Homicide: mortality and years of potential life lost

Homicídios: mortalidade e anos potenciais de vida perdidos

Homicidios: mortalidad y años potenciales de vida perdidos

Estefani Wu Chen[1] https://orcid.org/0000-0002-4122-4663
Ludmila Mourão Xavier Gomes[1] https://orcid.org/0000-0001-6442-5719
Thiago Luis de Andrade Barbosa[1] https://orcid.org/0000-0002-6985-9548

How to cite:
Chen EW, Gomes LM, Barbosa TL. Homicide: mortality and years of potential life lost. Acta Paul Enferm. 2022;35:eAPE01116.

DOI
http://dx.doi.org/10.37689/acta-ape/2022AO0111666

Keywords
Homicide; Mortality; Potential years of life lost; Mortality registries

Descritores
Homicídio; Mortalidade; Anos potenciais de vida perdidos; Registros de mortalidade

Descriptores
Homicidio; Mortalidad; Años potenciales de vida perdidos; Registros de mortalidad

Submitted
May 4, 2021

Accepted
December 7, 2021

Corresponding author
Ludmila Mourão Xavier Gomes
E-mail: ludyxavier@yahoo.com.br

Associate Editor (Peer review process):
Paula Hino
(https://orcid.org/0000-0002-1408-196X)
Escola Paulista de Enfermagem, Universidade Federal de São Paulo, SP, Brazil

Abstract

Objective: To investigate the trend of homicides and estimate the years of potential life lost due to this cause in southern Brazil.

Methods: This is a time series study for homicide constructed from the Mortality Information System. Years of potential life lost were estimated according to age group, sex and cause of death, and mortality rates were calculated. Trend analysis was verified by Prais-Winsten regression with calculation of annual percentage change.

Results: The South had a 14.5% increase in homicide mortality rates in the historical series, with emphasis on young adults (20 to 29 years) and the male population as the main victims of homicides and with greater years of potential life lost. The highest homicide rates were recorded in Paraná, with a stationary trend (APC= 0.10%; 95%CI= -1.23; 1.65; p= 0.875). In Rio Grande do Sul, there was a growing trend with an increase of 25.0% (APC=0.90%CI95%=0.49; 1.32; p<0.001). In Santa Catarina, there was a growing trend with an increase of 20.8% (APC= 0.70%; 95%CI= 0.09; 1.32, p<0.001). Regarding sex, there was a higher prevalence of males in Rio Grande do Sul with 27.7% (APC= 0.90%; 95%CI= 0.49; 1.32, p<0.001) and females in Santa Catarina with 17.4% (APC=0.70%; 95%CI=0.50; 0.91, p<0.001).

Conclusion: The trend was towards an increase in homicides in the southern states, with a predominance of homicides among young adults and the greater loss of years of life among males represents important socioeconomic issues for a preventable cause.

Resumo

Objetivo: Investigar a tendência dos homicídios e estimar os anos potenciais de vida perdidos por essa causa na região sul do Brasil.

Métodos: Estudo de série temporal por homicídio construído a partir do Sistema de Informação sobre Mortalidade. Estimados os anos potenciais de vida perdidos segundo faixa etária, sexo e causa de óbito e calculadas as taxas de mortalidade. A análise de tendência foi verificada pela regressão de Prais-Winsten com cálculo da variação percentual anual.

Resultados: A região sul teve um incremento de 14,5% nas taxas de mortalidade por homicídio na série histórica com destaque para adultos jovens (20 a 29 anos) e população masculina como principais vítimas dos homicídios e com maiores anos potenciais de vida perdidos. As maiores taxas de homicídio foram registradas no Paraná, com tendência estacionária (APC= 0,10%; IC95%= -1,23; 1,65; p= 0,875). No Rio Grande do Sul houve tendência crescente com aumento de 25,0% (APC= 0,90% IC95%=0,49; 1,32; p<0,001); Santa Catarina com tendência crescente com aumento de 20,8% (APC= 0,70%; IC95%= 0,09; 1,32, p<0,001).

[1]Instituto Latino-Americano de Ciências da Vida e da Natureza, Universidade Federal de Integração Latino-Americana, Foz do Iguaçu, PR, Brazil.
Conflicts of interest: nothing to declare.

Em relação ao sexo, houve maior prevalência do masculino no Rio Grande do Sul com 27,7% (APC= 0,90%; IC95%= 0,49; 1,32, p<0,001) e do feminino em Santa Catarina com 17,4% (APC= 0,70% IC95%= 0,50; 0,91, p<0,001).

Conclusão: A tendência foi de incremento dos homicídios nos estados da região sul com predominância de homicídio entre adultos jovens e a maior perda de anos de vida entre indivíduos do sexo masculino representa questões socioeconômicas importantes para uma causa prevenível.

Resumen

Objetivo: Investigar la tendencia de los homicidios y estimar los años potenciales de vida perdidos por esta causa en la región sur de Brasil.

Métodos: Estudio de serie temporal por homicidio construido a partir del Sistema de Información sobre Mortalidad. Se estimaron los años potenciales de vida perdidos según grupo de edad, sexo y causa de fallecimiento y se calcularon las tasas de mortalidad. El análisis de tendencia fue verificado por la regresión de Prais-Winsten con cálculo de la variación porcentual anual.

