99,5	83,5	72,1	95,4	-8,2
Ceará	1.720	1.530	1.910	3.445	2.916	4.032	81,7	72,7	90,7	142,9	121,0	167,3	74,9
Distrito Federal	649	604	693	605	549	669	120,3	111,9	128,4	85,1	77,2	94,0	-29,3
Espírito Santo	920	903	938	1.214	1.084	1.351	110,9	108,8	113,0	136,1	121,5	151,5	22,8
Goiás	1.759	1.605	1.926	2.095	1.814	2.424	128,3	117,1	140,5	130,1	112,7	150,5	1,4
Maranhão	1.310	1.161	1.462	1.416	1.196	1.662	78,5	69,6	87,6	63,1	53,3	74,1	-19,6
Mato Grosso	832	761	899	931	851	1.016	122,4	112,1	132,3	107,9	98,6	117,8	-11,8
Mato Grosso do Sul	624	597	650	605	553	664	108,1	103,5	112,6	90,5	82,8	99,3	-16,2
Minas Gerais	4.518	4.327	4.715	4.348	3.974	4.759	90,3	86,5	94,2	90,8	83,0	99,4	0,6
Pará	1.648	1.500	1.809	2.488	2.261	2.715	97,2	88,5	106,7	96,4	87,6	105,2	-0,9
Paraíba	830	787	876	1.182	1.050	1.331	76,9	72,9	81,2	115,8	102,9	130,4	50,7
Paraná	2.519	2.483	2.557	2.600	2.333	2.886	92,5	91,2	93,9	102,7	92,2	114,0	11,1
Pernambuco	2.826	2.776	2.881	3.428	3.075	3.774	118,0	115,9	120,3	139,3	125,0	153,4	18,1
Piauí	578	549	609	793	721	868	63,9	60,7	67,4	88,5	80,4	96,8	38,5
Rio de Janeiro	6.585	6.520	6.659	4.567	4.175	4.998	179,5	177,7	181,5	119,7	109,5	131,0	-33,3
Rio Grande do Norte	585	537	632	1.184	1.013	1.366	73,2	67,2	79,1	136,6	116,8	157,5	86,5
Rio Grande do Sul	2.603	2.569	2.637	2.145	1.959	2.347	101,1	99,8	102,5	90,7	82,8	99,2	-10,3
Rondônia	596	561	633	470	414	533	153,0	144,1	162,6	105,5	92,9	119,6	-31,1
Roraima	107	102	112	195	183	208	156,1	149,3	163,2	115,9	108,5	123,6	-25,8
Santa Catarina	1.344	1.292	1.401	1.195	1.088	1.316	94,6	90,9	98,7	78,0	71,1	86,0	-17,5
São Paulo	12.824	12.345	13.280	7.012	6.406	7.675	138,0	132,9	142,9	71,7	65,5	78,5	-48,0
Sergipe	500	464	537	810	703	932	97,4	90,3	104,6	133,5	115,9	153,6	37,1
Tocantins	243	222	265	347	306	388	77,9	71,0	85,0	81,1	71,5	90,7	4,2

Note: 95% UI - 95% Uncertainty Interval. LL: Lower Limit. UP: Upper Limit. PV: Percentage variation between 1990 and 2019.

Source: Data GBD 2019. Author's elaboration.

continuous reduction during the period. Among women, the rates declined in the three age groups in all of the regions and increased with age.

Figure 4 shows the percentage variation of the rates according to state, stratified by region, sex and age groups. The average reduction among males, 10 to 14 years of age, was 40%, which was lower in the Northeast (-20%) and higher in the Southeast (-50%). For the 15 to 19 years of age group, a broad regional variation was observed: an increase of nearly 100% in Northeastern states and a reduction of 50% in Southeastern states; the same occurred in the 20 to 24 years of age group. For females, the variability was less among age groups and among states. A reduction was observed in all three age groups: around 40% in the 10 to 14 and 20 to 24 years of age groups and about 20% in the 15 to 19 years of age group. Less reduction occurred in the Northeast, as compared to greater reduction in the Southeast and South.

Figure 5 shows proportionate mortality by causes of death, according to level 2 of the GBD 2019, for sex, age groups, and regions in 2019. Between 1990 to 2019, in all of the regions, among males (Figure 5B), mainly between the ages of 15 and 24 years, the predominant causes are inter-

