DOI: 10.1590/1980-549720200069

ORIGINAL ARTICLE / *ARTÍCULO ORIGINAL*

Study of suicide burden of mortality in México 1990-2017

Estudio de la carga de la mortalidad por suicidio en México 1990-2017

Claudio Alberto Dávila Cervantes[I], Ana Melisa Pardo Montaño[II]

ABSTRACT: ***Objective:*** The primary goal was to analyze the level and trend of the burden of suicide mortality in Mexico between 1990 and 2017 at a national and state scale. ***Methods:*** A secondary analysis based on the 2017 global burden of disease study. Mortality rates and years of life lost due to premature death (YLL) were reported here. A joinpoint regression analysis based on a log-linear model was used to analyze the trend of YLL. ***Results:*** The burden of disease due to suicides increased in Mexico, mainly in young males and females; though the raise that happened in the elderly is an additional challenge for the health system. The burden of disease varied substantially between states. The male mortality rates were higher than those of females during the whole period under study, nonetheless with a trend to reduce the difference between the sexes. A bimodal pattern of the burden of disease due to suicide in Mexico was also observed, with the higher rates located in those aged between 15 and 19 years, and an important increase in people older than 85 years of age. ***Conclusion:*** These results show a worrisome picture, not only from a social, economic and health point of view but also from the needs of public policies. This situation represents a wake-up call about the need to implement timely identification actions, a comprehensive multisectoral prevention strategy and the detailed study of suicide associated risk factors.

Keywords: Suicide. Mexico. Years of life lost. Mortality.

[I]Facultad Latinoamericana de Ciencias Sociales México – Ciudad de México, México.
[II]Instituto de Geografía, Universidad Nacional Autónoma de México – Ciudad de México, México.
Corresponding author: Ana Melisa Pardo Montaño. Universidad Nacional Autónoma de México, Circuito de la Investigación Científica, Ciudad Universitaria, C.P. 04510, Coyoacán, Ciudad de México, México. E-mail: melisa.pardo@comunidad.unam.mx
Conflict of interests: nothing to declare – **Financial support**: none.

RESUMEN: ***Objetivo:*** El principal objetivo fue analizar el nivel y la tendencia de la carga de mortalidad del suicidio en México entre 1990 y 2017, a escala nacional y estatal. ***Métodos:*** Análisis secundario basado en el estudio de la Carga Global de la Enfermedad de 2017. Se reportan tasas de mortalidad y los años de vida perdidos por muerte prematura (APMP). Para analizar la tendencia de los APMP se realizó un análisis de regresión *joinpoint* basado en el modelo log-lineal. ***Resultados:*** La carga de la enfermedad por suicidio se incrementó en México, principalmente en hombres y mujeres jóvenes; aunque el aumento en los adultos mayores es un reto adicional para los servicios de salud. La carga de la enfermedad varía sustancialmente entre los estados del país. Las tasas de mortalidad masculinas fueron mayores a las femeninas durante todo el periodo de estudio, aunque con una tendencia a reducir la diferencia entre ambos sexos. Se observó un patrón bimodal de la carga de la enfermedad por suicidio en México, con mayores tasas en los 15-19 años de edad y un importante incremento a partir de los 85 años de edad. ***Conclusión:*** los resultados obtenidos ponen de manifiesto un panorama preocupante, no solo desde el punto de vista social, económico y de salud, sino también en cuanto a las necesidades en materia de políticas públicas. Esto representa una llamada de atención sobre la necesidad de implementar acciones de identificación oportuna, una estrategia integral multisectorial de prevención y el estudio detallado de los factores de riesgo asociados.

Palabras clave: Suicidio. México. Años de vida perdidos. Mortalidad.

INTRODUCTION

Suicide is one of the main public health problems worldwide, which entails premature loss of life and a great social and economic burden on society[1]. It represents about half of the violent deaths of men and more than 70% for women[2-4]. In 2017, 800,000 suicides occurred (1.4% of the total deaths in the world) with a mortality rate of 10.4 per 100,000 inhabitants (6.7 for women and 14.1 for men)[5,6]. Suicide is the second leading cause of death worldwide between 15 and 29 years of age; and in adults from 30 to 49 years old, it is the fifth[3].

Most suicides occur in developing countries[7], where early identification is complicated because resources and services are scarce and limited, and sequelae treatment and support are insufficient[3]. In Latin America and the Caribbean, suicide mortality rates are low (6.1 suicides per 100,000 inhabitants), but in the last 20 years they have increased throughout the region[3]. In Mexico, suicide mortality has increased steadily for more than 40 years[8,9]. The rate went from 1.13 suicides in 1970[10] to 5.31 suicides in 2017. This increase occurred mainly in young people[8,9]. Suicide is the third leading cause of death in the 15-29 age group, behind only homicides and motor vehicle accidents. It is the first cause of death for women and the third for men between 10 and 19 years of age. Between 1990 and 2017, the suicide rate between 10-19 years of age tripled nationwide (from 1.56 to 4.5 suicides per 100,000).

States in Mexico are at different stages of the epidemiological transition. This translates into a wide heterogeneity of the mortality rate that leads to a dissonant transition in health among the federal entities[11]. This uneven transition in health implies a huge public health challenge. These inequalities emphasize the need to carry out detailed analyses of the trends

in the burden of suicide mortality in each federal state of the country to generate evidence that can be used for planning and evaluating suicide prevention policies and programs[12,13]. Despite the importance of this type of research, there are few studies that analyze the trend in mortality from suicide and the burden of mortality caused by this cause of death in Mexico and its states. That is why the main objective of this study is to analyze the level and trend of the mortality rate of suicide in Mexico between 1990 and 2017, at the national and state level, based on mortality rates and years of life lost due to premature death (YLL).

METHODS

A secondary analysis was carried out based on the 2017 Global Burden of Disease (GBD) study, which aimed to quantify the magnitude of health losses caused by diseases, injuries, and risk factors, locally, nationally, regionally, and globally[14]; to provide a standardized analytical approach that estimates the incidence, prevalence, and years that the disabled population lives by year, gender, cause, year, and location[15]. The study covers 195 countries and territories, with a sub-national disaggregation in 17 countries[16]. The GBD uses various sources of information: censuses, surveys, hospital records, administrative records, verbal autopsies, and others[16,17]; and for suicides, it uses administrative records and verbal autopsies[18].