Resultados: La región sur tuvo un incremento del 14,5 % en las tasas de mortalidad por homicidio en la serie histórica con énfasis en adultos jóvenes (20 a 29 años) y población masculina como principales víctimas de los homicidios y con mayores años potenciales de vida perdidos. Las mayores tasas de homicidio fueron registradas en Paraná, con tendencia estacionaria (APC= 0,10 %; IC95 %= -1,23; 1,65; p= 0,875). En Rio Grande do Sul hubo tendencia creciente con aumento del 25,0 % (APC= 0,90 % IC95 %=0,49; 1,32; p<0,001); Santa Catarina con tendencia creciente con aumento del 20,8 % (APC= 0,70 %; IC95 %= 0,09; 1,32, p<0,001). Con relación al sexo, hubo mayor prevalencia del masculino en Rio Grande do Sul con el 27,7 % (APC= 0,90 %; IC95 %= 0,49; 1,32, p<0,001) y del femenino en Santa Catarina con el 17,4 % (APC= 0,70 % IC95 %= 0,50; 0,91, p<0,001).

Conclusión: La tendencia fue de incremento de los homicidios en los estados de la región sur con predominancia de homicidio entre adultos jóvenes, y la mayor pérdida de años de vida entre individuos de sexo masculino representa cuestiones socioeconómicas importantes para una causa prevenible.

Introduction

Homicide is a global phenomenon with geographical differences of great importance in individuals' mortality and life expectancy. It has significant implications for society and public health, resulting in emotional, social and economic losses. In addition to its lethality, it has repercussions on epidemiological data due to the complex issues that surround it that are broad and difficult to change in the short term.[1,2]

In 2016, more than 560,000 people were violently murdered, approximately 385,000 of these deaths were intentional homicides, which still makes this phenomenon a major worldwide concern.[3]

Given the recent context, in 2015, the homicide rate in Latin America and the Caribbean was five times higher than the global average.[4] Brazil is in 26th place in the countries with the highest homicide mortality rates in the world.[4,5] Studies have shown a reduction in homicide deaths in most macroregions in Brazil, however, regardless of this fall, the country remains among the highest mortality rates in the world and has experienced the phenomenon of homicide interiorization.[1,4,6,7]

Homicide is also one of the main causes of early death in the world, with the young population being the main victim. More than half of homicides occur in the age group of 15 to 29 years and constitutes the main cause of loss of years of life in this age group.[7-9]

Despite efforts with public anti-violence policies in recent years, homicides continue to top the list of causes of death in southern Brazil.[10] Considering this situation, in addition to assessing the impact of homicide mortality on society through rates, years of potential life lost (YPLL) reveal that it is an important way to verify the impacts caused by this disease. This indicator consists of quantifying the number of years of life lost when death occurs before the expected number of years of survival. Moreover, there are no studies addressing the influence of YPLL generated by homicides in southern Brazil. In this sense, this investigation can contribute to the formulation of public health and public safety policies in order to prevent its occurrence. The aim of this study was to investigate the trend of homicides and estimate the YPLL for this cause in southern Brazil.

Methods

This is a descriptive study of time series (1996 to 2019) on mortality and YPLL for homicides in the states of Paraná, Santa Catarina and Rio Grande do Sul. The study was elaborated from data made available in the Mortality Information System (SIM - *Sistema de Informação sobre Mortalidade*) of the Ministry of Health (MoH).

Data were collected from the Department of Informatics of the Unified Health System

(DATASUS - *Departamento de Informática do Sistema Único de Saúde*). The International Classification of Diseases, Tenth Revision (ICD-10) was based to record deaths from assaults (X-85 to Y-09). Demographic data were obtained from census data and population estimates from the Brazilian Institute of Geography and Statistics (IBGE - *Instituto Brasileiro de Geografia e Estatística*). Cases with ignored information were not included in the data description.

Deaths from homicides were analyzed according to variables such as age (years), sex (male/female), and means used to carry out the assault. In this variable, homicides were grouped as follows: X93 to X95 assault by handgun discharge, X99 assault by sharp object, Y00 assault by blunt object and the others grouped in other means of assault.

Mortality rates were calculated by the ratio of the number of deaths that occurred in the year, considering the population at risk in the same period per 100,000 inhabitants. Standardization by the direct method by age was used for the purpose of comparing rates throughout the historical series. In this method of adjustment, a standard population is used in order to rule out the possibility of results found to be different from those existing in the population's age distribution. It is used to compare two or more populations with differences in age structures or the same population in different periods. To carry out this method, a standard reference population was defined for the other years of the time series.[11] The standard population considered was that of the last IBGE demographic census that took place in 2010.

The YPLL calculation was applied in this study, using the adaptation of the formula proposed by Romeder and McWhinnie.[12] For this purpose, deaths in individuals younger than one year and older than 70 years were excluded, followed by the calculation of the midpoint of the age groups. Thus, we subtracted from 70 years proposed age in the original method the midpoint of each age group and multiplied it by the number of deaths in each age group. The totals obtained in each age group were summed, obtaining the total YPLL in each state and in the analyzed region. Deaths as a result of homicides that occurred before 70 years of age define their precocity.[12] YPLL was calculated according to sex, age group and cause of death.

Considering the exclusion of deaths from homicides of children under one year and over 69 years of age, YPLL homicides were analyzed by sex and age group (01 to 09 years old, 10 to 19 years old, 20 to 29 years old, 30 to 39 years old, 40 to 49 years old, 50 to 59 years old and 60 to 69 years old), among the southern states.

Homicide mortality rates were analyzed by sex and state/region. Trend analysis was performed using the Prais-Winsten generalized linear analysis model.[13] Standardized homicide mortality rates were used as dependent variables (Y - dependent), while sequential years were used as independent variables (X - independent). The model adopted is indicated to correct the serial autocorrelation in time series. The verification of the existence of autocorrelation of the series was determined by the Durbin-Watson test, whose interpretation is established on a measurement scale ranging from 0 to 4. When the test value is close to zero, there is an indication of the existence of a maximum positive autocorrelation, while if the value is close to 4, the serial autocorrelation is negative, and when the test value is close to 2, there is no serial autocorrelation.[14]

To apply the chosen regression model, the method suggested by Antunes and Cardoso was used.[15] First, the logarithmic transformation of Y values was performed, followed by the application of the Prais-Winsten autoregressive model, in order to estimate the b1 values of standardized mortality rates, according to sex and total. Subsequently, the Annual Percent Change (APC) was identified from the values of b1 corresponding to each of the rates using the following formula:

$$APC = [-1+10^{b1}]*100\%$$

In the final stage of the modeling, the confidence intervals (CI) of the measurements of study b1 and of the APC were calculated, by applying the following formulas:

$$95\%_{CI} = [-1+10^{b1\ minimum}]*100\%; [-1+10^{b1\ maximum}]*100\%$$

The values of minimum b1 and maximum b1 are identified in the CI generated by the statistical analysis program and are applied in the formula. The minimum b1 value corresponding to the minimum point of the CI and the maximum b1 value corresponding to the maximum point of the CI.