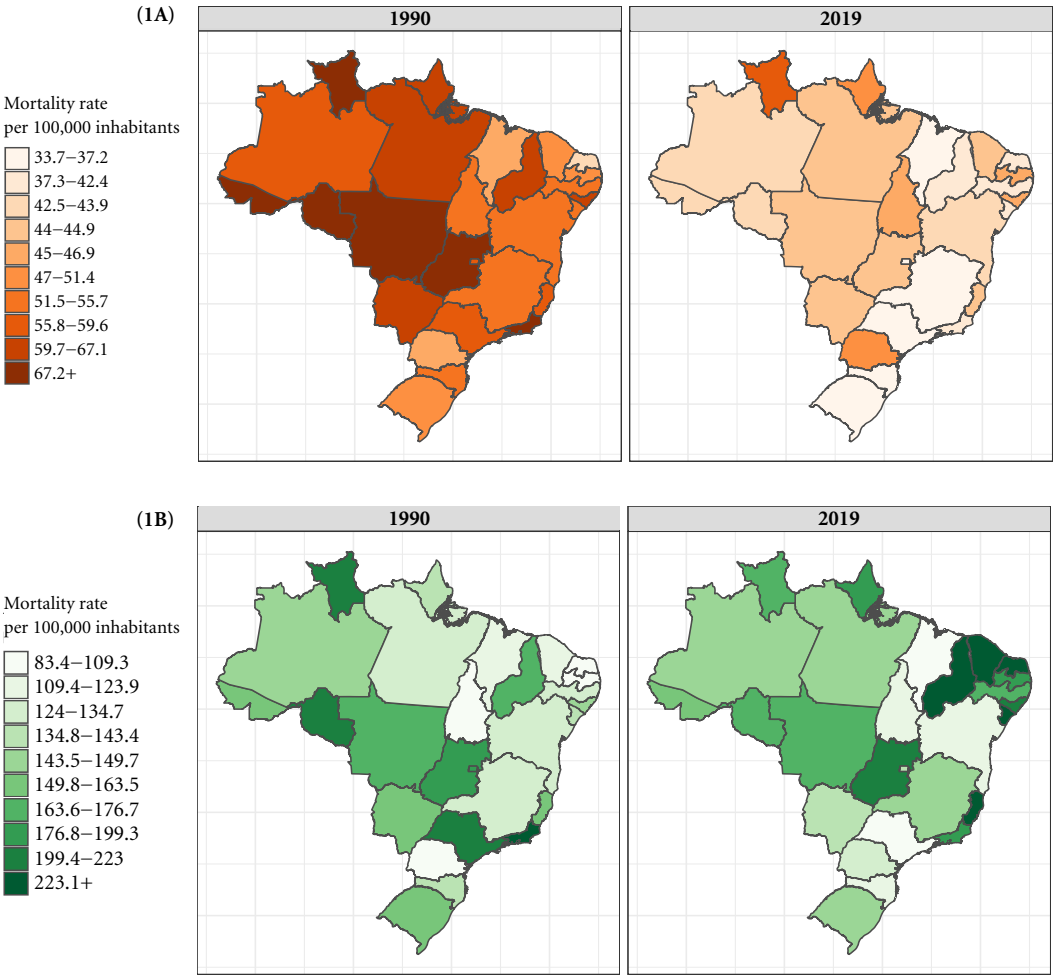


Figure 1. Mortality rates for individuals aged 10 to 24 years, according to sex (1A female, 1B male), Brazil and states, 1990 and 2019.

Source: Data GBD 2019. Author's elaboration.

personal violence, suicide, and traffic injuries: violent causes can reach as much as 90% of the causes of death. During the period, there was a reduction in communicable diseases and an increase in Non-Communicable Diseases (NCDs), with differences for age groups and regions. For females (Figure 5A), the profile of causes is similar, but the magnitude of external causes was lower, representing about 40% of all deaths. The NCDs stand out, as do maternal deaths and HIV.

Figure 6 compares the ranking of the 15 main causes of death in Brazil, in 1990 and 2019, according to mortality rates in the 10 to 24 years of age group and to sex. Among females (Figure 6A), a reduction in mortality rates was observed from 1990 to 2019, falling to the 10th place in the ranking, except for HIV/AIDS, which increased. The three leading causes in 1990 and 2019 were: traffic injuries, interpersonal violence (aggression), and maternal causes. Suicide, which was the 6th cause of death in 1990 moved up to 4th in 2019. Respiratory infections dropped from 4th (1990) to 5th place (2019); leukemia went from 8th place (1990) to 6th place in 2019; and HIV/AIDS was in 7th place. Eight NCDs stood out among the 15 main causes in 2019.

Among males (Figure 6B), interpersonal violence as a cause of death rose in the age group of 10 to 24 years, between 1990 and 2019, from 58/100,000 to 78.9/100,000 inhabitants, remain-

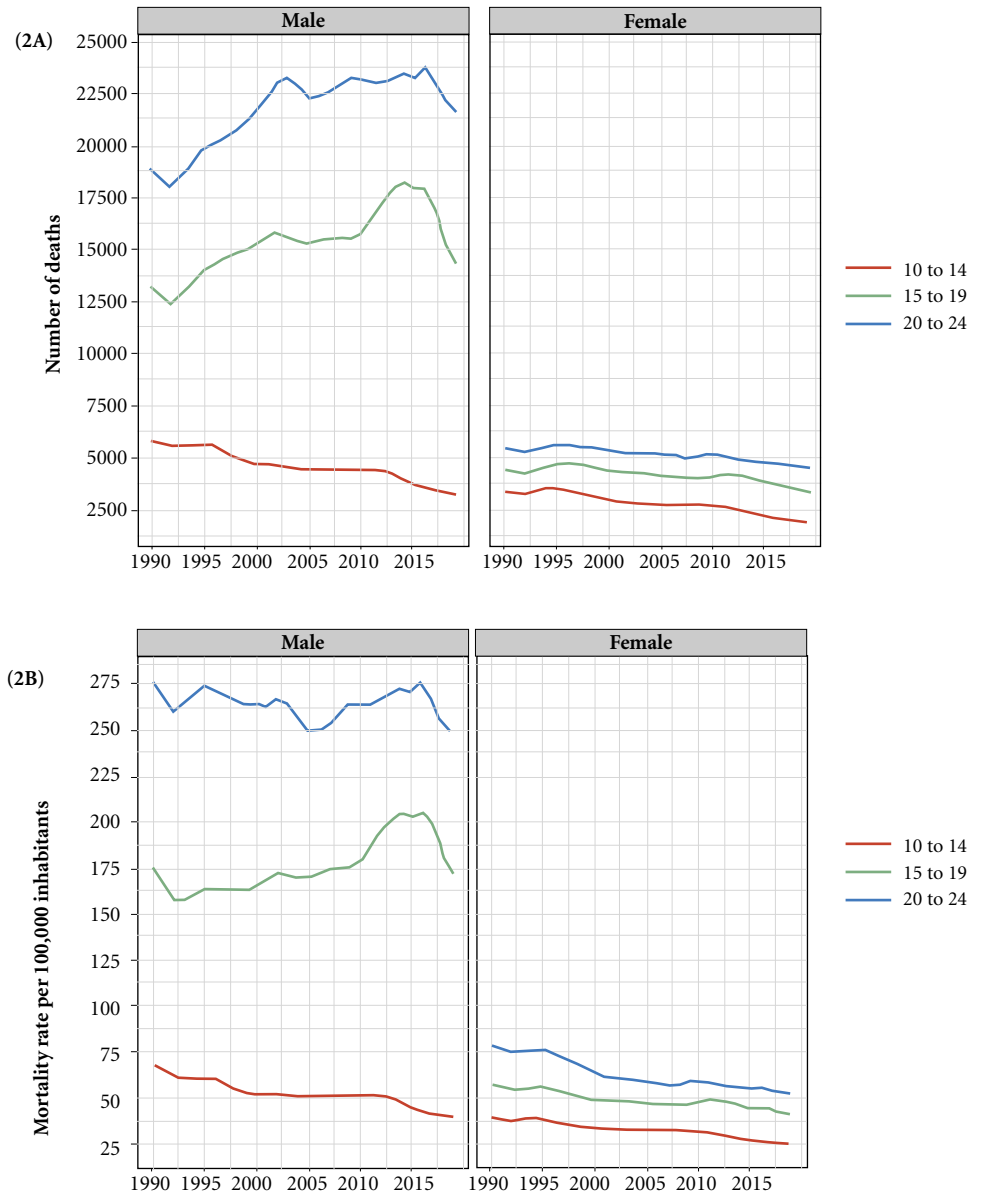


Figure 2. Time series of the absolute number (A) and of the mortality rates (B) for age groups 10 to 14, 15 to 19, and 20 to 24 years, according to sex, Brazil, 1990 and 2019.