The definition of suicide from the International Classification of Diseases (ICD-10) (codes X60-X84; Y870) was adopted. The information was disaggregated nationally and by state, gender, and age group, between 1990 and 2017. Emphasis is placed on the analysis of the impact of suicide on mortality, for which data on the mortality rate and the YLL are presented. To describe the degree of confidence of each indicator, given the uncertainty in the initial data and the subsequent calculations, the GBD generates the respective 95% confidence intervals (95% CI)[14,16]. Due to the incorrect assignment of certain deaths by suicide[19], the GBD makes a correction of the information, redistributing the deaths of codes due to ill-defined external causes (Y10-Y34), exposure to unspecified factors (X59), and other ill-defined causes (R99)[18] which may include deaths from suicide[20].

In order to obtain the YLL, the lowest specific mortality rates observed by location and gender were calculated in all estimation years in populations greater than 5 million people to establish a theoretical minimum risk reference table[16] and thus avoid problems with small populations[6]. YLL are a metric obtained by multiplying the estimated number of deaths by the life expectancy referenced at the age of death[16,21]. This indicator weighs premature deaths by applying a greater weight to those deaths that occur in the youngest[16]; provides a simple method to identify causes of death that need intervention[22]; and determines the social cost of causes of death[23].

To analyze the trend of YLL rates, a segmented regression analysis (joinpoint regression) was performed based on a log-linear model[24]. This method describes changes in the trend of rates in successive segments over time and the amount of change in each of them. The resulting line between each cutoff point is described by the annual percentage change

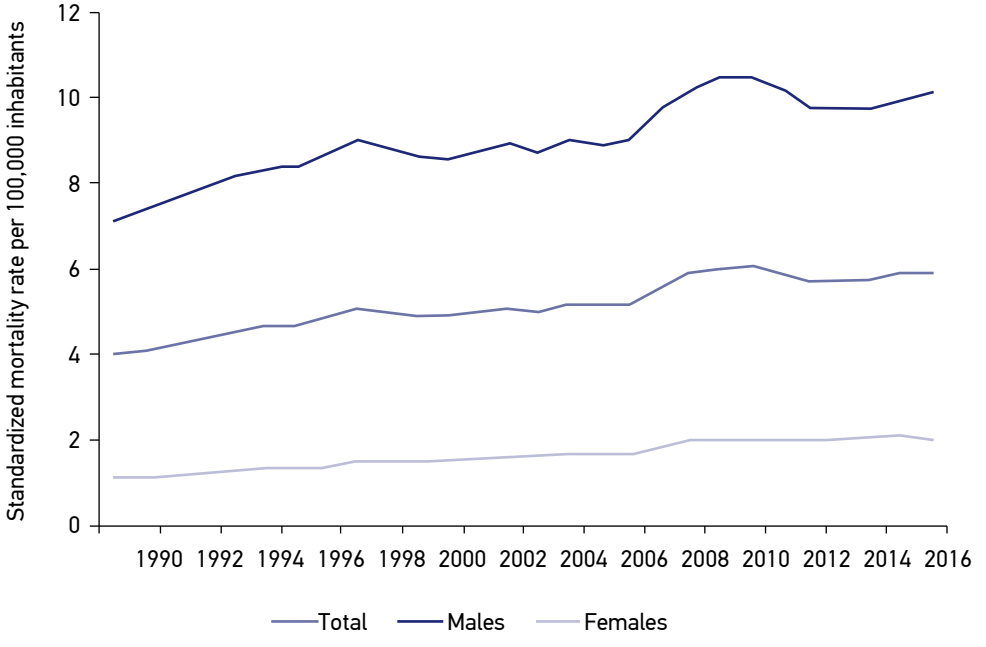
(APC), based on the slope of the line in that section and the mean APC[22]. These models start with the minimum number of nodes in the trend (a straight line) and test if the slope of the trend in each segment is statistically different from a previous one[25]. A statistical significance level of 5% was used. The Bayesian information criterion (BIC) and degrees of freedom were included as a measure of adequacy. The analysis was performed using the Joinpoint Regression 4.6.0.0 software.

Since aggregated secondary data was used, the confidentiality of the subjects under study is guaranteed, thus, there are no ethical conflicts. All the databases used in this study are accessible to the public.

RESULTS

According to the GBD, the number of suicides in Mexico increased from 2,851 in 1990 to 7,634 in 2017, 0.66% and 1.1% of total deaths, respectively. This is reflected in the increased mortality rate for both genders (Figure 1), going from 4 suicides per 100,000 inhabitants (95%CI 3.9 – 4.1) in 1990 to 5.9 suicides (95%CI 5.7 – 6.1) in 2017. The female rate increased in a greater proportion than the male one (84 *vs*. 42%), so the male / female ratio of the rates varied from 6.4 male suicides for each female suicide in 1990, to 4.9 in 2017.