Microsoft Excel 2019 was used to build indicators, standardize and prepare tables. To analyze the trend in homicide mortality, the statistician Bioestat 5.0 from the *Universidade Federal do Pará* (UFPA) and Tabwin for Windows from DATASUS were used. In this study, a significance level of 5% was adopted.

As this was a study with secondary data without identification of participants, there was no need for submission to the Institutional Review Board. The Resolution 466 of December 12, 2012 of the Brazilian National Health Council (CNS - *Conselho Nacional de Saúde*) was respected.

Results

In the analyzed period, 4,141,193 deaths were recorded in the South, of which 468,206 were due to external causes, representing 10.6% of the total. Of this amount, 262,634 were caused by homicides, which represented 5.9% of all deaths in the South and 56.1% of all deaths from external causes. The distribution of homicide deaths in the southern states was: 47.9% in Paraná, 39.6% in Rio Grande do Sul and 12.5% in Santa Catarina.

Tables 1 and 2 present the evolution of mortality rates and analysis of the trend of homicides from 1996 to 2019 in southern states. During the historical series, the highest homicide rates were recorded in Paraná, presenting the highest means of the analyzed period, as well as the highest average ratio of homicides between men and women of 10.4, a value higher than the South with 9.6. In the first half of the period (1996 to 2007), this state had the highest growth rates (male=90.9%; female=27.3%; total=73.6%) and the largest reductions (male= -48.3% female= -34.1% total= -45.7%) in the other half of the series (2008 to 2019). The South showed similar behavior in both periods, with the exception of female homicide rates, which decreased from 1996 to 2007.

When comparing the last year in relation to the first of the historical series, it is verified that only the states of Rio Grande do Sul and Santa Catarina showed a significant upward trend. In the first state, the increase was 25.0% in the period (APC= 0.90%; 95%CI=0.49; 1,32; p<0.001) while the second was 20.8% (APC= 0.70%; 95%CI= 0.09; 1.32, p<0.001), both higher than the increase presented by the southern region of 14.5% (APC= 0.50%; 95%CI= -0.11; 1.12;), but not significant (p= 0.079). Although the state of Paraná has the highest homicide mortality rates (APC= 0.10%; 95%CI=-1.23; 1,65; p=0.875), a stationary trend was found. Regarding male sex, there was a higher increase in Rio Grande do Sul with 27.7% (APC= 0.90%; 95%CI= 0.49; 1.32, p<0.001), while female sex was higher in Santa Catarina with an increase of 17.4% (APC= 0.70%; 95%CI= 0.50; 0.91, p<0.001).

There was a predominance of years lost in the age group from 20 to 29 years in both sexes when comparing the first and last year of the historical series (Table 3). Among men, this age group counted more than 40.0% of the total YPLL, and in women this percentage reached 35.0%. Also in this analysis, the percentage variation of YPLL, in relation to the male public, Santa Catarina stood out with an increase of 200% of YPLL among individuals aged 60 to 69 and a reduction of 75.0% among children aged 1 to 9 years. In the female public, the same behavior of YPLL elevation was observed in older adults, with emphasis on Paraná with 700.0% and YPLL retraction in the younger public (01 to 19 years) in Rio Grande do Sul with 50.0% in individuals from 01 to 09 years old. In relation to the total for each state, there was a greater increase for older adults with 216.7% and a reduction for children with 42.5%, both in Santa Catarina. In the South, the behavior was similar to the age groups with the highest YPLL

Table 1. Mortality rates from homicides (per 100,000 inhab.)

