

## Violence deaths and its impact on life expectancy: a comparison between Mexico and Brazil

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**Abstract** *Using official data, this study analyzed violent deaths (homicide, suicide, events of undetermined intent and deaths due to legal intervention) in Brazil and Mexico in the three-year periods 2002-2004 and 2012-14, the impact of these causes of death on life expectancy in both countries and the role of the different age groups in years of life expectancy lost (YLEL). Abridged life tables were constructed for both countries for both periods. Temporary life expectancy and YLEL between zero and 80 years by selected causes and age groups were calculated for each triennium. The leading cause of YLEL among men was homicide in both periods in Brazil (1.5 years) and in the second period in Mexico (one year). Violent deaths (VD) accounted for around 16% of YLEL in Brazil and 13% in Mexico in 2012-2014. Among women, YLEL due to homicides and suicides showed the greatest relative increase in both countries, although VD accounted for barely 3% of total YLEL. The highest percentage of YLEL due to VD was found among the 15 to 29 year age groups in both countries and for both sexes. The increase in rates of VD in Mexico, above all among young people, has curbed further increases in life expectancy in recent years, especially among men. Likewise, the high rates of VD in Brazil in both periods have hindered the growth of life expectancy.*

**Key words** *Violence, Homicide, Life expectancy, Mortality*

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## Introduction

Since the last century, the World Health Organization (WHO)<sup>1</sup> has recognized that violence is not only a serious social problem, but also one of the most pressing problems in the field of health and an overlooked epidemic that has become one of the main causes of morbidity and premature death. According to the WHO, at the beginning of the twenty-first century, 90% deaths resulting from interpersonal violence worldwide occurred in developing countries<sup>1</sup>. Recent studies place Latin America as one of the most violent regions on the planet, with homicide rates that are four times greater than the global average<sup>2</sup>.

Violence has accompanied humanity throughout history and is related to the social, political, economic and cultural features of any given community<sup>3</sup>. That said, violence is not an inevitable part of the human condition, but rather a sociohistorical construction in response to the real moment in which we live<sup>4</sup>, a symptom and reflection of social problems that require answers from different sectors of society, since it has a ripple effect across all walks of life at individual, group and national level<sup>5</sup>.

In practice, societies have developed an array of mechanisms, systems and institutions aimed at violence reduction and prevention with varying degrees of success<sup>3</sup>. Despite these efforts, millions of people around the world are victims of the psychological, physical, social, and economic impacts of violence annually, whether or not it leads to death.

Brazil and Mexico are a good example of this. A recent report published by the Inter-American Development Bank showed that the economic costs of violence and crime among Latin American countries in 2014 were highest in these two countries: US\$124 billion in Brazil and US\$41 billion in Mexico<sup>2</sup>. Although the size of these countries' respective economies may partially explain why these countries top the list, their ranking leaves no room for doubt in relation to the huge impact that violence has on their societies. This is particularly the case when one considers the high level of homicides in the region. The average social cost of homicide in these countries in the period 2010 and 2014 expressed as a percentage of gross domestic product (GDP) was estimated at 0.23% and 0.17%, respectively<sup>6</sup>, which is among the highest on the continent.

However, the impact of violence (including self-inflicted, interpersonal, or collective violence) on life expectancy, one of the best and

most commonly-used indicators of population health status, has so far been insufficiently studied in both countries<sup>7-9</sup>. According to the Pan American Health Organization (PAHO)<sup>10</sup>, life expectancy at birth in Mexico has increased by around one and a half years over the last 10 years, while in Brazil it has increased by almost four years thanks to a notable decline in infant mortality in recent years. This raises the following question: would there have been further increases in both countries if violence had not been such a pressing problem in recent decades?

In light of the above, this study aims to determine the impact of mortality due to violence and other causes of death on life expectancy in Brazil and Mexico in the three-year periods 2002-2004 and 2012-2014 and the proportional impact of this cause on potential years of life lost across different age groups.

## Methods

A descriptive cross-sectional study was conducted in Brazil and Mexico because they are the largest countries in Latin America in terms of land area, population and size of economy. Over 80 % of the population of these two countries live in urban areas. In 2104, gross national income per capita and the Gini coefficient was US\$9,870 and 48.1, respectively, in Mexico, and US\$11,790 and 52.9, respectively, in Brazil, which is above the average for Latin America<sup>10</sup>.

Population and mortality data was obtained from the following official databases: the National Health Information System of the Secretariat of Health (*Sistema Nacional de Información en Salud de la Secretaría de Salud*)<sup>11</sup> and the National Population Council (*Consejo Nacional de Población*)<sup>12</sup> in Mexico; and the Mortality Information System (*Sistema de Información sobre Mortalidad - SIM*) of the Ministry of Health in Brazil<sup>13</sup>.