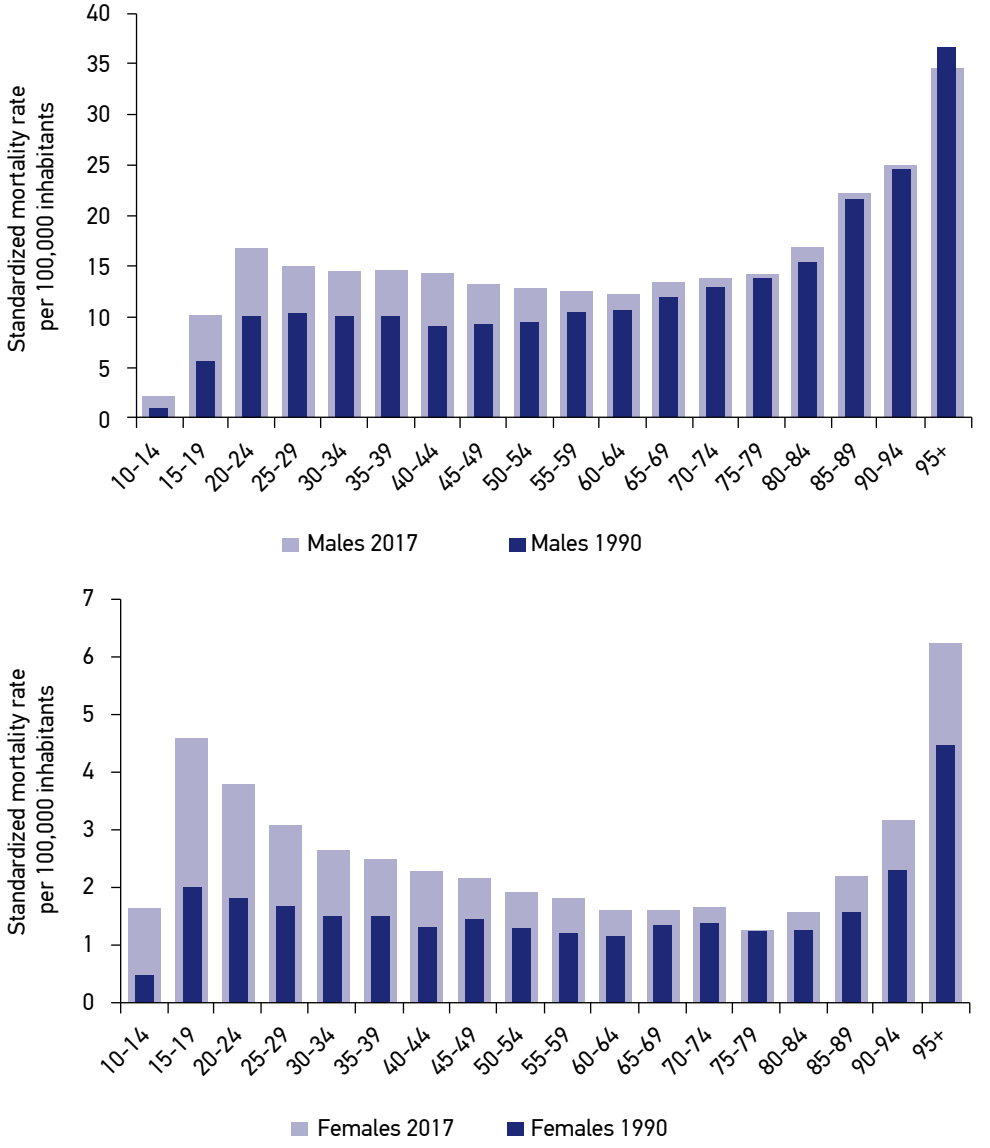
Suicide rates reached the highest level in the last age groups in both genders (Figure 2). The male rate increased between 1990 and 2017 in almost all age groups, except in those



Source: based on data from IHME[5].

Figure 1. Standardized suicide mortality rates by gender, Mexico 1990-2017.

over 95 years of age. This increase occurred in those under 50 years of age, with a percentage greater than 42% in these age groups, highlighting an increase of 122.4% in adolescents from 10 to 14 years old and 81.4% in those of 15 at 19 years old. For women, the rate increased at all ages. This change occurred to a greater extent in those younger than 45 years, whose percentage of change exceeded 68% in those age groups; the age groups of 10–14 and 15–24 years old stand out, with an increase of 243.3% in the former and greater



Source: based on data from IHME[5].

Figure 2. Standardized suicide mortality rates by age and gender, Mexico 1990-2017: (A) males; (B) females.

than 110% in the latter. The female rates presented a bimodal distribution, with the highest rates located in the age groups of 15–19 years old and in those older than 95 years; while the highest male rates occurred in the 95-year-old and older group.

In 1990, deaths from suicide translated to a total of 149,361 YLL, a figure that increased to 384,213 in 2017. The highest number of YLL occurred in young people and adults (between 15–45 years of age), where more than 77% were concentrated of the total YLL for this cause, reaching the highest level in the group of 20-24 years of age. YLL increased across the age range between 1990 and 2017, with increases of more than 120%. The segmented regression analysis of the YLL rates shows that the cut-off points were located in 1997, 2006, and 2010 (Table 1), dividing the trend into four significantly different periods: 1990–1997; 1997–2006; 2006–2010; and 2010–2017. In the three periods from 1990 to 2010, there was an increase in YLL for suicide (with a significant APC of 3.3, 0.7 and 5.1%); in the last period (2010–2017), the YLL rate presented a significant reduction (a APC of -0.9%). The YLL rate showed a similar trend between men and women, with increasing behavior for men (52.4%) and women throughout the entire period, highlighting that this rate almost doubled for women. It is worth noting that the male YLL rate exceeded the female rate, although the greater increase in female rates reduced the gender gaps, which reflected in a lower ratio of men/women (from 5.7 in 1990 to 4.3 in 2017).

The burden of suicide mortality varied among the states. Tabasco, Campeche, Quintana Roo, and Yucatán (located in the southeast of the country) presented the highest mortality rates and YLL from suicide in 1990 and in 2017 for both genders; and for women, Chihuahua was among the states with the highest rates in both years (Figure 3). Guerrero, Sinaloa, Hidalgo, and Tlaxcala were the states with the lowest values in both male rates; while for women it was Sinaloa and Baja California (Table 2). The entities with a greater change in both indicators were Guanajuato, Aguascalientes, Mexico, Jalisco, Puebla, Chiapas, Yucatan, and Quintana Roo, all of them with increases greater than 62% in both rates; Guanajuato highlights that it doubled its YLL rate (an increase of 120%); and for women, Chihuahua and Durango showed a significant increase during the period. In contrast, the states with the least increase in the suicide mortality burden were Colima, Sinaloa, Baja California, Tamaulipas, and Tabasco; Hidalgo and Oaxaca had a low increase for women; and for men, Tamaulipas and Tabasco presented a reduction in both indicators. In all states, men had greater suicide rates than women. A reduction in the male/female ratio of the rates was observed in all states, except Chiapas; those where there was greater reduction in this indicator were Baja California, Baja California Sur, Chihuahua, Coahuila, Nuevo León, Sonora, Tamaulipas (all of them located in the north of the country), and Tabasco.