Source: Data GBD 2019. Author's elaboration.

ing in first place in the ranking. The second leading cause of death was traffic injuries, with a reduction in the rate during the period. Suicide went from 4th to 3rd place, switching positions with drowning, which dropped to 4th place. Respiratory infection took 5th place, and murders by police went from 77th place (0,05/100.000) to 6th place (2,22/100.000) in that period, representing the highest rise in causes of death among male adolescents and young adults during that period.

Figure 7 shows the rates of the 10 main causes of death according to states and sex in 1990 and 2019. For females, in 1990, the highest rates were due to malaria in the states of Rondônia (37/100,000) and Roraima (33.3/100,000). Traffic injuries were the first or second cause of death

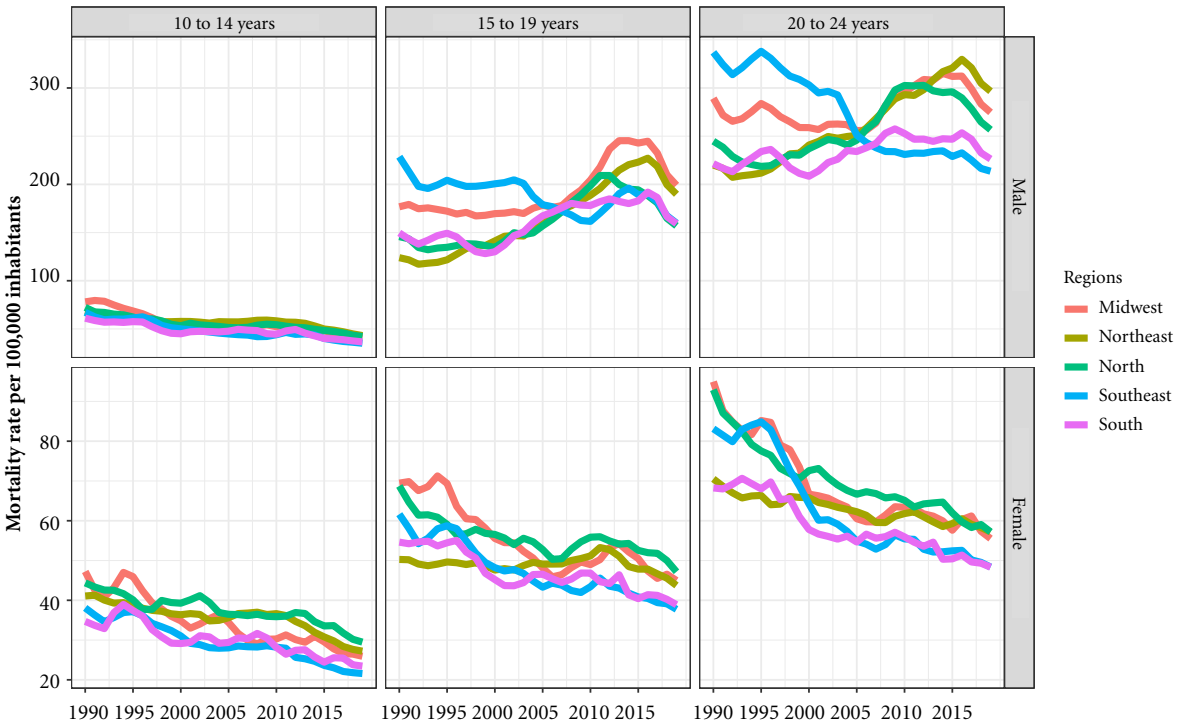


Figure 3. Time series of the mortality rates for age groups 10 to 14, 15 to 19, and 20 to 24 years, according to sex, regions of Brazil, 1990 and 2019.

Source: Data GBD 2019. Author's elaboration.

in almost every state. Interpersonal violence ranks second in most states. Maternal deaths were the third cause in the majority of states, with the highest rate occuring in Pernambuco (10.1/100,000). Other causes were respiratory infection, drowning, suicide, stroke, leukemia, and congenital conditions.

In 2019, a significant change in the pattern of mortality was observed among women (Figure 7B); malaria, responsible for high mortality rates in states of the North region and in Mato Grosso in 1990, is no longer one of the top 10 causes of death. Traffic injuries remain in the first or second places, accounting for the highest mortality rates in Mato Grosso (9.1/100,000) and Tocantins (9.1/100,000), and interpersonal violence, which also appears as the first or second cause of death in almost every state, especially Espírito Santo (9.9/100,000) and Roraima (9.4/100,000). Maternal causes continued to be the third cause of death in the majority of the states, and suicide rose to fourth place. Other causes were respiratory infection, leukemia, HIV/AIDS, congenital conditions, and stroke.

Among men (Figure 7C), in 1990, interpersonal violence was the leading cause of mortality in every state, and was highest in Rio de Janeiro (160.1/100,000), in São Paulo (84.5/100,000), and in Roraima (70.5/100,000). This was followed by traffic injuries, drowning, suicide, other accidents, respiratory infection, HIV/AIDS, falls, leukemia, and stroke.