Year	Paraná				Santa Catarina				Rio Grande do Sul				South region			
	Total	M	F	M/F	Total	M	F	M/F	Total	M	F	M/F	Total	M	F	M/F
1996	16.5	29.6	3.6	8.3	9.1	15.4	2.9	5.3	16.7	29.5	4.2	7.0	15.1	26.6	3.7	7.2
1997	18.2	34.1	3.6	9.4	9.2	16.4	2.1	7.9	18.2	32.8	4.0	8.3	16.5	29.9	3.4	8.7
1998	17.9	33.3	4.0	8.4	9.0	15.3	2.8	5.5	16.6	29.8	3.7	8.0	15.7	28.1	3.6	7.8
1999	18.9	35.3	4.1	8.7	8.1	14.2	2.1	6.8	16.4	30.0	3.3	9.1	15.9	28.7	3.3	8.6
2000	18.6	35.7	3.4	10.4	8.6	15.3	2.0	7.6	17.5	31.9	3.5	9.2	16.3	29.8	3.1	9.5
2001	21.2	40.3	4.1	9.7	9.4	16.4	2.3	7.0	19.3	35.5	3.5	10.0	18.2	33.3	3.5	9.4
2002	22.8	44.3	4.0	11.0	11.4	20.1	2.8	7.1	19.7	36.0	3.9	9.3	19.5	35.8	3.7	9.7
2003	25.6	49.5	4.7	10.6	12.9	23.3	2.5	9.3	19.3	35.9	3.3	11.0	20.8	38.4	3.6	10.6
2004	27.7	53.7	5.0	10.7	12.0	21.1	3.0	7.2	19.9	36.5	3.8	9.6	21.7	39.8	4.1	9.7
2005	28.4	56.0	4.6	12.1	11.7	20.8	2.6	8.1	19.9	36.4	3.8	9.5	22.0	40.5	3.9	10.5
2006	29.5	57.8	4.9	11.8	12.0	21.0	3.2	6.7	19.4	36.3	3.0	12.2	22.2	41.2	3.8	10.9
2007	28.6	56.6	4.5	12.4	11.0	19.7	2.3	8.6	20.7	38.2	3.5	11.0	22.2	41.2	3.6	11.4
2008	31.5	61.5	5.7	10.9	13.8	24.8	2.9	8.5	22.9	42.0	4.1	10.1	25.0	45.8	4.5	10.3
2009	33.4	64.6	6.2	10.4	14.1	25.0	3.2	7.8	21.4	38.8	4.2	9.2	25.1	45.7	4.8	9.6
2010	33.5	64.6	6.4	10.0	13.7	23.9	3.5	6.8	20.1	36.5	4.2	8.7	24.4	44.3	4.9	9.0
2011	30.6	59.7	5.3	11.3	13.3	24.2	2.5	9.9	20.1	36.8	3.8	9.6	23.1	42.6	4.1	10.5
2012	31.7	61.4	6.2	10.0	13.2	23.0	3.3	7.0	23.1	42.0	4.7	8.9	24.7	44.9	4.9	9.1
2013	26.4	51.0	5.1	10.0	12.2	21.3	3.1	6.9	22.1	40.8	3.8	10.8	21.9	40.1	4.1	9.7
2014	26.9	51.6	5.3	9.8	13.3	23.2	3.3	7.1	26.2	48.3	4.6	10.6	23.9	43.6	4.5	9.6
2015	25.8	50.1	4.5	11.1	14.3	25.5	2.9	8.7	28.1	51.6	5.0	10.2	24.5	44.9	4.3	10.3
2016	27.0	53.0	4.3	12.4	14.9	26.5	3.3	8.1	30.9	56.6	5.7	10.0	26.1	48.0	4.6	10.5
2017	24.0	46.1	4.5	10.2	16.0	28.6	3.3	8.6	31.7	58.3	5.6	10.4	25.5	46.5	4.6	10.0
2018	20.8	39.7	3.8	10.5	12.1	21.3	2.8	7.7	25.7	47.1	4.8	9.9	20.9	38.1	3.9	9.7
2019	17.1	31.8	3.7	8.5	11.0	18.6	3.4	5.5	20.8	37.6	4.3	8.8	17.2	30.8	3.8	8.0

M - Male; F - Female; M/F - Male:Female ratio

Table 2. Analysis of homicide mortality trends (total and by sex)

State/Region	b1	95%CI		APC%	95%CI		Δ%1996/2007	Δ%2008/2019	Δ%1996/2019	Mean	R^2	p-value	Trend
		Low. lim	Up. lim		Low. lim	Up. lim							
Paraná													
Male	0.002	-0.012	0.016	0.20	-1.23	1.65	90.9	-48.3	7.2	48.4	0.002	0.826	Stationary
Female	0.003	-0.005	0.011	0.30	-0.52	1.13	27.3	-34.1	4.3	3.6	0.018	0.544	Stationary
Total	0.001	-0.013	0.015	0.10	-1.33	1.55	73.6	-45.7	3.8	25.1	0.001	0.875	Stationary
Santa Catarina													
Male	0.005	0.002	0.014	0.80	0.19	1.43	27.7	-24.9	20.8	21.0	0.257	0.013	Upward
Female	0.008	0.005	0.009	0.70	0.50	0.91	-20.4	16.5	17.4	2.8	0.566	<0.001	Upward
Total	0.007	0.001	0.013	0.70	0.09	1.32	19.9	-20.2	20.8	11.9	0.284	0.009	Upward
Rio Grande do Sul													
Male	0.009	0.005	0.013	0.90	0.49	1.32	29.6	-10.4	27.7	39.4	0.493	<0.001	Upward
Female	0.006	0.002	0.010	0.60	0.19	1.02	-18.0	3.0	0.8	4.1	0.247	0.016	Upward
Total	0.009	0.005	0.013	0.90	0.49	1.32	24.0	-9.1	25.0	21.5	0.487	<0.001	Upward
South region													
Male	0.006	0.000	0.012	0.60	-0.01	1.22	54.6	-32.8	15.5	38.7	0.133	0.087	Stationary
Female	0.007	0.005	0.009	0.70	0.50	0.91	-2.5	-13.8	3.2	4.0	0.579	<0.001	Upward
Total	0.005	-0.001	0.011	0.50	-0.11	1.12	47.7	-30.9	14.5	21.2	0.140	0.079	Stationary

b1- slope; APC - Annual Percent Change; 95%CI - 95% confidence interval, Low. limit= lower limit; Up. limit = upper limit

and also in relation to the percentage increase and reduction of YPLL.

Regarding the means used to perpetrate homicide (Table 4), there was higher YPLL in deaths caused by the use of handgun discharges in all states comparing the two years of the historical series. This cause represented more than half of the total years lost by homicides, especially in Santa Catarina, with an increase of 81.8%. There is an increase in YPLL caused by blunt object in the South and in most states, especially Rio Grande do Sul with 271.5%. In turn, assaults through unspecified means reduced 33.6% in the comparison made in the same state. In the global analysis of the causes of homicide, there was a higher percentage increase in Santa Catarina with 74.4%, a value higher than the states and the South.