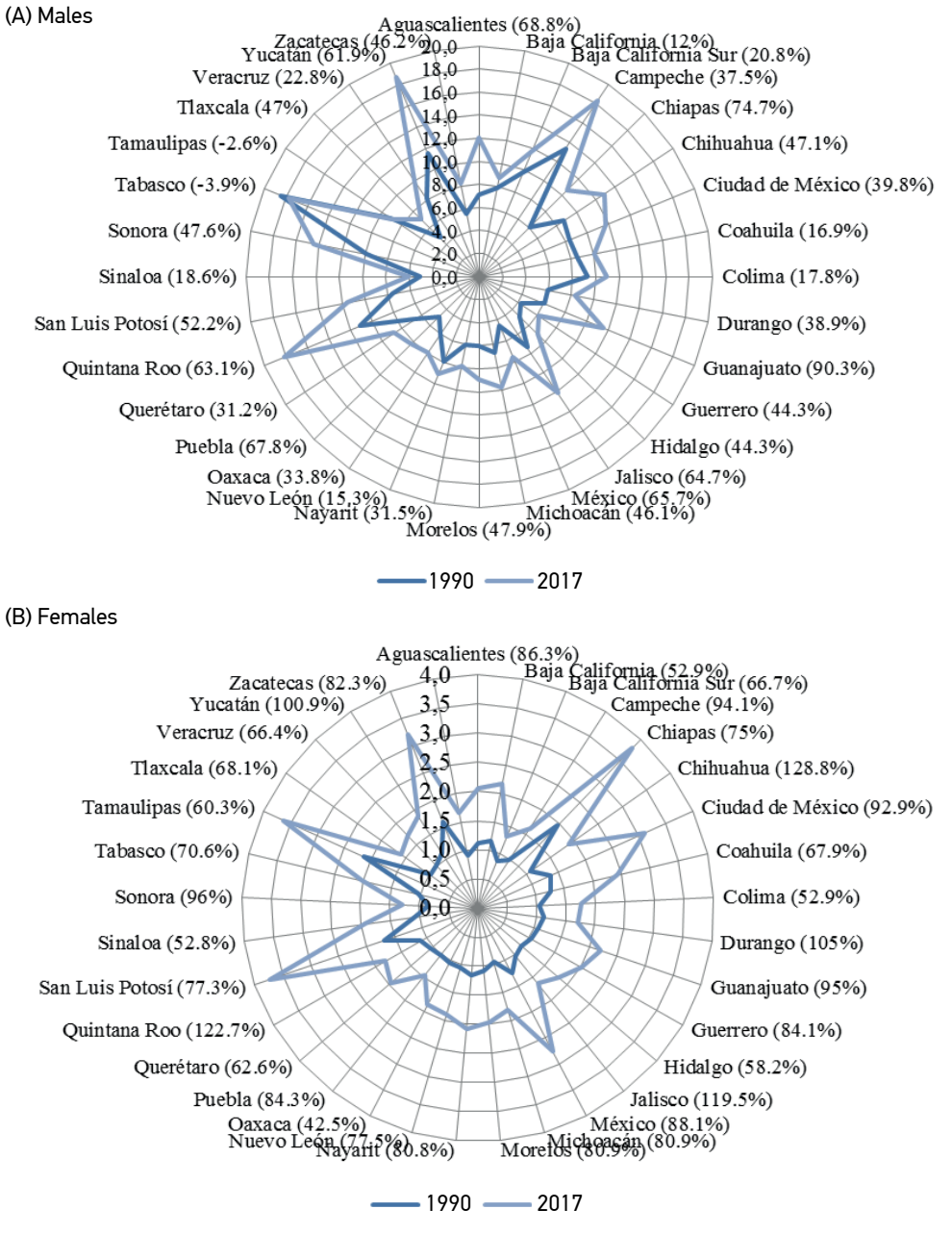
Table 1 presents the results of the joinpoint regression analysis of YLL rates by state. It is observed that Aguascalientes, Guanajuato, and the State of Mexico had the highest APC (3%) in the entire period; Baja California and Tamaulipas had little and no significant growth; while Tabasco was the only state entity with a decrease (APC of -0.34). Among those states with the highest increase throughout the period, it is worth noting that Aguascalientes presented a trend divided into three periods, two of them with significant growth; in turn,

Table 1. Joinpoint analysis of years of life lost due to premature death (YLL) by suicides by state, Mexico 1990–2017.