Causes of death were classified according to the International Classification of Diseases, Tenth Edition (ICD-10)<sup>14</sup>. The following categories of violent death were considered for the purposes of this study: self-inflicted violence - Suicide (X60-X84, Y87.0), interpersonal violence - Homicide (X85-Y09, Y87.1); and collective violence - Legal Intervention (Y35). We also included deaths caused by events where intent could not be determined (Y10-Y34, Y87.2), a code that often masks assaults not declared as such at the time of registration or which are not adequately

identified as the fundamental cause of death on the death certificate<sup>15</sup>.

We also analyzed the following causes: Motor Vehicle Traffic Accidents (MVTAs) - [V02-V04 (.1, .9), V09.2-V09.3, V09.9, V12-V14 (.3-.9), V19.4-V19.6, V20-V28 (.3-.9), V29-V79 (.4-.9), V80.3-V80.5, V81.1, V82.1, V83-V86(.0-.3), V87.0-V87.8, V89.2, V89.9]; Mortality due to Diabetes Mellitus (E10-E14); Ischemic heart diseases (I20-I25) and Malignant neoplasms (C00-C97), all of which are among the main causes of death in each country. The three-year periods chosen for the study (2002-2004 and 2012-2014) allowed for a consistent analysis of changes over a ten-year period using only ICD-10 classifications.

According to PAHO criteria (percentage of underreported or poorly-defined causes of death under 10%) the quality of mortality data in Mexico was high for both periods, while in Brazil quality was considered high for the period 2012-2014 and "incomplete" for the period 2002-2004<sup>16,17</sup>. However, studies evaluating the quality of mortality data in Brazil in the first decade of this century have shown a clear improvement in information by sex, age and causes (with completeness of information percentages of over 95% even in the case of assault)<sup>9,18</sup>. For this reason, we decided to work with official mortality statistics disclosed by the respective governments of the two countries and correct data for situations where data was not age and sex specific (under 1% of all deaths in each period)<sup>11,13</sup> by proportionally redistributing nonspecific data across all causes and for each specific examined cause according to the relative weight of each age group and by sex<sup>7</sup>.

Age-adjusted mortality rates were computed for each category of violent death using the direct method, where the standard population was taken as the sum of the populations of both countries in the period 2012-2014. Abbreviated life tables by sex were then elaborated for both countries and both periods using the software EpiData v3.1<sup>19</sup>. Elaborating three-year life tables helps to reduce random variation in mortality rates that may distort data interpretation.

Using the life tables and the method proposed by Arriaga<sup>20-22</sup>, we calculated both temporary life expectancy (TLE) between zero and 80 years, as a measure of variation in mortality, and potential years of life lost (PYLL) between the two ages (in general, due to the causes under study, and by age group in each period). Each measure was calculated using the software EpiData v3.1. The

method proposed by Arriaga has been employed by various authors and is described in detail in the relevant literature<sup>9,20-23</sup>.

In practical terms, PYLL represents the difference between the maximum possible number of years of life remaining between the two ages and TLE, which is the average number of years lived between these ages<sup>20</sup>, i.e. PYLL are years not lived. The sum of years not lived by age group or cause provides the total PYLL attributable to each cause or each age group, as the case may be.

We calculated PYLL between zero and 80 years assuming the total absence of deaths (null mortality) between both ages. This assumption facilitates interpretation of the indicator: total PYLL between zero and 80 years is equal to the difference between the maximum possible number of years of life remaining between each age if mortality is eliminated (in this case 80 years) and TLE between zero and 80 years (i.e., the average number of years actually lived)<sup>23</sup>.

Calculating the age-adjusted mortality rates using this method allows one to measure differences in levels of mortality within and between populations. Furthermore, this index provides a value expressed in years of life expectancy that is easily understandable.

## Results

According to official statistics (Table 1), there were over 200,000 violent deaths in Brazil in both periods (209,210 in the period 2002-2004 and 235,173 in the period 2012-2014). Around 12% of victims were women. In Mexico, the number of violent deaths practically doubled between the two periods, increasing from 50,100 in the period 2002-2004 (14.6% women) to 99,470 in the period 2012-2014 (13.4% women). In Brazil, violent deaths accounted for over 10% of total deaths among men and 2% among women in both periods, while in Mexico they accounted for 5.5% among men and 1.2% among women in the period 2002-2004 and 8.3% among men and 1.8% among women in the period 2012-2014.

The leading cause of violent death was homicide: three in every four deaths among Brazilian men and seven in every 10 deaths among Mexican men in 2012-2014. Homicide was also the leading cause of violent death among women, although to a lesser degree.

Adjusted homicide rates were higher in Brazil than in Mexico in both periods for both men and women. However, this difference was less marked

**Table 1.** Deaths (absolute and relative figures) and adjusted rates of mortality due to violence (per 100,000 population) by sex. Brazil and Mexico, 2002-2004 and 2012-2014.