Table 3. Percentage distribution and years of potential life lost by homicides, by sex and age group

Age group	Paraná					Santa Catarina					Rio Grande do Sul					South region				
	1996		2019		YPLL Δ% 2019/1996	1996		2019		YPLL Δ% 2019/1996	1996		2019		YPLL Δ% 2019/1996	1996		2019		YPLL Δ% 2019/1996
	YPLL	%	YPLL	%		YPLL	%	YPLL	%		YPLL	%	YPLL	%		YPLL	%	YPLL	%	
Male																				
01 to 09 years	193.5	0.4	258	0.4	33.3	258	2.1	64.5	0.3	-75.0	451.5	1.0	387	0.6	-14.3	903	0.9	709.5	0.5	-21.4
10 to 19 years	8580	19.2	8745	14.6	1.9	2200	18.1	4015	18.6	82.5	9185	19.6	14520	20.8	58.1	19965	19.3	27280	18.0	36.6
20 to 29 years	20295	45.3	26730	44.7	31.7	5175	42.6	8640	39.9	67.0	19440	41.6	29340	42.1	50.9	44910	43.3	64710	42.8	44.1
30 to 39 years	10150	22.7	15750	26.3	55.2	2835	23.3	5320	24.6	87.7	11130	23.8	16135	23.1	45.0	24115	23.3	37205	24.6	54.3
40 to 49 years	4200	9.4	5900	9.9	40.5	1175	9.7	2650	12.2	125.5	4775	10.2	6700	9.6	40.3	10150	9.8	15250	10.1	50.2
50 to 59 years	1155	2.6	2175	3.6	88.3	450	3.7	780	3.6	73.3	1590	3.4	2340	3.4	47.2	3195	3.1	5295	3.5	65.7
60 to 69 years	200	0.4	270	0.5	35.0	55	0.5	165	0.8	200.0	185	0.4	330	0.5	78.4	440	0.4	765	0.5	73.9
Female																				
01 to 09 years	193.5	3.3	387	5.5	100.0	193.5	7.6	193.5	4.9	0.0	387	5.3	193.5	2.5	-50.0	774	4.9	774	4.2	0.0
10 to 19 years	1320	22.4	825	11.8	-37.5	770	30.3	825	20.9	7.1	1815	24.9	1485	19.3	-18.2	3905	24.8	3135	16.8	-19.7
20 to 29 years	2790	47.4	2520	36.1	-9.7	675	26.6	1530	38.7	126.7	2610	35.8	3015	39.1	15.5	6075	38.6	7065	37.9	16.3
30 to 39 years	875	14.9	1995	28.6	128.0	595	23.4	665	16.8	11.8	1435	19.7	1715	22.2	19.5	2905	18.5	4375	23.5	50.6
40 to 49 years	525	8.9	925	13.3	76.2	225	8.9	575	14.6	155.6	825	11.3	800	10.4	-3.0	1575	10.0	2300	12.3	46.0
50 to 59 years	180	3.1	285	4.1	58.3	75	3.0	135	3.4	80.0	195	2.7	450	5.8	130.8	450	2.9	870	4.7	93.3
60 to 69 years	5	0.1	40	0.6	700.0	5	0.2	25	0.6	400.0	25	0.3	55	0.7	120.0	35	0.2	120	0.6	242.9
Total																				
01 to 09 years	387	0.8	645	1.0	66.7	451.5	3.1	258	1.0	-42.9	838.5	1.6	580.5	0.7	-30.8	1677	1.4	1484	0.9	-11.5
10 to 19 years	9900	19.5	9570	14.3	-3.3	2970	20.2	4840	18.9	63.0	11000	20.4	16005	20.7	45.5	23870	20.0	30415	17.9	27.4
20 to 29 years	23085	45.6	29250	43.8	26.7	5850	39.8	10170	39.8	73.8	22050	40.8	32355	41.8	46.7	50985	42.7	71775	42.3	40.8
30 to 39 years	11025	21.8	17745	26.6	61.0	3430	23.4	5985	23.4	74.5	12565	23.2	17850	23.0	42.1	27020	22.6	41580	24.5	53.9
40 to 49 years	4725	9.3	6825	10.2	44.4	1400	9.5	3225	12.6	130.4	5600	10.4	7500	9.7	33.9	11725	9.8	17550	10.3	49.7
50 to 59 years	1335	2.6	2460	3.7	84.3	525	3.6	915	3.6	74.3	1785	3.3	2790	3.6	56.3	3645	3.1	6165	3.6	69.1
60 to 69 years	205	0.4	310	0.5	51.2	60	0.4	190	0.7	216.7	210	0.4	385	0.5	83.3	475	0.4	885	0.5	86.3

YPLL - years of potential life lost

Discussion

The present study presents limitations by the use of secondary data obtained from the SIM as the basis of analysis of each southern state. It is noteworthy that the indicators studied point to the collective reality – at the state and regional level – and do not reflect risk at the individual level. Homicide deaths may be underestimated based solely on SIM data, due to the existence of an undetermined category in the various variables analyzed in the study. Moreover, the exclusion of deaths of individuals under one year and older than 70 years in the calculation of YPLL may lead to underestimation of this indicator. However, the results shown in this study denote the behavior of mortality rates and YPLL for homicide in southern Brazil, corroborating a better understanding of the reality of deaths in the context of this region. The use of YPLL, with the aim of determining the potential for life lost in each death, helps in the process of determining a new criterion for the selection of priorities, assigning more weight to the deaths of younger people. The use of these epidemiological measures can significantly contribute significantly to monitoring the burden of death by homicide, in addition to assessing the effectiveness of reducing these deaths resulting from the introduction of previous preventive measures.