State	Period 1		Period 2		Period 3		Period 4		DF	BIC
	Years	APC	Years	APC	Years	APC	Years	APC		
National	90–97	3.3*	97–06	0.7*	06–10	5.1*	10–17	-0.9*	20	-7.15
AGS	90–07	3.0*	07–11	5.5*	11–17	-0.4	-	-	22	-7.29
BC	90–97	5.2*	97–13	-1.2*	13–17	1.2	-	-	22	-6.26
BCS	90–96	4.6*	96–10	1.2*	10–13	-5.9	13–17	0.4	20	-6.65
CAM	90–07	1.0*	07–10	6.0*	10–13	-2.1	13–17	1.9*	20	-7.14
CHS	90–98	4.8*	98–04	-1.0	04–10	6.7*	10–17	-0.9	20	-6.70
CHI	90–98	5.1*	98–10	1.3*	10–17	-0.9	-	-	22	-6.61
COA	90–07	2.3*	07–10	-6.6	10–17	-3.4*	-	-	22	-6.64
COL	90–93	2.2	93–07	-0.1	07–10	4.8	10–17	0.1	20	-7.66
CDMX	90–95	5.9*	95–05	-1.0	05–17	3.0*	-	-	22	-5.86
DUR	90–06	2.3*	06–09	13.3*	09–17	-3.7*	-	-	22	-6.74
GUA	90–98	4.8*	98–06	1.5*	06–09	7.5*	09–17	1.1*	20	-7.12
GUE	90–04	1.8*	04–11	5.7*	11–14	-9.5	14–17	1.4	20	-6.13
HID	90–98	3.7*	98–06	-0.5	06–09	8.8*	09–17	-1.0*	20	-6.67
JAL	90–95	5.5*	95–17	1.6*	-	-	-	-	22	-6.30
MEX	90–95	0.0	95–06	2.3*	06–10	9.2*	10–17	0.3	20	-7.06
MICH	90–96	6.4*	96–04	-0.8	04–09	3.2*	09–17	-0.7	20	-6.81
MOR	90–96	2.9*	96–06	-0.8	06–09	9.7	09–17	0.3	20	-5.97
NAY	90–00	0.8*	00–03	6.0	03–17	0.7*	-	-	22	-6.53
NL	90–95	-0.7	95–10	3.3*	10–14	-4.9*	14–17	1.4	20	-6.27
OAX	90–06	1.2*	06–10	5.2*	10–13	-5.3	13–17	1.9	20	-6.52
PUE	90–95	4.2*	95–17	2.0*	-	-	-	-	24	-6.17
QUE	90–99	3.7*	99–07	-1.0*	07–10	8.3*	10–17	-1.3*	20	-6.91
QR	90–04	2.1*	04–09	7.3*	09–14	-4.3*	14–17	3.6*	20	-7.46
SLP	90–98	3.0*	98–07	1.3*	07–10	7.7*	10–17	-1.1*	20	-7.30
SIN	90–95	4.8*	95–11	1.0*	11–17	-2.5*	-	-	22	-6.93
SON	90–97	4.8*	97–07	0.3	07–10	6.4*	10–17	-0.8	20	-7.13
TAB	90–98	2.8*	98–01	-7.2	01–09	1.6*	09–17	-2.3*	20	-6.24
TAM	90–10	1.0*	10–17	-3.6*	-	-	-	-	24	-6.58
TLX	90–97	3.1*	97–06	-0.3	06–10	7.5*	10–17	-0.1	20	-6.38
VER	90–98	4.0*	98–07	0.0	07–10	5.2	10–17	-2.7*	20	-6.44
YUC	90–04	2.2*	04–10	4.0*	10–14	-2.5*	14–17	5.3*	20	-7.32
ZAC	90–07	2.0*	07–10	7.6*	10–13	-5.1	13–17	0.9	20	-6.40

APC: anual percentage change; *statistically significant trend; DF: degrees of freedom; BIC: Bayesian information criterion; AGS: Aguascalientes; BC: Baja California; BCS: Baja California Sur; CAM: Campeche; CHS: Chiapas; CHI: Chihuahua; COA: Coahuila; COL: Colima; CDMX: Ciudad de México; DUR: Durango; GUA: Guanajuato; GUE: Guerrero; HID: Hidalgo; JAL: Jalisco; MEX: México; MICH: Michoacán; MOR: Morelos; NAY: Nayarit; NL: Nuevo León; OAX: Oaxaca; PUE: Puebla; QUE: Querétaro; QR: Quintana Roo; SLP: San Luis Potosí; SIN: Sinaloa; SON: Sonora; TAB: Tabasco; TAM: Tamaulipas; TLX: Tlaxcala; VER: Veracruz; YUC: Yucatán; ZAC: Zacatecas.
Source: based on data from IHME[5].

Guanajuato had four periods of significant increase, with the period of greatest increase located between 2006 and 2009; while in the State of Mexico, there was a stability of the rates as of 2010. It was also observed that 11 states presented at least two periods of very



*The figures in parentheses indicate the percentage change in the indicator between 1990 and 2017.
Source: based on data from IHME[5].

Figure 3. Standardized suicide mortality rates, by state and gender, 1990 and 2017: (A) males; (B) females.

Table 2. Years of life lost due to premature death (YLL) from suicide in Mexico and percentage change between 1990-2017 by state and gender.

Year	Males			Females		
	1990	2017	% Cambio	1990	2017	% Cambio
National	322.0	483.9	50.3%	56.9	112.3	97.4%
Aguascalientes	308.8	582.5	88.6%	58.1	118.2	103.4%
Baja California	359.0	398.3	11.0%	43.2	69.4	60.6%
Baja California Sur	423.1	531.0	25.5%	48.8	85.3	74.8%
Campeche	627.8	865.0	37.8%	99.8	199.0	99.4%
Chiapas	280.4	529.5	88.9%	57.0	105.0	84.2%
Chihuahua	398.3	586.5	47.3%	69.2	172.4	149.2%
Ciudad de México	362.4	565.4	56.0%	63.2	133.7	111.6%
Coahuila	369.9	467.9	26.5%	51.8	90.6	74.9%
Colima	412.7	490.8	18.9%	56.2	87.8	56.2%
Durango	271.5	395.3	45.6%	53.1	120.0	125.9%
Guanajuato	267.5	585.7	118.9%	51.9	111.6	115.0%
Guerrero	203.2	298.7	47.0%	52.2	102.6	96.6%
Hidalgo	221.4	341.9	54.5%	53.8	90.4	67.9%
Jalisco	333.9	576.3	72.6%	63.2	151.3	139.3%
México	203.5	375.7	84.7%	48.2	101.5	110.5%
Michoacán	315.1	479.0	52.0%	55.6	108.9	95.7%
Morelos	278.8	421.3	51.1%	58.7	111.0	88.9%
Nayarit	282.3	375.0	32.8%	54.0	103.0	90.6%
Nuevo León	339.9	419.8	23.5%	51.1	99.2	94.1%
Oaxaca	280.9	392.4	39.7%	53.7	80.3	49.7%
Puebla	219.9	406.8	85.0%	55.1	108.6	97.3%
Querétaro	296.9	415.4	39.9%	56.5	96.6	71.2%
Quintana Roo	496.8	827.3	66.5%	86.8	193.7	123.2%
San Luis Potosí	349.6	566.3	62.0%	56.3	107.1	90.3%
Sinaloa	230.3	268.8	16.7%	41.5	69.1	66.5%
Sonora	425.1	659.7	55.2%	51.4	108.6	111.3%
Tabasco	893.9	838.3	-6.2%	112.0	198.6	77.3%
Tamaulipas	413.6	389.8	-5.8%	49.7	82.1	65.2%
Tlaxcala	217.8	339.1	55.7%	53.0	94.5	78.5%
Veracruz	373.0	466.0	24.9%	59.0	101.4	71.9%
Yucatán	504.6	885.1	75.4%	77.8	167.7	115.4%
Zacatecas	263.5	389.6	47.8%	46.8	89.1	90.6%
Rate level	Low	Medium	High			
Percentage of change	Low	Medium	High			

Source: based on data from IHME[5].

high significant growth (greater than 3% annually). It is important to mention that despite the fact that the majority of the states presented an increase in the YLL, not all of them occurred in a sustained manner since in Coahuila, Durango Sinaloa, Tamaulipas (located in the north of the country), Querétaro, San Luis Potosí, Hidalgo, Tabasco, and Veracruz had a significant decrease in the YLL rate from 2009 or 2010 (Annexes 1, 2, 3 and 4).