Also among males, in 2019 (Figure 7D), interpersonal violence continued to stand out as the main cause of death, especially in the states of the Northeast region: Pernambuco (149.1/100,000), Rio Grande do Norte (148.1/100.000), Ceará (144.6/100.000), Sergipe (136,3/100.000), Alagoas (135,7/100,000), Amapá (106/100,000), Paraíba (101.6/100,000), and Rio de Janeiro, (108.8/100,000). The lowest rate was in São Paulo (37.1/100,000). In second place were traffic inju-

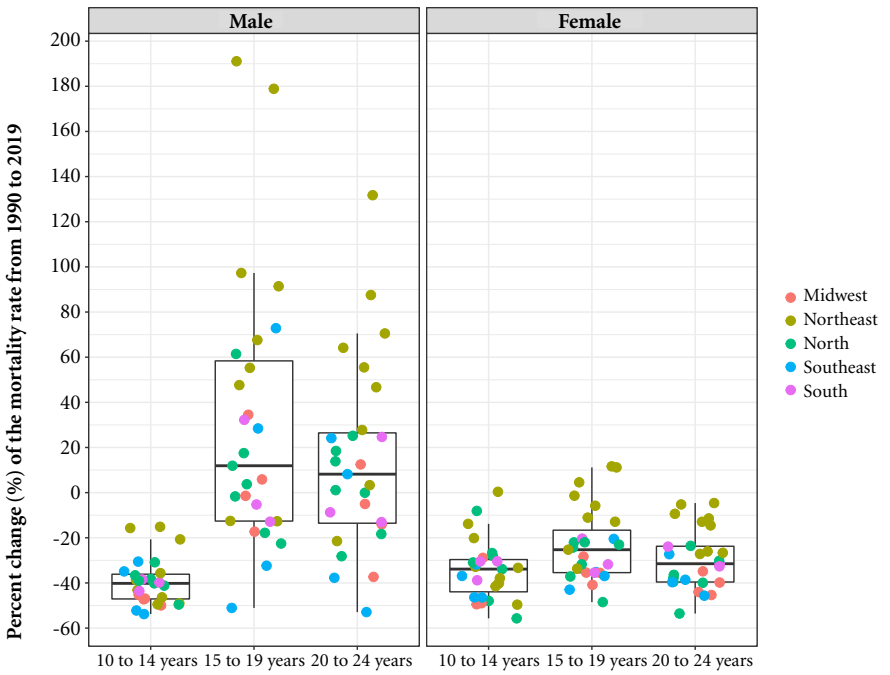


Figure 4. Percentage variation of mortality rates for age groups 10 to 14, 15 to 19, and 20 to 24 years, according to state, stratified by region and sex, 1990 and 2019.

Note: each circumference represents a state in the respective region.

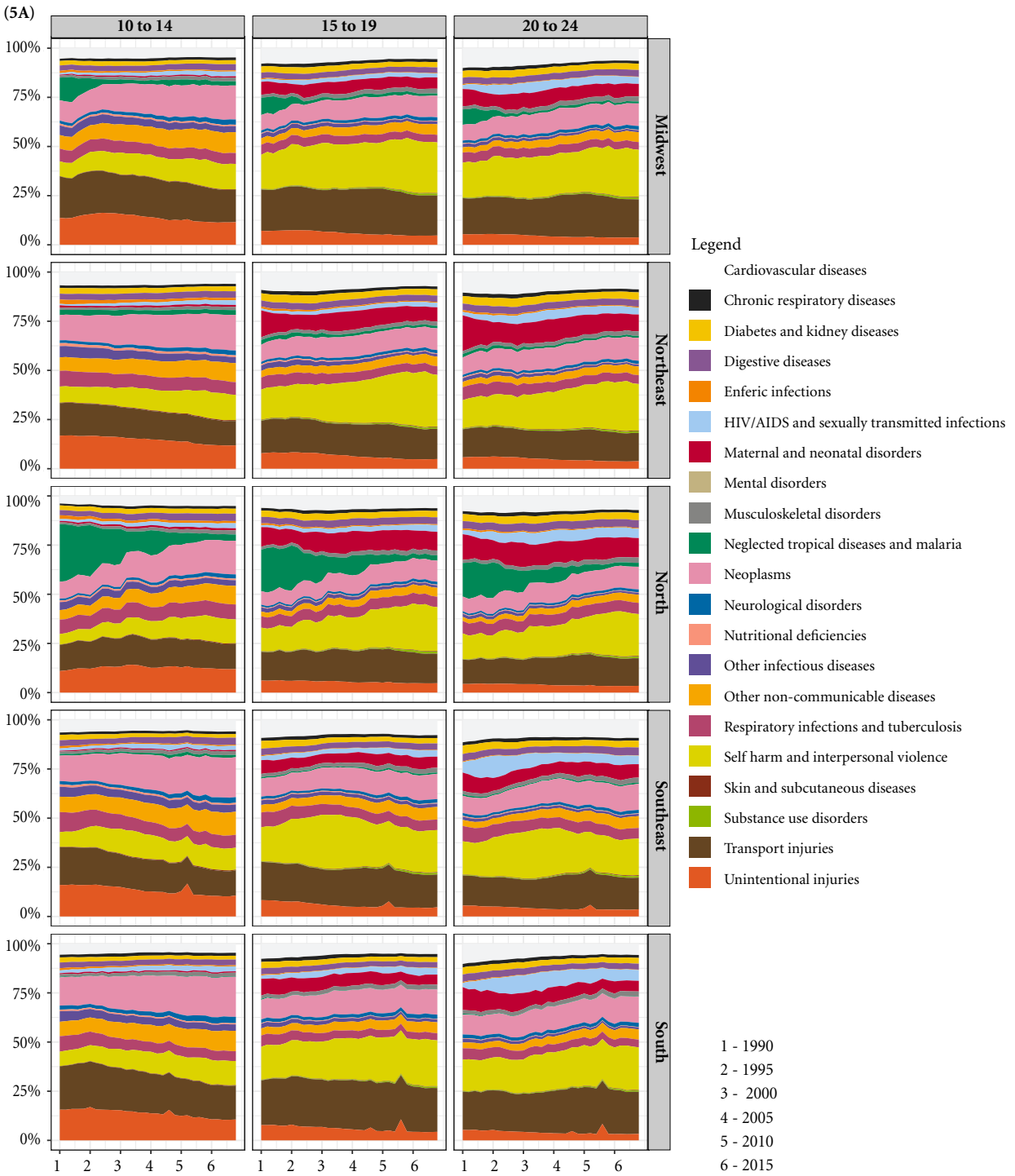
Source: Data GBD 2019. Author´s elaboration.

ries, with rates varying from state to state: Mato Grosso (41.7/100,000), Rondônia (39.2/100,000), and Bahia (13/100,000). Suicides rose to third cause, varying between 11.9/100,000 in Roraima to 3.3/100,000 in Maranhão. Police executions appeared in 6th place, followed by drowning, respiratory infections, leukemia, accidents caused by mechanical forces, HIV/AIDS, and malignant neoplasms.