It is emphasized-that Paraná had a higher magnitude of homicide rates throughout the time series, registering the highest percentage increase in the first half and reduction in the second half of the period, in relation to sex and total. Although it has a stationary trend, this state has 90.0% of the most violent municipalities in southern Brazil, presenting greater risk for its location in the border region with other countries, and probably due to the greater availability of illegal drugs and handgun discharges present there.[8,12,16] Therefore, the magnitude of homicide in this state lies in the spread of violence in the state between regions and municipalities, and it can be highlighted Foz do Iguaçu as a municipality with high homicide rates in the state, marked by the presence of inequalities, drug

Table 4. Percentage distribution and years of potential life lost by homicides, according to the means used

Cause of death	Paraná				
	1996		2019		YPLL
	%	YPLL	%	YPLL	Δ%2019/1996
Handgun discharge	58.1	30744.5	63.3	44394	44.4
Blunt object	6.4	2754.5	5.3	3065	11.3
Sharp object	24.8	12035	21.4	13134.5	9.1
Other means	10.7	5128	10.1	6211.5	21.1
Total	100.0	50662	100.0	66805	31.9
Cause of death	**Santa Catarina**				
	1996		2019		YPLL
	%	YPLL	%	YPLL	Δ%2019/1996
Handgun discharge	53.6	8129	52.3	14779	81.8
Blunt object	6.6	879.5	10.5	2119.5	141.0
Sharp object	24.5	3510	25.3	6075	73.1
Other means	15.3	2168	11.9	2639.5	21.7
Total	100.0	14686.5	100.0	25613	74.4
Cause of death	**Rio Grande do Sul**				
	1996		2019		YPLL
	%	YPLL	%	YPLL	Δ%2019/1996
Handgun discharge	67.9	37633.5	75.4	60889.5	61.8
Blunt object	1.8	729.5	4.4	2710	271.5
Sharp object	17.9	9493	14.4	9754	2.7
Other means	12.4	6192.5	5.8	4112	-33.6
Total	100.0	54048.5	100.0	77465.5	43.3
Cause of death	**South region**				
	1996		2019		YPLL
	%	YPLL	%	YPLL	Δ%2019/1996
Handgun discharge	62.0	76507	67.1	120062.5	56.9
Blunt object	4.3	4363.5	5.6	7864.5	80.2
Sharp object	21.6	25038	18.9	28963.5	15.7
Other means	12.0	13488.5	8.4	12963	-3.9
Total	100.0	119397	100.0	169853.5	42.3

YPLL - years of potential life lost; YPLL Δ%2019/1996 - Percentage change of YPLL comparing the last year with the first year of the time series

trafficking, concentration and irregular distribution of income, large flow of people and other existing clandestine activities.

In this study, men were more vulnerable to homicides than women in all states and southern regions. The higher mortality in this public has been linked to masculinity and violence, present in Brazilian culture, in which since childhood and/or adolescence, greater freedom for boys is granted than girls. This fact ends up expanding the possibility of men being more aggressive with advancing age, making them potential perpetrators or victims of this violence.[7,16,17] It is also added that many studies[18-21] relate testosterone levels with the highest rates of violence which could be an explanation for the results of this study.

Regarding age distribution, there was a disproportionate impact of homicide on young people, a profile that was consistent with all national levels of income and Canada.[1,9,22-23] A large portion of YPLL for homicides occurred among young people aged 20 to 29 years, and this age group in which victimization for this cause presents its maximum expression, despite the educational shield reaching the maximum point of protection against the occurrence of homicides.[24]

On the world stage, approximately 95.0% of homicides occur in men and half of victims are under the age of 30.[1] Almost half of youth homicides occurred in Latin America and the Caribbean, which places Brazil among the 5 countries (Bolivian Republic of Venezuela, Honduras, Colombia, Salvador and Brazil) with the highest homicide rates among youths.[4] This pattern of greater male sex exposure is similar to other realities in the country. [6,10,18,25]

National studies on the profile of violence have shown, in recent years, that most regions and states have had an increase or maintenance in number and homicide rates. [5,7,10,26] In this study, it was possible to observe similar behavior associated with increased risk of loss of years of life due to this cause of death throughout the South. The premature loss of years of life associated with high mortality rates imply higher economic figures for the country in losses related to individuals' life expectancy.

A historical series investigation similar to this study, over the period from 2008 to 2018, showed stability in homicide rates in the South, while there was a decrease in the indicator in the Southeast, while in the Midwest, North and Northeast there was a notorious increase in rates.[7,10] However, this study, because it is an analysis of the 24-year time series, from 1996 to 2019, this stability does not reflect the reality of the southern region, as the mortality rates and YPLL comprised in the studied period showed an upward trend with a significant increase. This increase may be due to population growth, increased criminal organizations, and the illegal economies present[10,12] in addition to the economic crisis and the state's difficulties in providing policies that address security and social areas effectively.

It is emphasized the need for an in-depth study of the culture of violence and its internalization in Brazilian spaces. A recent[27] study made an analysis of the installation of the culture of violence in Venezuela

and found that it has become acceptable and encouraged within the culture in which institutions and the State have discredited the population. In view of this debate in Venezuela, it is important to deepen the theoretical debate of Brazilian culture to understand the roots of violence and thus act in a preventive and corrective way to improve homicide indicators in the face of the increase detected in this study.

Rio Grande do Sul stood out with the highest annual increase and by period of homicide rates during the time series to men, being one of the eleven states that do not correspond to the North and Northeast regions of Brazil, with a gradual growth in the total homicide rates in the last ten years,[10] while Santa Catarina is the state with the highest increase for women.