DISCUSSION

The main objective of this work was to analyze the level and trend of death rates and YLL from suicide in Mexico between 1990 and 2017, at the national and state levels. During the 28 years under study, the burden of disease increased in Mexico. It was observed that young people in Mexico kill themselves at an alarmingly high rate, which could be classified as a public health crisis[12], since it is the leading cause of death in Mexico for adolescent women aged 10–19 years and the third cause of death among men. The burden of the disease increased mainly in young people; but the increase observed in older adults outlines an additional challenge for health services. There are notable differences in suicide mortality between the genders and the burden of the disease varies substantially between states. The trends analyzed here can serve as input to implement policies for the prevention and monitoring of the suicide burden at the state level[12].

Male mortality rates were higher than female mortality rates, but with a tendency to reduce the difference between the genders, reflected in the fact that the male-female ratio of the rates decreased in the study period. Although suicides by gender vary throughout the world, in most countries there is a higher male mortality rate[3], as is the case in Mexico. It is known that women make more suicide attempts, but men usually see through with it more often. This is known as the "gender paradox" of suicide[3,26-28]. A possible explanation for this is related to the gender identity models due to which men become intentionally exposed to risky situations[29]. Also, differences in socially acceptable methods of dealing with stress and conflict for men and women and differences in patterns of alcohol consumption[3,30-33] have been cited as causing the divergence in mortality from suicide between the genders, as well as their resorting more frequently to violent and lethal methods of committing suicide, such as hanging or shooting with a fire weapon, while women usually use poisoning with various chemical substances[34,35]. As men, boys learn to take risks, internalizing the behaviors associated with masculinity[29]. This is expressed mainly during adolescence and young adulthood, ages at which intentional exposure to risky situations becomes an expected social situation that legitimizes them as men, although they expose their health and well-being in the process and, in some cases, may be lead to find their own death[36]. That is why the observed trends in female mortality from suicide and its continuous increase in men suggest the need to continue evaluating the complex relationships between gender and suicidal behavior to facilitate the development of prevention strategies[37,38]. This is relevant, since Mexico is against the current trend of suicide in the

world that, according to the WHO[3] and the GBD[5], adjusted suicide rates have decreased in recent years for both genders, while in the country there was an increase in the same period; being more notorious in the female rate[39].

YLL's national trend for suicide grew until 2010; and from that year on, there was a slight decrease. This increase has been explained by social, demographic, and economic factors, such as the growing economic and social deterioration, and limited access to education and well-paid jobs[8]. It is not surprising that in the two periods of greatest increase (1990–1997 and 2006–2010), two of the main economic crises in the country in the last 30 years occurred (1994 and 2008); In addition to this, there has been a social deterioration in the country since 2007 with the increase in mortality from homicides[11]. The decreasing trend of the YLL between 2010 and 2017 opens the door for future research to investigate what were the factors related to this behavior of the phenomenon.

Although national-scale estimates are necessary to show the level and general trend of the phenomenon, they hide the large variations in suicide mortality rates per state in Mexico that were observed from the analysis of the level of death rates and from YLL, from the study of trends and the male-female ratio. A wide heterogeneity of the suicide mortality burden was observed between the states, both in the level reached and in the trends and percentages of growth. This is related to a dissonant transition in health between the country's federal entities[11].

By age, a bimodal pattern of the burden of suicide disease was observed in Mexico, with higher female rates in those aged 15–19 years old and an increase from 85 years of age on. A similar pattern emerged in men, although the maximum value in young ages was less marked than in women. An important result is that the greatest growth in the mortality burden from suicide occurred among the youngest, in both genders, which is consistent with other studies carried out in Mexico[8,9,40] and in other contexts[22,41-43]. Adolescence is a period of transition between childhood and early adulthood characterized by major emotional, social, and physical changes that occur during this crucial moment of development, which can facilitate the development of depressive symptoms or suicidal behaviors due to the inability to face such changes[44]. Older adults are also a vulnerable group to suicide. Social isolation, depression, functional disability, illness, and feeling like a burden on the family have been reported among the reasons expressed for developing suicidal ideation in this age group[45-47]. However, little research has been conducted in Mexico on suicide in this age group. Given the aging population in which the country is immersed, the study of the increase in the burden of suicide disease in older adults should be addressed in more detail to provide empirical evidence that leads to the development of strategies and directed actions to decrease the prevalence of suicide in this population group.

According to Durkheim[48], suicide occurs in societies with disintegration, lack of cohesion, and little coexistence between the community and the institutions, which is why it can be considered as a reflection of them, lacking social cohesion and a sense of belonging. Thus, the results obtained show a worrying panorama, not only from the social, economic, and health point of view, but also in terms of public policy needs. They represent a wake-up call on the need to implement timely identification actions, a comprehensive multi-sectoral prevention

strategy and the detailed study of associated risk factors. Suicide prevention should be based on strategies such as: the identification and treatment of individuals with mental disorders, promoting mental health[9]; increasing access to health care; promoting a reduction in the harmful consumption of alcohol and substances; limiting access to usable means of committing suicide such as firearm control; promoting responsible information by the media; and better training of health personnel in the management of mental and substance abuse disorders[3].

Despite the relevance of the results obtained, some limitations of the study must be considered. There is a certain tendency to hide suicide cases for cultural or religious reasons, as well as for problems in the registration procedure; therefore, the information may be underreported[49], which would imply that mortality rates and YLL may be underestimated. However, the GBD study presents an advanced statistical methodology focused on reducing biases that arise when estimating mortality causes[14]. This makes it a key source, although it has been little explored in the region despite its wealth of data and timing, for the formulation of public policies.