Discussion

The present study analyzed the mortality of young people between 10 and 24 years of age over the last 30 years. The number of deaths remained high throughout the period. Approximately 50,000 adolescents and young adults die each year, many because of causes that could be avoided. Mortality rates are up to 3 times higher for men when compared to women and present significant regional variations. External causes are predominant for both sexes, with interpersonal violence standing out, followed by traffic injuries, suicide, and unintentional accidents. Interpersonal violence is the leading cause of death among young men. Although in the last 30 years the mortality rates due to this cause in males have decreased in the Southeast and South of the country, there has been a significant increase in the Northeast and North regions. The growth in numbers of suicide stands out for both sexes, and, among males, police executions went from 77th place (0,05/100,000) to 6th (2.22/100,000) during the period. Among women, maternal causes took third or fourth place, and the increase in mortality due to neoplasms and cardiovascular diseases stands out. There was also a decline in such diseases as malaria and HIV/Aids.

According to the GBD, in 2017, there were 1.55 million deaths of young adults between 10 and 24 years of age around the world. The mortality rates for adolescents and young adults show an increase in several countries, revealing a certain neglect towards this social group[3,4,14,21]. Countries, such as Brazil and Mexico, show re-



it continues

Figure 5. Proportionate mortality due to main causes of death, according to sex (5A female and 5B male), region and age groups 10 to 14, 15 to 19, and 20 to 24 years, 2019.

duction of mortality rates for children, although they have maintained high mortality rates for adolescents and young adults[22].

Brazil is part of a group of countries with the highest risk of death by homicide. The results displayed here show, in recent years, high rates

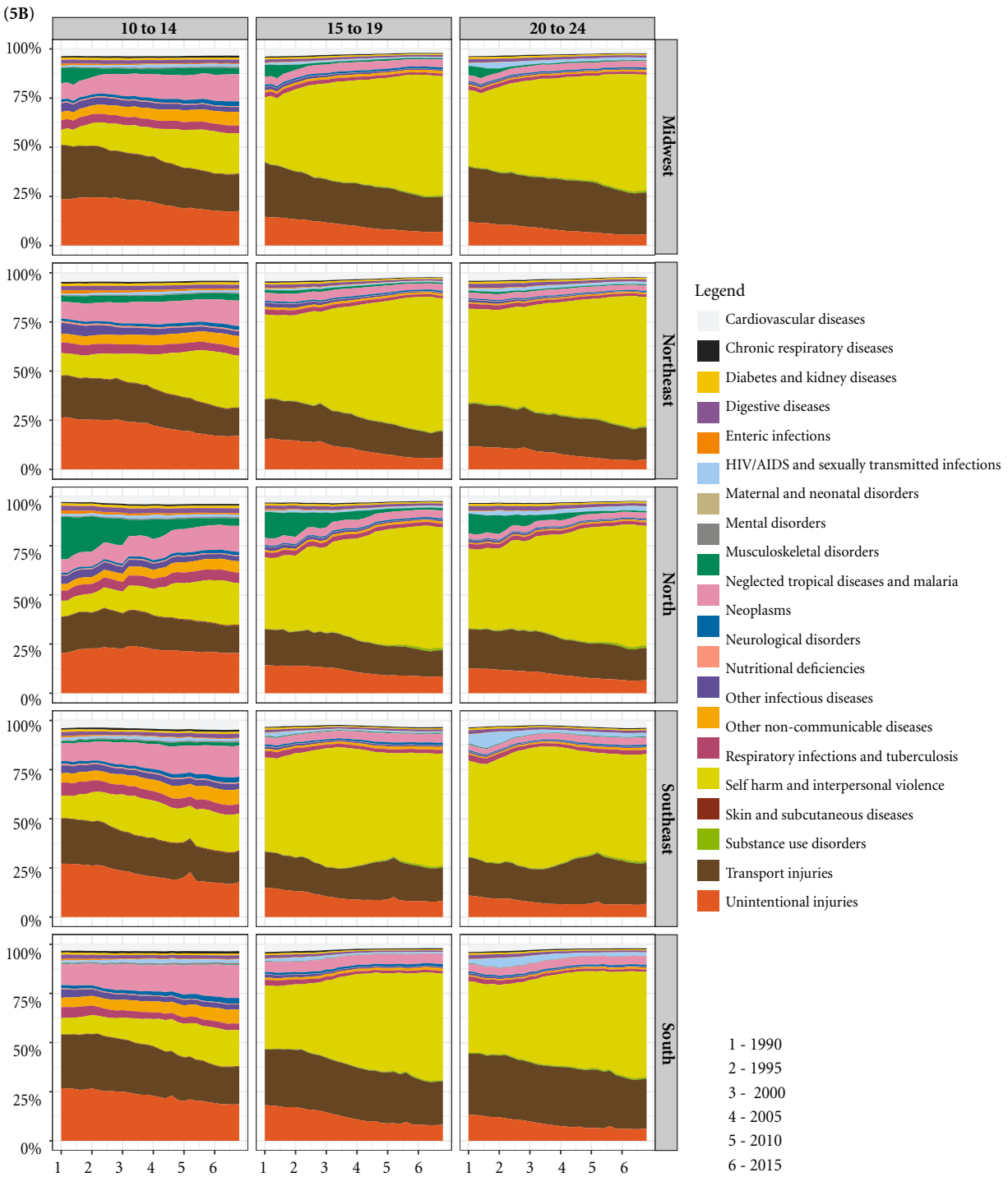


Figure 5. Proportionate mortality due to main causes of death, according to sex (5A female and 5B male), region and age groups 10 to 14, 15 to 19, and 20 to 24 years, 2019.