Santa Catarina's notorious femicide reflects the construction of virility from the violence exhibited by the culture of this place, which consists of a patriarchal model, with inequity of sex, emphasizing the power of dominion attributed to men by the zeal of women's behavior, and may penalize women's actions through violence when they violate the social norms of gender governed by the culture of honor.[28,29]

The findings of this study indicated higher YPLL among individuals aged 20 to 29 years, with a ratio higher than 35.0% in both sexes in the South. Among the external causes, homicides stand out in relation to premature deaths, especially in young age groups, causing strong impacts in different areas of the health sector.[30] This type of death is among the main causes of disability, falling below only ischemic heart disease. By committing younger populations, individuals in full productive capacity, homicides trigger harmful consequences with high individual and collective costs.[16]

Despite this high ratio among young people aged 20 to 29 years, in the period analyzed, there was a greater growth of YPLL, mainly among older adults aged between 60 and 69 years and, on the other hand, a greater reduction in individuals aged between 10 and 19 years, with this behavior being similar between the states and the South. The implications of this may be associated with the increase in violence against older adults in the family environment with low compliance with the Elderly Statute.[31] On the other hand, reduction in rates for adolescents may indicate that educational activities and policies for the inclusion of this public in training activities in schools may have had a positive impact on this public. [22]

Regarding specific causes, it is important to highlight, in the present investigation, homicides caused by handgun discharges in the South and its states comprise a higher percentage than in other forms of assault, corroborating studies carried out in Brazil, Colombia and other Latin American countries. [7,10,32]

The use of handgun discharges in deaths is a global reality, and in 2016, it contributed to the death of about 210,000 people, with 81.0% of intentional homicide deaths. Included in that same year, a high ratio of deaths from handgun discharges was recorded in Latin America and the Caribbean.[3] It is emphasized that 10.0% of all homicides in the world are concentrated in Brazil, because it has a disposition of handgun discharges and has police violence.[1,3,33] Leaving the national landmark, in most African countries and the United States, handgun discharges account for a minimum of 50.0% lethal violent incidences.[3]

Interestingly, Rio Grande do Sul is the state with the highest possession of handgun discharges by the Brazilian population.[34] Despite the advent of the Disarmament Law, the state proved ineffective in curbing violence after the implementation of the Disarmament Statute in 2003. Despite 15 years of existence, the effects of this document are still insufficient to reduce the increase in premature deaths caused by homicides among southern states.[35]

Another fact that stands out in this investigation is the increase in the use of cold weapons as a means, especially blunt object. Despite this elevation, the handgun discharge remains the main means of committing murder. Cold weapons, in turn, are a means of murder widely used by men, especially by young adults and adolescents.[12]

Conclusion

The trend observed was an increase in homicides in southern states with a predominance of homicide

among young adults and the greatest loss of years of life among male individuals represents important socioeconomic issues for a preventable cause. The magnitude of the violence verified in the mortality rates points to the adoption of preventive strategies to change this scenario in southern Brazil, especially for Rio Grande do Sul among men, and Santa Catarina, among women. As it is of multicausal origin, homicides require an intersectoral articulation of public and private companies and the whole society in general to form partnerships with schools and institutes that work with young people to work together, in order to carry out continuous actions enabling vocational education for insertion in the labor market in order to reduce the levels of violence and its causes.

Acknowledgments

This study was conducted with financial support and also scientific initiation funded by the *Universidade Federal da Integração Latino-Americana* (UNILA).

Collaborations

Chen EW, Gomes LMX and Barbosa TLA declare that they participated in project conception, data analysis and interpretation, article writing, critical review of the relevant intellectual content and final approval of the version to be published.

References

1. United Nations Office on Drugs and Crime (UNODC). Global Study on Homicide 2019: Trends, Contexts, Data. Vienna: UNODC; 2019 [cited 2021 Apr 28]. Available from: https://www.unodc.org/unodc/en/data-and-analysis/global-study-on-homicide.html
2. Veloso AO, Medeiros KK, Soares RA, Pereira FJ, Silva Neto CF, Cavalcanti AL. Contexto socioespacial de vítimas de homicídio doloso em uma capital do nordeste brasileiro. Cad Saude Colet. 2020;28(2):180-8.
3. McEvoy C, Hideg G. Global violent deaths 2017: time to decide. Geneva: Small Arms Survey; 2017 [cited 2021 Apr 28]. Available from: https://assets-dossies-ipg-v2.nyc3.digitaloceanspaces.com/sites/3/2018/04/SAS-Report-GVD2017.pdf
4. United Nations Children's Fund (UNICEF). A familiar face: violence in the lives of children and adolescents. New York (USA): UNICEF; 2017 [cited 2021 Apr 28]. Available from: https://data.unicef.org/resources/a-familiar-face/
5. Oliveira AL, Luna CS, Silva MG. Homicídios do Brasil na última década: uma revisão integrativa. Cien Saude Colet. 2020;25(5):1925-34. Review.
6. Tavares R, Catalan VD, Romano PM, Melo EM. Homicídios e vulnerabilidade social. Cien Saude Colet. 2016;21(3):923-34.
7. Soares Filho AM, Merchan-Hamann E, Vasconcelos CH. Expansão, deslocamento e interiorização do homicídio no Brasil, entre 2000 e 2015: uma análise espacial. Cien Saude Colet. 2020;25(8):3097-105.
8. Rocha GG, Nunes BP, Silva EF, Wehrmeister FC. Análise temporal da mortalidade por homicídios e acidentes de trânsito em Foz do Iguaçu, 2000-2010. Epidemiol Serv Saúde. 2016;25(2):323-30.
9. Costa DH, Schenker M, Njaine K, Souza ER. Homicídios de jovens: os impactos da perda em famílias de vítimas. Physis. 2017;27(3):685-705.
10. Soares Filho AM, Duarte EC, Merchan-Hamann E. Tendência e distribuição da taxa de mortalidade por homicídios segundo porte populacional dos municípios do Brasil, 2000 e 2015. Cien Saude Colet. 2020;25(3):1147-56.
11. Instituto de Pesquisa Econômica Aplicada (IPEA). Atlas da violência 2020. Brasília (DF): IPEA; 2020 [citado 2021 Abr 28]. Disponível em: https://www.ipea.gov.br/atlasviolencia/download/24/atlas-da-violencia-2020
12. Nogueira VD, Xavier-Gomes LM, Barbosa TL. Homicide mortality in border regions in the State of Paraná, Brazil. Cien Saude Colet. 2020;25(8):3107-18.
13. Andrade SS, Mello-Jorge MH. Mortality and potential years of life lost by road traffic injuries in Brazil, 2013. Rev Saude Publica. 2016;50(59):1-9.
14. Cunha AP, Cruz MM, Torres RM. Aids mortality trends according to sociodemographic characteristics in Rio Grande do Sul State and Porto Alegre City, Brazil: 2000-2011*. Epidemiol Serv Saúde 2016;25(3):477-86.
15. Antunes JL, Cardoso MR. Uso da análise de séries temporais em estudos epidemiológicos. Epidemiol Serv Saúde. 2015;24(3):565-76.
16. Malta DC, Minayo MC, Soares Filho MA, Silva MM, Montenegro MM, Ladeira RM, et al. Mortality and years of life lost by interpersonal violence and self-harm: in Brazil and Brazilian states: analysis of the estimates of the Global Burden of Disease Study, 1990 and 2015. Rev Bras Epidemiol. 2017;20(1):142-56.
17. Anjos Júnior OR, Lombardi Filho SC, Ciríaco JS, Silva MV. Testando a hipótese de dependência espacial na taxa de crime dos municípios da região sul do Brasil. Desenvol Regional Debate. 2018;8(1):118-1.
18. Barreto MS, Teston EF, Latorre MR, Mathias TA, Marcon SS. Traffic accident and homicide mortality in Curitiba, Paraná, Brazil, 1996-2011. Epidemiol Serv Saúde. 2016;25(1):95-104.
19. Zahnow R, Mcveigh J, Bates G, Hope V, Kean J, Campbell J, et al. Identifying a typology of men who use anabolic na drogenic steroids (AAS). Int J Drug Policy. 2018;55:105-12.
20. Dunn M, Bartle J, Mckay FH. Exploring judicial opinion on the relationship between anabolic-androgenic steroid use and violent offending. Perform Enhanc Heal. 2016;5(1):31-3.
21. Delgado PF, Maya-Rosero E, Franco M, Montoya-Oviedo N, Guatibonza R, Mockus I. Testosterona y homicidio: aspectos neuroendocrinos de la agresión. Rev Fac Med. 2020;68(2):283-94.
22. Silva MM, Meschial WC, Oliveira ML. Mortalidade de adolescentes por causas externas no estado do Paraná: análise de dados oficiais. Rev Bras Pesq Saúde. 2016;18(3):17-23.