	BRAZIL				MEXICO			
	Men		Women		Men		Women	
	2002-2004	2012-2014	2002-2004	2012-2014	2002-2004	2012-2014	2002-2004	2012-2014
	Nº							
Homicide	137.424	158.350	11.641	14.323	25.666	60.772	3.803	7.820
Suicide	18.602	24.801	5.010	6.720	10.051	14.375	2.036	3.416
Events where intent could not be determined	27.761	22.039	7.625	7.414	7.092	10.710	1.451	2.046
Legal intervention	1.141	1.505	6	21	1	318	0	13
Violence	184.928	206.695	24.282	28.478	42.810	86.175	7.290	13.295
	%	%	%	%	%	%	%	%
Homicide	74,31	76,61	47,94	50,29	59,95	70,52	52,17	58,82
Suicide	10,06	12,00	20,63	23,60	23,48	16,68	27,93	25,69
Events where intent could not be determined	15.01	10.66	31.40	26.03	16.57	12.43	19.90	15.39
Legal intervention	0.62	0.73	0.02	0.07	0.00	0.37	0.00	0.10
Violence	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	RATE							
Homicide	53.02	52.84	4.36	4.69	18.56	36.90	2.50	4.35
Suicide	7.89	8.35	1.95	2.14	7.20	8.71	1.31	1.90
Events where intent could not be determined	9.39	9.02	3.08	2.19	5.30	6.58	0.97	1.13
Legal intervention	0.41	0.50	0.002	0.006	0.001	0.19	0.00	0.007
Violence	73.16	69.26	9.39	9.02	31.07	52.39	4.80	7.39

Standard population: sum of the populations of both countries in the period 2012-2014.

Source: Authors' elaboration based on data obtained from the National Health Information System (SINAIS, acronym in Portuguese) in Mexico and Mortality Information System (SIM, acronym in Portuguese) of the Ministry of Health in Brazil.

among men in the second period (2012-2014), when the homicide rate in Brazil was 43% higher than in Mexico, compared to almost three times higher in 2002-2004. This gap also narrowed among women: while the homicide rate in Brazil remained relatively stable over the two periods, in Mexico it almost doubled.

Similar adjusted suicide rates were found for both countries in both periods, although it should be noted that rates among Mexican men exceeded those among Brazilian men in the period 2012-2014.

The rate of deaths caused by events where intent could not be determined was higher in Brazil for both sexes, despite a decrease in rates in this country between the two periods and an increase in Mexico. Finally, the rate of deaths due to legal intervention, albeit low, increased in all cases.

Overall adjusted mortality rates were lower in Mexico. However, a slight decrease in rates in Brazil together with an increase in Mexico means

that the overall gap between the two countries narrowed. This narrowing was particularly pronounced among women.

Table 2 shows that there was an increase in TLE between zero and 80 years among both sexes in Brazil and that this increase was more marked among men (1.67 years). This increase corresponds with a reduction in the number of PYLL among both men and women.

In contrast, in Mexico there was an increase in the number of PYLL among men (from 10.55 to 10.68 years) and a slight decrease among women, corresponding to a decrease in TLE of 0.13 years among men and an increase of 0.40 years among women.

Table 3 shows that the leading cause of PYLL among Brazilian men in both periods was homicide, with a slightly higher rate than malignant neoplasms. The table also shows that there was a small increase in PYLL due to homicide, suicide and legal intervention. Overall, violent deaths ac-

counted for over 16% of PYLL among men in the period 2012-2014, an increase compared to the period 2002-2004.

With regard to Mexico, homicide showed the largest increase in PYLL between the two periods, more than doubling to become the second

leading cause of PYLL among men in the period 2012-2014 behind diabetes mellitus. Despite this increase, PYLL due to homicide in Mexico among men remained lower than in Brazil. PYLL due to the rest of the causes and the percentage of PYLL due to these causes almost doubled over

**Table 2.** Temporary life expectancy (TLE) and years of life expectancy lost (YLEL) between zero and 80 years by sex. Brazil and Mexico, 2002-2004 and 2012-2014.

	TLE				YLEL			
			Change				Change	
	2002-2004	2012-2014	Absolute 2002-04 / 2012-14	Relative 2002-04 / 2012-14 (%)	2002-2004	2012-2014	Absolute 2002-04 / 2012-14	Relative 2002-04 / 2012-14 (%)
Brazil (Men)	66.60	68.27	1.67	2.44	13.40	11.73	-1.67	-12.50
Mexico (Men)	69.45	69.32	-0.13	-0.19	10.55	10.68	0.13	1.25
Brazil (Women)	72.11	73.30	1.19	1.63	7.89	6.70	-1.19	-17.65
Mexico (Women)	72.91	73.31	0.40	0.55	7.10	6.70	-0.40	-5.62

Source: Authors' elaboration based on data obtained from the National Health Information System (SINAIS, acronym in Spanish) in Mexico and Mortality Information System (SIM, acronym in Portuguese) of the Ministry of Health in Brazil.

**Table 3.** Years of life expectancy lost (YLEL) due to selected causes between zero and 80 years by sex. Brazil and Mexico, 2002-2004 and 2012-2014.