Source: Data GBD 2019. Author's elaboration.

of homicide in the North and Northeast regions, as well as a significant reduction in the Southeast, especially in São Paulo and Rio de Janeiro. The role of organized crime groups that migrated

(6A)

1990		
Rank	Rate	Cause of death
1	9.62	Road injuries
2	5.6	Interpersonal violence
3	4.76	Maternal disorders
4	3.09	Lower respiratory infections
5	2.39	Drowning
6	2.34	Self-harm
7	2.02	Stroke
8	1.63	Leukemia
9	1.54	Malaria
10	1.49	Congenital birth defects
11	1.23	Other malignant neoplasms
12	1.19	Meningitis
13	1.16	HIV/AIDS
14	1.06	Chronic kidney disease
15	1.02	Rheumatic heart disease
18	0.92	Diabetes mellitus
20	0.83	Other musculoskeletal disorders
21	0.78	Brain and central nervous system cancer

2019		
Rank	Rate	Cause of death
1	6.18	Road injuries
2	6.03	Interpersonal violence
3	2.32	Maternal disorders
4	2.03	Self-harm
5	1.72	Lower respiratory infections
6	1.38	Leukemia
7	1.28	HIV/AIDS
8	1.2	Other malignant neoplasms
9	1.1	Congenital birth defects
10	1.04	Stroke
11	0.92	Brain and central nervous system cancer
12	0.89	Other musculoskeletal disorders
13	0.87	Drowning
14	0.6	Chronic kidney disease
15	0.59	Diabetes mellitus
24	0.37	Meningitis
30	0.23	Rheumatic heart disease
64	0.06	Malaria

(6B)

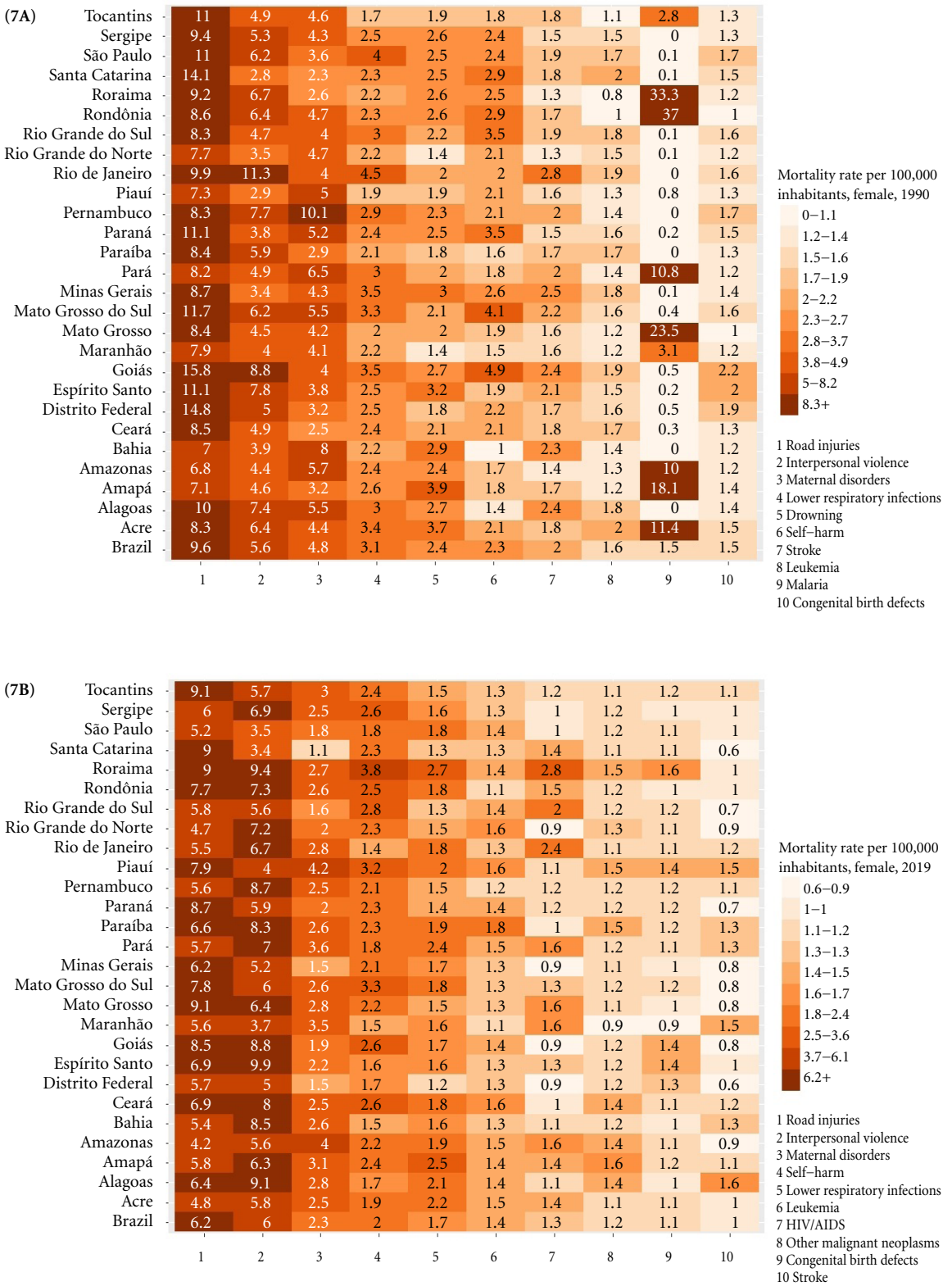
1990		
Rank	Rate	Cause of death
1	58.04	Interpersonal violence
2	34.01	Road injuries
3	13.07	Drowning
4	6.72	Self-harm
5	4.53	Other unintentional injuries
6	4.32	Lower respiratory infections
7	3.3	HIV/AIDS
8	3.28	Falls
9	2.24	Leukemia
10	2.13	Stroke
11	2.06	Exposure to mechanical forces
12	1.95	Malaria
13	1.77	Other transport injuries
14	1.74	Meningitis
15	1.73	Cirrhosis and other chronic liver diseases
16	1.68	Other malignant neoplasms
17	1.5	Congenital birth defects
19	1.12	Ischemic heart disease
22	0.89	Brain and central nervous system cancer
77	0.05	Executions and police conflict

2019		
Rank	Rate	Cause of death
1	78.94	Interpersonal violence
2	26.65	Road injuries
3	6.58	Self-harm
4	5.38	Drowning
5	2.43	Lower respiratory infections
6	2.22	Executions and police conflict
7	1.88	Leukemia
8	1.83	Exposure to mechanical forces
9	1.8	HIV/AIDS
10	1.72	Other malignant neoplasms
11	1.71	Other unintentional injuries
12	1.51	Falls
13	1.24	Brain and central nervous system cancer
14	1.22	Ischemic heart disease
15	1.2	Congenital birth defects
16	1.19	Stroke
17	0.97	Other transport injuries
21	0.7	Cirrhosis and other chronic liver diseases
26	0.57	Meningitis
73	0.06	Malaria

Figure 6. Ranking of the 15 main causes of death, according to mortality rates for each 100,000 inhabitants in the age group of 10 to 24 years by sex (6A female, 6B male), Brazil, 1990 and 2019.