23. Lachaud J, Donnelly PD, Henry D, Kornas K, Calzavara A, Bornbaum C, et al. A population-based study of homicide deaths in Ontario, Canada using linked death records. Int J Equity Health. 2017;16(1):133-9.

24. Waiselfisz JJ. Educação: blindagem contra a violência homicida? Recife: FLACSO Brasil; 2016 [citado 2021 Abr 28]. Disponível em: https://flacso.org.br/files/2016/07/educ_blindagem2.pdf

25. Lima CC, Lima RP, Nobre AC. Uso de drogas ilícitas na prática do homicídio. Cad Ibero Amer Dir Sanit. 2017;6(3):118-28.

26. França EB, Passos VM, Malta DC, Duncan BB, Ribeiro AL, Guimarães MD, et al. Cause-specific mortality for 249 causes in Brazil and states during 1990–2015: a systematic analysis for the global burden of disease study 2015. Popul Health Metr. 2017;15(1):39.

27. Crespo F. Debate teórico sobre el proceso de instalación de una cultura de la violencia en Venezuela. Rev Crim. 2019;62(1):117-32.

28. Nascimento SG, Silva RS, Cavalcante LM, Carvalho AP, Bonfim CV. External causes of mortality in pregnant and puerperal women. Acta Paul Enferm. 2018;31(2):181-6.

29. David LV, Minamisava R, Vitorino PV, Rocha MJ, Carneiro VS, Vieira MA. Perfil dos óbitos femininos por homicídios no município de Goiânia. Rev Bras Enferm. 2020;73(Suppl 4):e20180985.

30. Garcia LA, Camargo FC, Pereira GA, Ferreira LA, Iwamoto HH, Santos AS, et al. Anos potenciais de vida perdidos e tendência de mortalidade na população adulta em um município do Triângulo Mineiro, 1996-2013. Medicina (Ribeirão Preto). 2017;50(4):216-26.

31. Santana IO, Vasconcelos DC, Coutinho MP. Prevalência da violência contra o idoso no Brasil: revisão analítica. Arq Bras Psicol. 2016;68(1):126-39. Review.

32. Chaparro-Narváez P, Cotes-Cantillo K, León-Quevedo W, Castañeda-Orjuela C. Mortalidad por homicídios en Colombia, 1998-2012. Biomédica. 2016;36(4):572-82.

33. Canudas-Romo V, Aburto JM. Youth lost to homicides: disparities in survival in Latin America and the Caribbean. BMJ Glob Health. 2019;4(2):e001275.

34. Oliveira CA, Rostirolla CC. Mais armas de fogo, mais homicídios? Uma evidência empírica para a Região Metropolitana de Porto Alegre a partir de dados em painel. In: XX Encontro de Economia da Região Sul, 2017, Porto Alegre. Anais do XX Encontro de Economia da Região Sul, 2017 [citado 2021 Abr 28]. Disponível em: https://www.anpec.org.br/sul/2017/submissao/files_I/i8-2482198d4504562fba23934168cc49f4.pdf

35. Ferro WC, Teixeira EC. Efeito do estatuto do desarmamento sobre as mortes por armas de fogo no Brasil. Rev Desenvol Economico. 2019;3(44):56-87.