	HOM	SUIC	EUI	LI	MVTA	DM	IHD	MN	YLEL due to VIOLENCE (%)
Brazil (Men)									
2002-2004	1.49	0.19	0.28	0.01	0.81	0.31	0.95	1.48	14.70
2012-2014	1.52	0.21	0.18	0.02	0.88	0.32	0.86	1.47	16.37
Relative change (%) 2002-04 /2012-14	2.02	8.06	-36.26	100.00	9.54	5.37	-9.98	-0.38	
Mexico (Men)									
2002-2004	0.49	0.19	0.13	0.00	0.43	1.06	0.84	1.06	7.65
2012-2014	1.01	0.23	0.16	0.01	0.61	1.21	0.93	1.00	13.18
Relative change (%) 2002-04 /2012-14	105.36	23.02	27.93	...	42.32	14.69	10.05	-5.68	
Brazil (Women)									
2002-2004	0.13	0.05	0.05	0.00	0.19	0.36	0.54	1.33	2.96
2012-2014	0.14	0.06	0.04	0.00	0.20	0.33	0.45	1.36	3.49
Relative change (%) 2002-04 /2012-14	9.54	10.15	-31.44	0.00	5.57	-8.27	-16.49	2.33	
Mexico (Women)									
2002-2004	0.07	0.04	0.02	0.00	0.12	1.16	0.46	1.26	1.85
2012-2014	0.13	0.06	0.03	0.00	0.15	1.13	0.46	1.16	3.17
Relative change (%) 2002-04 /2012-14	81.19	47.78	27.00	0.00	29.80	-2.46	-0.17	-7.91	

HOM: Homicide; SUIC: Suicide; EUI: Events of Undetermined Intent; MVTA: Motor Vehicle Traffic Accidents; DM: Diabetes Mellitus; IHD: Ischemic Heart Diseases; MN: Malignant Neoplasms

Source: Authors' elaboration based on data obtained from the National Health Information System (SINAIS, acronym in Spanish) in Mexico and Mortality Information System (SIM, acronym in Portuguese) of the Ministry of Health in Brazil.

the period, accounting for 13.2% of all PYLL between zero and 80 years in the period 2012-2014.

It is important to note that, in both Mexico and Brazil, PYLL due to homicide among men were significantly greater than PYLL due to MVTAs in both periods, despite an increase in the latter in both countries. Together, PYLL due to violence and MVTAs accounted for almost one quarter of PYLL among men in Brazil and one fifth among men in Mexico during the period 2012-2014.

In contrast, the effect of violence on PYLL is less apparent among women in both countries, although the percentage increased between the two periods, reaching slightly over 3% in both countries. PYLL due to homicide showed the greatest relative increase among all causes, with similar values being observed in both Brazil and Mexico in the period 2012-2014. However, PYLL due to homicide were less than PYLL due to MVTAs and the chronic degenerative diseases considered by this study in both periods. Furthermore, there was a small increase in PYLL due to suicide in both countries and due to events where intent could not be determined in Mexico.

Figure 1 shows PYLL due to homicide and suicide by age group and sex. While PYLL due to homicide among Mexican men increased across all ages (more than doubling for the age groups between 15 and 39 years), rates remained relatively stable, albeit higher than in Mexico, among Brazilian men, especially in younger age groups. It is also interesting to note that in Brazil there was an increase in PYLL among the 10 to 19 year age groups and that PYLL more than tripled in the 15 to 19 year age group in Mexico.

PYLL due to homicide also increased across all age groups among Mexican women, while among Brazilian women it increased in the 0 to 49 year age groups. This increase was particularly marked in the 15 to 39 year age groups among Mexican women and in the younger age groups among Brazilian women, where the highest rate of PYLL in the period 2012-2014 was found among the 15 to 19 year age group.

PYLL due to suicide increased across practically all age groups among both Mexican and Brazilian men. Rates were highest in the 20 to 29 year age groups, where rates were higher among Mexican men. PYLL due to suicide among women increased across almost all age groups in Mexico, while in Brazil the increase was particularly marked from the 25 year group onward. It is important to note that PYLL was highest in the 15