Source: Data GBD 2019. Author's elaboration.

from the Southeast to border regions is relevant, associated with drug trafficking and creating areas of armed conflict, disputes within prisons, and promoting wars between organized crime groups, increasing the risk of deaths in those regions[23].



it continues

Figure 7. Ranking of mortality rates for individuals of 10 and 24 years of age, according to state and sex, in 1990 (7A female and 7C male) and 2019 (7B female e 7D male).

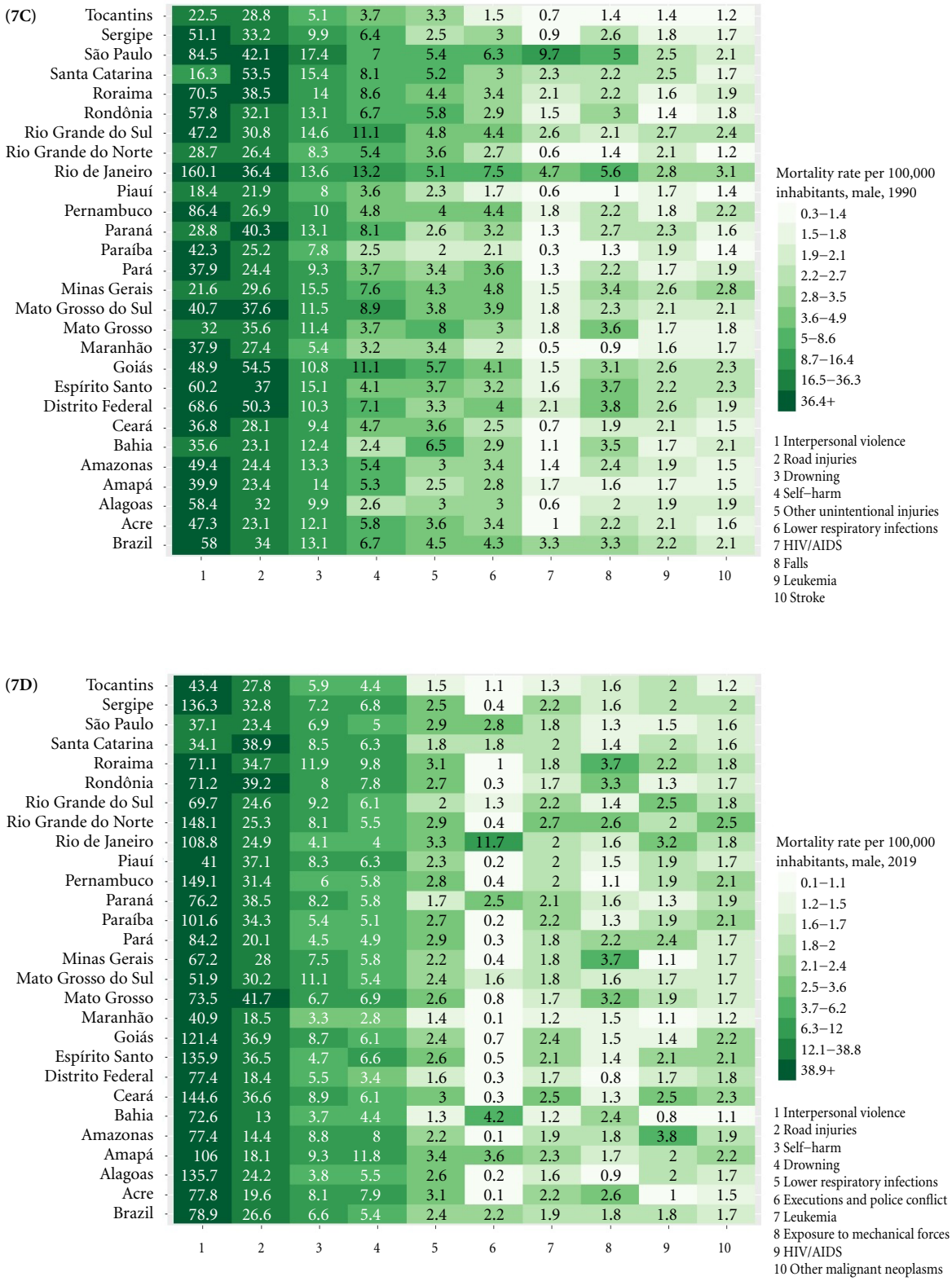


Figure 7. Ranking of mortality rates for individuals of 10 and 24 years of age, according to state and sex, in 1990 (7A female and 7C male) and 2019 (7B female e 7D male).

Source: Data GBD 2019. Author's elaboration.

This study also indicates the seriousness of the problem of murders of men, 10 to 24 years of age, by the police, when comparing the rates for 1990 and 2019. Data from the Forum of Public Safety point to the fact that the official numbers are under-reported[23] and that most of the murders by police occur among the poor, young black men, from poor outlying urban areas, a result of structural racism[24].

Deaths by violence in Brazil are associated with structural inequalities, a lack of efficient and effective social policies for young people, unemployment, conflict in areas of agricultural borders, land disputes, and inadequate public safety policies[25,26]. Teenager and young adult homicides are heavily linked to school dropout rates, previous criminal records, drug trafficking and abuse, alcohol abuse, and domestic violence[27].