CONCLUSION

The increasing trend of the burden of suicide disease in Mexico is a serious public health problem. Suicide is one of the main causes of death in young people in Mexico, whose prevalence has increased over time. This report provides an analysis of the trend of suicide in the states of the country in the last 28 years. This analysis opens the doors for future research on the social, economic, and political reasons that led to the behavior of suicide mortality in the country and in the states. A national suicide prevention strategy is necessary, adapted to the context of each state, and which takes into account all the variations in the trends observed among the federal entities[12], to reduce the suicide rates in Mexico.

REFERENCES

1. Brazinova A, Moravansky N, Gulis G, Skodacek I. Suicide rate trends in the Slovak Republic in 1993-2015. Int J Soc Psychiatry 2017; 63(2): 161-8. https://doi.org/10.1177/0020764016688715
2. Machado DB, Rasella D, Dos Santos DN. Impact of income inequality and other social determinants on suicide rate in Brazil. PLoS One 2015; 10(4): e0124934. https://doi.org/10.1371/journal.pone.0124934
3. World Health Organization. Preventing suicide: A global imperative. Geneva: World Health Organization; 2014.
4. Rendon-Quintero E, Rodríguez-Gómez R. [Experiences of Individuals With Suicidal Ideation and Attempts]. Rev Colomb Psiquiatr 2016; 45(2): 92-100. https://doi.org/10.1016/j.rcp.2015.08.003
5. Evaluation IfHMa. GBD compare: data visualization 2019 [Internet]. 2019 [acceso en el 20 jun. 2019]. Disponible en: https://vizhub.healthdata.org/gbd-compare/.
6. GBD 2016 Causes of Death Collaborators. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet 2017; 390(10100): 1151-210. https://doi.org/10.1016/S0140-6736(17)32152-9

7. Nakanishi M, Endo K, Ando S. The Basic Act for Suicide Prevention: Effects on Longitudinal Trend in Deliberate Self-Harm with Reference to National Suicide Data for 1996-2014. Int J Environ Res Public Health 2017; 14(1): 104. https://dx.doi.org/10.3390%2Fijerph14010104
8. Hernandez-Bringas HH, Flores-Arenales R. Suicide in Mexico. Papeles Poblac 2011; 17(68): 69-101.
9. Borges G, Orozco R, Benjet C, Medina-Mora ME. Suicide and suicidal behaviors in Mexico: Retrospective and current status. Salud Publica Mexico 2010; 52(4): 292-304.
10. Borges G, Rosovsky H, Gómez C, Gutiérrez R. Epidemiology of suicide in Mexico from 1970 to 1994. Salud Publica Mexico 1996; 38(3): 197-206.
11. Gómez-Dantés H, Fullman N, Lamadrid-Figueroa H, Cahuana-Hurtado L, Darney B, Avila-Burgos L, et al. Dissonant health transition in the states of Mexico, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2016; 388(10058): 2386-402. https://doi.org/10.1016/S0140-6736(16)31773-1
12. India State-Level Disease Burden Initiative Suicide Collaborators. Gender differentials and state variations in suicide deaths in India: the Global Burden of Disease Study 1990-2016. Lancet Public Health 2018; 3(10): E478-E89. https://doi.org/10.1016/S2468-2667(18)30138-5
13. Bosetti C, Bertuccio P, Malvezzi M, Levi F, Chatenoud L, Negri E, et al. Cancer mortality in Europe, 2005–2009, and an overview of trends since 1980. Ann Oncol 2013; 24(10): 2657-71. https://doi.org/10.1093/annonc/mdt301
14. Murray CJL, Lopez AD. Measuring global health: motivation and evolution of the Global Burden of Disease Study. Lancet 2017; 390(10100): 1460-4. https://doi.org/10.1016/S0140-6736(17)32367-X
15. GBD 2015 Disease and Injury Incidence and Prevalence Collaborators. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016; 388(10053): 1545-602.
16. GBD 2017 Causes of Death Collaborators. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018; 392(10159): 1736-88. https://doi.org/10.1016/S0140-6736(18)32203-7
17. GBD 2017 Mortality Collaborators. Global, regional, and national age-sex-specific mortality and life expectancy, 1950-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet 2018; 392(10159): 1684-735. https://doi.org/10.1016/S0140-6736(18)31891-9
18. Naghavi M, Global Burden of Disease Self-Harm Collaborators. Global, regional, and national burden of suicide mortality 1990 to 2016: systematic analysis for the Global Burden of Disease Study 2016. BMJ 2019; 364: 194. https://doi.org/10.1136/bmj.l94
19. Tøllefsen IM, Hem E, Ekeberg Ø. The reliability of suicide statistics: a systematic review. BMC Psychiatry 2012; 12: 9. https://doi.org/10.1186/1471-244X-12-9
20. GBD 2017 Causes of Death Collaborators. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017. The Lancet 2018; 392(10159): 1736-88. https://doi.org/10.1016/S0140-6736(18)32203-7
21. GBD 2015 Mortality and Causes of Death Collaborators. Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 2016; 388(10053): 1459-544. https://doi.org/10.1016/S0140-6736(16)31012-1
22. Izadi N, Mirtorabi SD, Najafi F, Nazparvar B, Nazari Kangavari H, Nazari SSH. Trend of years of life lost due to suicide in Iran (2006-2015). Int J Public Health 2018; 63(8): 993-1000. https://doi.org/10.1007/s00038-018-1151-1
23. Kamel MH, Moore PC, Bissada NK, Heshmat SM. Potential years of life lost due to urogenital cancer in the United States: trends from 1972 to 2006 based on data from the SEER database. J Urol 2012; 187(3): 868-71. https://doi.org/10.1016/j.juro.2011.10.142
24. López-Campos JL, Ruiz-Ramos M, Soriano JB. Mortality trends in chronic obstructive pulmonary disease in Europe, 1994-2010: a joinpoint regression analysis. Lancet Respir Med 2014; 2(1): 54-62. https://doi.org/10.1016/S2213-2600(13)70232-7
25. Svihrova V, Barakova A, Szaboova V, Kamensky G, Hudeckova H. Trends in standardized mortality rates for select groups of cardiovascular diseases in Slovakia between 1980 and 2010. Public Health 2016; 130: 43-50. https://doi.org/10.1016/j.puhe.2015.09.006
26. Vijayakumar L. Suicide Prevention: Beyond Mental Disorder. Indian J Psychol Med 2016; 38(6): 514-6. https://dx.doi.org/10.4103%2F0253-7176.194916
27. Runeson B, Tidemalm D, Dahlin M, Lichtenstein P, Langstrom N. Method of attempted suicide as predictor of subsequent successful suicide: national long term cohort study. BMJ 2010; 341: c3222. https://doi.org/10.1136/bmj.c3222
28. Canetto SS, Sakinofsky I. The gender paradox in suicide. Suicide Life Threat Behav 1998; 28(1): 1-23.
29. Figueroa JG. El derecho a la salud en la experiencia de los varones: ¿un concepto ambivalente en los modelos de masculinidad vigentes? Coeducando 2007; 1: 77-97.