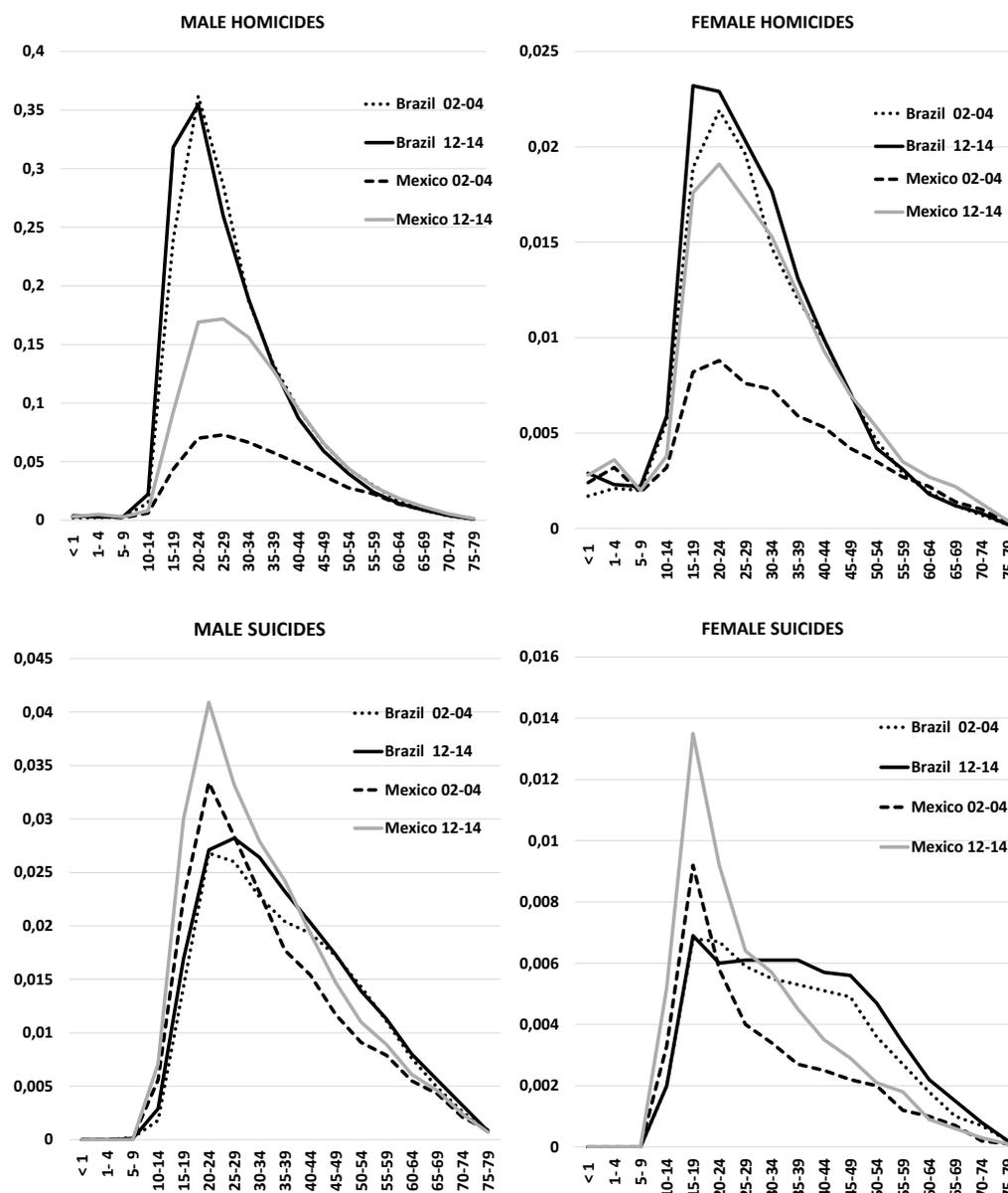
to 19 year age group in both periods in Mexico and in the period 2012-2014 in Brazil.

Finally, the analysis of PYLL by cause and age in the period 2012-2014 (Figure 2) reveals that violent deaths, particularly homicide, account for a little over one-half of PYLL among Brazilian men aged between 15 and 24 years and that the proportion of PYLL due to these causes was greatest in the 15 to 19 year age group. The findings also show that violent deaths together with deaths due to MVTA accounted for 70% of PYLL among the 15 to 24 year age groups. It is only after the age of 40 that the chronic degenerative diseases considered by this study account for more PYLL than violence.

Violent deaths, particularly homicide, accounts for approximately 40% of PYLL among Mexican men aged between 15 and 29 years and the proportion of PYLL due to these causes was greatest in the 20 to 24 year age group. Violent deaths together with deaths due to MVTA accounted for around 60% of PYLL. As is the case with Brazil, it is only after the age of 40 that chronic degenerative diseases have a greater impact on PYLL than violence. In both countries, PYLL due to homicide among men aged between 15 and 39 years was greater than PYLL due to the three chronic degenerative diseases considered by this study combined.

In both countries, the impact of violent deaths on PYLL among women is greatest in the 15 to 24 year age groups (around 20%). This impact is particularly marked in the 15 to 19 year age group. Furthermore, in the 15 to 29 year age groups, violent deaths account for more PYLL than any other of the causes taken separately. Violent deaths together with deaths due to MVTA account for between 30% and 40% of PYLL in the 15 to 24 years age groups in both countries.

It is important to note that in both countries the proportional impact of suicide on PYLL among women is greater than among men. This difference is particularly marked in Mexico, where the impact of suicide on PYLL is similar to that of homicide in the 10 to 19 year age groups. It is also interesting to note that while in Brazil deaths due to MVTAs among women account for more PYLL than homicide across all age groups, in Mexico homicide causes more PYLL than MVTAs in the 15 to 44 year age groups. After the age of 30, the chronic degenerative diseases considered by this study account for more PYLL among women than violence in both countries.