Gender inequalities stand out concerning violence. The mortality rates for young men are up to four times higher than those for young women, which is also true for global studies[4]. The difference in the number of violent deaths according to sex, mentioned in previous studies, points to cultural aspects that encourage aggressive behavior in men since childhood, involvement with drugs, weapons, organized crime, and a higher likelihood of risky behavior[26]. However, in Brazil, the rates of violence against girls and women are higher than in most countries. One UN report indicates that Brazil is in 5th place in female murders related to sexual violence and chauvinism[27]. Studies emphasize that murdered women are usually young, black, single, with little education, and low income[28], although female murders occur in all social classes.

Traffic injuries result in approximately 1.35 million deaths around the world and are the main cause of death of people of 5 to 29 years of age worldwide[29]. The current study indicates high rates of mortality caused by traffic injuries in the majority of states, being the second or third main cause of death, which suggests the need to implement policies to prevent deaths related to traffic injuries. In Brazil, fast economic growth and access to purchasing motorcycles has caused a great increase in mortality rates for the studied age groups. The higher risk of death is related to not wearing helmets, poor law enforcement, poor safety, and problems in the transport infrastructure[30]. The disparities in mortality due to traffic injuries among states are significant, with the rates higher in the Midwest and the Northeast, which indicates a lower government intervention ability in these regions[31] and low investment in prevention[32].

The present study points to suicide as an increasingly important cause of death among young people. It has risen to a higher position in the ranking and reached 3rd place among males and 4th among females. Worldwide data shows that self-inflicted lesions are becoming more frequent and are one of the main causes of death in Europe and Asia[4]. Several factors can account for this increase, such as mental illnesses, substance abuse, lack of perspective for the future, unemployment, violence, social or geographic isolation, difficulty in access to clinical care[33], physical and sexual abuse, and difficulties with sexual orientation[34,35]. Among the measures indicated to reduce suicide, we can highlight the importance of providing more access to mental health services, family support, reduction of inequalities, as well as the restriction of access to firearms, and lethal chemical products[10,36].

Maternal causes are an important cause of death worldwide, and added to causes of death due to communicable diseases, they represent one third of the deaths of adolescents and young adults (ages 10 to 24 years of age)[4]. The study points out to the fact that, although the rates have declined, maternal causes have remained in 3rd place as a cause of female death, which shows a lack of access to contraceptive methods and health services[37]. The regional differences in numbers of maternal deaths are expressive, the highest rates can be found in the Northeast. Overcoming inequalities in the access to health service and overcoming inequalities in the social conditions of young women, are fundamental needs to improve the health of adolescents and mothers.

Another important cause of death is HIV/AIDS, and an increase in rates caused by this disease has been observed among females. Currently, it is the 7th most important cause of death among women, and the 9th among men. In 2019, states, such as Rondônia and Rio de Janeiro, showed high rates among women (4th place). This must be investigated in terms of vertical transmission (from mother to son), as well as for transmission connected to prostitution and drug use among adolescents and young adults[38]. Analysis of data from SINAN shows a reduction in mortality and an overall reduction in rates among the general population, except for the age group of 10 to 29 years of age[38]. The higher incidence in that age group suggests failure in prevention measures, which can compromise an entire generation. Among omissions and failures, what stands out is the reduction of investments in communication and prevention campaigns, reduction in distribu-

tion of condoms, and others[37]. Data from PENSE, from 2009 to 2015, reveal a reduction in the use of condoms by 13 to 15-year-old teenagers, as well as a reduction in sex education and health in schools and less access to condoms[37,39]. That indicates a deficiency in the conduction of programs for health promotion and an increase in conservative and religious attitudes within society[39].

One can highlight progress in terms of tropical diseases, such as malaria in the North and other neglected infectious diseases in the Northeast and Midwest, a victory achieved by the efforts of the Brazilian Unified Health System (SUS) and by science in providing vaccines, treatment, supervision, and control actions[40].

Data also indicates a growth in NCDs, such as cardiovascular diseases, cancer (including leukemia), among other diseases, which reflects the effects of changes in lifestyle, consumption of processed foods, lack of physical activity, pollution, radiation[41], as well as the effects of genetic heritage and aging of the population.

Data from the GBD 2019 study has limitations related to the production of estimates of mortality and related to the sources of data used in the study. In the case of Brazil, the data source for the GBD 2019 is the SIM. Although it has been improved in terms of obtaining records and has improved in quality in recent years, it still has not included deaths in some states, and it has incomplete records and a high proportion of garbage codes. The analysis of the global burden of adolescent mortality uses modeled data, and the estimates shown here should be considered within this context.

Reducing adolescent mortality requires facing the cultural, social, and economic inequalities, and investments in education, employment, and social inclusion[7,12,42]. Although the Child and Adolescent Statute (ECA, in Portuguese) recognizes that adolescents have rights, it has been 30 years since its creation, and Brazil still fails to protect this segment of the population. Adolescents and young adults still do not benefit from the accelerated reduction of mortality that has happened for younger children[8].

The 2030 Agenda is a warning for the country. Brazil needs to prioritize public policies to expand the rights of children and adolescents and those can guarantee conditions for their development[23], investing in equality and in the eradication of extreme poverty, hunger, and racism; offering quality education and health, and promoting a peaceful and inclusive society. These are commitments for the present and the future, aimed at reducing the differences between the rich and the poor, as well as the mortality rates in this age group, especially deaths from external causes[43].

Conclusion

This study revealed profound inequalities in the mortality of adolescents and young adults according to sex, causes, regions and Brazilian states. The improvements in young people´s health have been slow, and there are still great challenges to be achieved in order to reduce violence, improve unsafe environments, reduce maternal mortality, and diminish failures in contraception programs. Although there has been an increasing recognition of the importance of adolescent and young adult health for future economic growth and development, when this study points to the causes of mortality, it points as well to the health risks in this age segment. There is a need to develop approaches to deal with the growing inequalities in this age group.

In the political arena, agendas such as the reduction of the age of criminal responsibility, and the relaxation in the Disarmament Statute, have been gaining ground. These measures, if approved, can affect even more the future of Brazilian youth, which need, on the contrary, protective measures and more initiatives aimed at promoting a culture of non-violence and peace. Social inclusion, the promotion of quality education, and access to employment are the right approaches to be taken, according to those who work with this age group and who are concerned about the future of Brazil.

Collaborations

DC Malta and MCS Minayo conceived the study and produced the preliminary version. GAV performed the data extraction. All authors performed the data interpretation and critical revision, contributed to the final version of the article, and approved it.

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