30. Devries K, Watts C, Yoshihama M, Kiss L, Schraiber LB, Deyessa N, et al. Violence against women is strongly associated with suicide attempts: evidence from the WHO multi-country study on women's health and domestic violence against women. Soc Sci Med 2011; 73(1): 79-86. https://doi.org/10.1016/j.socscimed.2011.05.006
31. Maselko J, Patel V. Why women attempt suicide: the role of mental illness and social disadvantage in a community cohort study in India. J Epidemiol Community Health 2008; 62(9): 817-22. https://doi.org/10.1136/jech.2007.069351
32. Manoranjitham SD, Rajkumar AP, Thangadurai P, Prasad J, Jayakaran R, Jacob KS. Risk factors for suicide in rural south India. Br J Psychiatry 2010; 196(1): 26-30. https://doi.org/10.1192/bjp.bp.108.063347
33. Parkar SR, Nagarsekar BB, Weiss MG. Explaining suicide: identifying common themes and diverse perspectives in an urban Mumbai slum. Soc Sci Med 2012; 75(11): 2037-46. https://doi.org/10.1016/j.socscimed.2012.07.002
34. Beautrais AL. Gender issues in youth suicidal behaviour. Emerg Med (Fremantle) 2002; 14(1): 35-42. https://doi.org/10.1046/j.1442-2026.2002.00283.x
35. Híjar M, Rascón R, Blanco J, López MV. Los suicidios en México. Características sexuales y geográficas (1979-1993). Revista Salud Mental 1996; 19(4): 14-21.
36. Treviño S, Villanueva M, Marcelino Y, Álvarez F. Masculinidad, accidentes viales y políticas públicas. In: Figueroa JG, editor. Políticas públicas y la experiencia de ser hombre Paternidad, espacios laborales, salud y educación. Ciudad de México: El Colegio de México; 2014. p. 71-121.
37. Dandona R, Bertozzi-Villa A, Kumar GA, Dandona L. Lessons from a decade of suicide surveillance in India: who, why and how? Int J Epidemiol 2017; 46(3): 983-93. https://doi.org/10.1093/ije/dyw113
38. Vijayakumar L. Suicide in women. Indian J Psychiatry 2015;57(Supl. 2): S233-8. https://doi.org/10.4103/0019-5545.161484
39. Borges G, Garcia JA, Borsani L. Epidemiologia de las conductas suicidas en Mexico. In: Organización Panamericana de la Salud, editor. Prevención de la conducta suicida. Washington, D.C.: Organización Panamericana de la Salud; 2016. p. 48-56.
40. Dávila CA, Pardo AM. [Suicide mortality in Colombia and Mexico: Trends and impact between 2000 and 2013]. Biomedica 2016; 36(3): 415-22. https://doi.org/10.7705/biomedica.v36i3.3224
41. Hedegaard H, Curtin SC, Warner M. Suicide Mortality in the United States, 1999-2017. NCHS Data Brief 2018; (330): 1-8.
42. Laanani M, Ghosn W, Jougla E, Rey G. Impact of unemployment variations on suicide mortality in Western European countries (2000-2010). J Epidemiol Community Health 2015; 69(2): 103-9. https://doi.org/10.1136/jech-2013-203624
43. Mascayano F, Irrazabal M, D Emilia W, Vaner SJ, Sapag JC, Alvarado R, et al. Suicide in Latin America: a growing public health issue. Rev Fac Cien Med Univ Nac Cordoba 2015; 72(4): 295-303.
44. Braush AM, Muehlenkamp JJ. Body image and suicidal ideation in adolescents. Body Image 2007; 4(2): 207-12. https://doi.org/10.1016/j.bodyim.2007.02.001
45. Wand APF, Peisah C, Draper B, Brodaty H. Why Do the Very Old Self-Harm? A Qualitative Study. Am J Geriatr Psychiatry 2018; 26(8): 862-71. https://doi.org/10.1016/j.jagp.2018.03.005
46. Wei J, Zhang J, Deng Y, Sun L, Guo P. Suicidal Ideation among the Chinese Elderly and Its Correlates: A Comparison between the Rural and Urban Populations. Int J Environ Res Public Health 2018; 15(3). https://doi.org/10.3390/ijerph15030422
47. Wiktorsson S, Rydberg Sterner T, Mellqvist Fässberg M, Skoog I, Ingeborg Berg A, Duberstein P, et al. Few Sex Differences in Hospitalized Suicide Attempters Aged 70 and Above. Int J Environ Res Public Health 2018; 15(1). https://doi.org/10.3390/ijerph15010141
48. Durkheim E. El Suicidio, estudio de sociología. Madrid: Akal; 2003. 540 p.
49. Jiménez RA, Cardiel L. El suicidio y su tendencia social en México: 1990-2011. Papeles Poblac 2013; 19(77): 205-29.

Received on: 03/20/2019
Revised on: 06/28/2019
Accepted on: 09/11/2019

Author's contributions: The conception and design of the work were carried out by CA Dávila-Cervantes and AM Pardo-Montaño. Data collection, as well as its processing, analysis, and interpretation were carried out by CA Dávila-Cervantes and AM Pardo-Montaño. CA Dávila-Cervantes wrote the first version of the manuscript. CA Dávila-Cervantes and AM Pardo-Montaño reviewed the manuscript and made contributions. Both authors approved the final version.