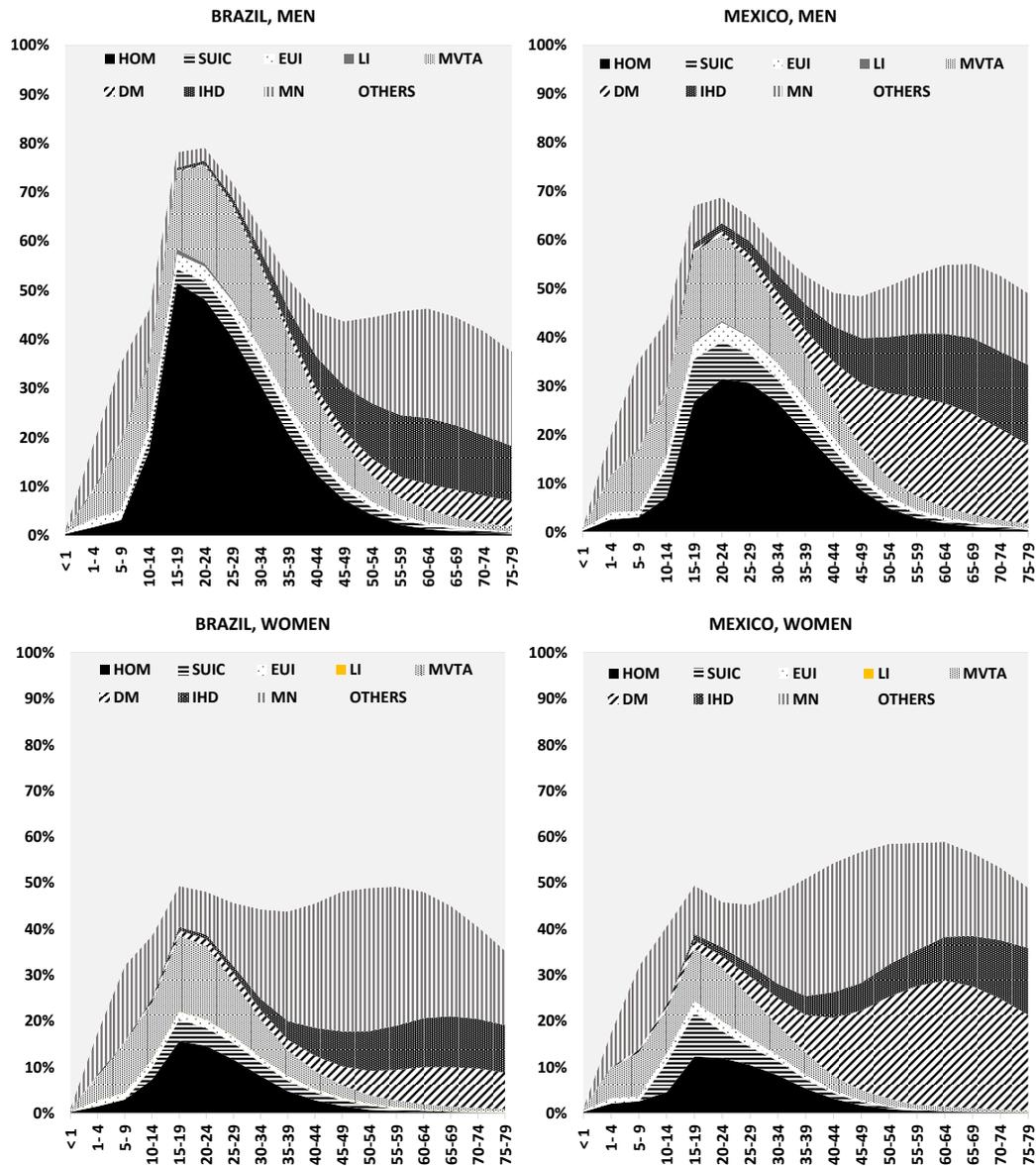
**Figure 1.** Years of life expectancy lost (YLEL) due to homicide and suicide by sex and age group. Brazil and Mexico, 2002-2004 and 2012-2014.

Source: Authors' elaboration based on data obtained from the National Health Information System (SINAIS, acronym in Spanish) in Mexico and Mortality Information System (SIM), Ministry of Health, Brazil.

## Discussion

The findings of this study reveal that despite a slight decrease in PYLL due to violent deaths (around two years) among Brazilian men, the proportional impact of these deaths on PYLL in-

creased: one-sixth of overall PYLL in the period 2012-2014 were due to violent deaths, particularly homicide, which was the cause that accounted for the largest number of PYLL in both periods (practically one and a half years in each period). It can thus be concluded that the increase



HOM: Homicide; SUIC: Suicide; EUI: Events of Undetermined Intent; MVTA: Motor Vehicle Traffic Accidents; DM: Diabetes Mellitus; IHD: Ischemic Heart Diseases; MN: Malignant Neoplasms

**Figure 2.** Percentage of years of life expectancy lost (YLEL) due to the causes considered in this study, by sex and age group. Brazil and Mexico, 2012-2014.

Source: Authors' elaboration based on data obtained from the National Health Information System (SINAIS, acronym in Spanish) in Mexico and Mortality Information System (SIM, acronym in Portuguese) of the Ministry of Health in Brazil.

in TLE among men, due, to a large extent, to a reduction in infant and early-age mortality rates, would have been greater but for these factors. In contrast, there was an increase in PYLL due to

violent deaths among women and homicide was the cause that accounted for the greatest relative increase in PYLL, also hindering growth in TLE among women. The ratio between men and

women of PYLL due to violence was 8.6:1 in the period 2002-2004 and 8.1:1 in the period 2012-2014.

There was a substantial increase in PYLL due to violence among both men and women in Mexico (for all causes, with a particularly marked increase in PYLL due to homicide). The proportional impact of these causes on overall PYLL also increased: in the period 2012-2014, homicide was the second leading cause of PYLL among men (one year), behind only diabetes mellitus, and was the cause that accounted for the greatest relative increase in PYLL, thus contributing to a slight decline in TLE among men in the period under study.

Despite a decrease in PYLL due to chronic degenerative diseases among Mexican women, an increase in PYLL due to violence hindered growth in TLE among women. The ratio between men and women of PYLL due to violence was 6.2:1 in the period 2002-2004 and 6.4:1 in the period 2012-2014.

The results also show that although the impact of violent deaths on PYLL continues to be greater in Brazil among both men and women, the gap between the two countries narrowed notably during the ten-year period under study. Furthermore, the findings show that life expectancy would have increased more during this period, especially among men, if rates of violent death, particularly homicide, had not been so high and had not therefore caused so many PYLL. The combined effect on life expectancy of PYLL due to violent deaths and MVTAs, which are essentially avoidable causes, is even greater.

The gap in TLE between zero and 80 years between the two countries narrowed considerably during the period under study due to the impact of violent deaths, particularly among women, with rates reaching similar levels in both countries in the period 2012-2014.

In general, the findings of this study are similar to previous studies that show that both countries have high levels of violence and some of the highest homicide rates in Latin America, especially among men and young people, and that these factors influence life expectancy.

Salama<sup>24</sup>, for example, shows that there was a reduction in life expectancy at birth at the beginning of the twenty-first century in cities such as Rio de Janeiro, São Paulo and Recife due to violence, while a study by Beltrão and Dellasoppa<sup>9</sup> revealed that there was an increase in PYLL due to homicide and assault among men aged between 15 and 65 years in the last decades of

the last century. This study went on to show that figures stabilized in 2000 and 2005 at around 1.2 PYLL, which is similar, albeit slightly lower, than the level found by the present study for the period 2002-2004 across most ages. Similar results were obtained for women (0.1 PYLL compared to 0.13 found by the present study). PYLL was proportionally highest in the age groups 15 to 24 years among both men and women.

Likewise, various authors have reported an increase in homicide and suicide rates in Mexico and demonstrated the negative impact of this rise on TLE, particularly among men. These studies emphasize the high number of PYLL due to these causes among young men and an increase in PYLL over the last decade. In this respect, one study showed that there was an increase in PYLL due to homicide among men in 10 states in the first decade of this century, showing that total PYLL due to this cause surpassed two in some cases<sup>7</sup>, while another study showed that PYLL due to suicide among men and women in 2013 was 0.42 and 0.20, respectively, an increase compared to 2000<sup>25</sup>.

While it is evident that supermortality among men due to violence is common to both countries, which means that the impact of deaths due to these causes on TLE is much more marked among men than in women, it is important to interpret these results from a gender perspective in order to gain a better understanding of this phenomenon. In predominantly sexist societies such as Mexico and Brazil, exercising masculinity implies having and exercising power. The power traditionally associated with masculinity from childhood in our societies fosters violent, extreme and risky behavior<sup>26</sup>. In such an environment, children are taught from an early age that violence is an accepted way of resolving conflicts. This helps us to understand why men are more likely than women to become involved in dangerous crime and shady dealings that are solved on the edge of the law (such as activities related to organized crime, particularly drug trafficking) and that put their lives at risk.

At the same time, however, we should not overlook the fact that there was also an increase in PYLL due to homicide among women in both countries during the period under study. It is evident that the causes and contexts of male and female homicide differ<sup>27</sup>. Literature shows that many murdered women are killed by intimate partners or by someone who is part of their family or social circle, emphasizing the significance of domestic violence, the absence of a social safety

net that offers these women protection, and the lack of capacity and effectiveness of the government to ensure adequate social coexistence in both countries.

Brazil and Mexico share another common feature: violence is particularly prominent among young people and therefore the number of PYLL due to these causes is particularly high at younger ages in both men and women. It is a fact that the social impact of homicide involving young people, be they victims or perpetrators, is greater, since violence at a younger age has a greater proportional impact on the overall social burden of premature death, injury and disability<sup>28</sup>. Furthermore, this phenomenon also reveals the underlying social problems that contribute to high youth homicide rates in Brazil and Mexico<sup>29-32</sup>; on the one hand, the presence of organized crime, especially the drug cartels, that prey on the vulnerability of a considerable percentage of young people caused by factors such as family breakdown, unemployment, and lack of access to quality education, using them to sell drugs on the streets of major cities or as heavily-armed soldiers and *sicarios* (child assassins); and, on the other, structural factors common to both countries, such as marked social inequality due to the uneven distribution of wealth, huge regional disparities in development, the lack of specific policies to address urban development, and, notably, the shocking levels of impunity and corruption in the countries' public security and justice systems<sup>24,32-36</sup>. Together, these factors help us to understand why violence has curbed the increase in life expectancy in these countries.

In this respect, it is also important to give due emphasis to the increase in suicide rates in the two countries among both sexes and the resulting impact on PYLL, which is greater among men. The increase in suicide rates in younger age groups, particularly in Mexico, paint a disturbing picture, not only from a social, economic and health point of view, but also in relation to public policy implications, given that suicide should be considered not only as a personal decision, but also as a social phenomenon that obeys sociocultural factors that directly influence suicidal behavior<sup>25,36</sup>.

A last important aspect of violent behavior is deaths due to legal intervention, particularly among men. Although the impact of this cause on PYLL is practically null, the increase observed in both countries should not be overlooked. This is because it is the result of increasing repression rather than increased police effectiveness in soci-

eties where the police are marked by a repressive past inherited from dictatorial systems (Brazil), or where the army wages war on drug cartels without the effective implementation of social policy (Mexico). Repression is contributing factor rather than a solution to violence<sup>24</sup>.

Finally, this study has a number of limitations. Firstly, official statistics are often subject to underreporting, particularly in less developed regions, which tends to lead to an underestimation of death rates and thus overestimate life expectancy, despite the fact the coverage and quality of the data are regarded as being satisfactory. Furthermore, mortality data produced in Brazil at the beginning of the century are not considered reliable by the PAHO. Therefore, although reports by various authors on Brazilian mortality statistics in the first decade of this century allow us to be optimistic as to their quality<sup>9,18</sup>, the estimates of this study should be treated with a certain degree of caution.

Furthermore, as mentioned by previous studies<sup>15</sup>, both countries showed a significant proportion of deaths classified as events where intent could not be determined. This includes cases that otherwise could have been classified in other codes (principally homicide), which suggests that both homicide rates and PYLL due to this cause may have been underestimated.

Finally, in relation to the method employed to calculate PYLL, none of the three possible assumptions greatly alter (bias) the results. The null mortality assumption employed in this study is recommended by the literature<sup>23</sup> since it not only facilitates the interpretation of results, but also fully explains changes in TLE and the causes of death.

Despite the above limitations, the findings of the present study indicate with reasonable certainty that life expectancy, particularly among men, would increase significantly in Brazil and Mexico if there were a decrease in the high levels of violence in both countries. In view of the unquestionable fact that life expectancy in Brazil and Mexico has reached relatively high levels and that, in the case of Mexico, growth has slowed over the last decade, a reduction in mortality due to homicide and other causes of violent death, particularly among young people, seems essential to achieving further increases in life expectancy in these two countries.

That said, the successful reduction of the unacceptable levels of violence in these two countries requires urgent changes in the eminently repressive methods currently used to address the

problem of violence and the formulation and effective implementation of public policies. These policies should be aimed not only at reshaping the justice system, reducing levels of impunity and corruption, tackling drug cartels and organized crime, and reducing the number of illegal firearms in circulation, but also at encouraging the integration of adolescents and youth into social safety nets (family support, access to education, the creation of adequately paid employment, etc.) and reducing the social and economic inequalities that prevent people from fully exercising their citizenship<sup>5,31</sup>.

Furthermore, it is necessary to question the values related to the concept of hegemonic masculinity conveyed from the beginning of the pro-

cess of socialization, which implicitly leads to a lifestyle whereby men are more likely to be involved in violent acts and are exposed to a greater risk of death than women<sup>26</sup>; without forgetting that it is necessary to strive towards true gender equality and the empowerment of women in order to reverse the upward trend in violent deaths among the female population.

These actions require a solid base. The analysis of violence from an epidemiological perspective as conducted by this study add strategic value to the analysis of mortality due to these causes over time and provides decision-makers from different sectors with valuable insights into the impact of violence on life expectancy in Brazil and Mexico.

## Collaborations

GJ González-Pérez participated in study design and coordination, data analysis and interpretation, and in drafting this manuscript. MG Vega-López participated in study design, data analysis and interpretation, and in drafting this manuscript. ER Souza participated in study design and coordination, data interpretation, and in the critical revision of this manuscript. LW Pinto participated in data collection, analysis and interpretation, and in the critical revision of this manuscript. All authors revised the approved the final version of this article.

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Article submitted 15/01/2017

Approved 18/04/2017

Final version submitted 18/05/2017

