Analysis of the trend and impact of mortality due to external causes: Mexico, 2000-2013

Análisis de la tendencia e impacto de la mortalidad por causas externas: México, 2000-2013

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ABSTRACT The objective of this study was to analyze mortality due to the main external causes of death (traffic accidents, other accidents, homicides and suicides) in Mexico, calculating the years of life lost between 0 and 100 years of age and their contribution to the change in life expectancy between 2000 and 2013, at the national level, by sex and age group. Data came from mortality vital statistics of the Instituto Nacional de Estadística y Geografía (INEGI) [National Institute of Statistics and Geography]. The biggest impact in mortality due to external causes occurred in adolescent and adult males 15-49 years of age; mortality due to these causes remained constant in males and slightly decreased in females. Mortality due to traffic accidents and other accidents decreased, with a positive contribution to life expectancy, but this effect was canceled out by the increase in mortality due to homicides and suicides. Mortality due to external causes can be avoided through interventions, programs and prevention strategies as well as timely treatment. It is necessary to develop multidisciplinary studies on the dynamics of the factors associated with mortality due to these causes.
KEY WORDS Mortality; Cause of Death; Life Expectancy; Mexico.

RESUMEN El objetivo de este artículo es analizar la mortalidad por las principales causas externas (accidentes de tránsito, otros accidentes, homicidios y suicidios) en México, calculando los años de vida perdidos entre 0 y 100 años de edad y su contribución al cambio en la esperanza de vida entre 2000 y 2013, a nivel nacional, por sexo y grupos de edad. La información provino de las estadísticas vitales de mortalidad del Instituto Nacional de Estadística y Geografía (INEGI). El mayor impacto de la mortalidad por causas externas entre 2000 y 2013 se presentó en hombres jóvenes y adultos de 15 a 49 años de edad; la mortalidad por estas causas se mantuvo constante en hombres, mientras que disminuyó en mujeres. La mortalidad por accidentes de tránsito y otros accidentes disminuyó, lo que significó un aporte positivo a la esperanza de vida, que fue cancelado por un incremento de la mortalidad por homicidios y suicidios. La mortalidad por causas externas es prevenible por medio de intervenciones, programas y estrategias de prevención y tratamiento oportuno. Es necesario desarrollar estudios multidisciplinarios sobre la dinámica de los factores asociados con la mortalidad por estas causas.
PALABRAS CLAVES Mortalidad; Causas de Muerte; Esperanza de Vida; México.

INTRODUCTION

Mortality due to external causes is one of the most significant concerns of public health in Latin America[1,2] and it is also an indicator of health inequality, which has a great social and economic impact on the population. [1] The mortality rate due to external causes in the region is indeed high and its effect on the overall mortality rate has recently increased.[1,3] The external causes of mortality can be divided into intentional causes (suicides and homicides), unintentional causes (traffic accidents or other accidents) and causes of undetermined intent.[4]

The World Health Organization (WHO) estimates that, at a global level, 1.6 million individuals die every year due to acts of violence (520,000 due to homicides and 815,000 due to suicides), which is equivalent to over 2.5% of the total number of deaths[5,6,7]; 1.2 million individuals die due to traffic accidents, which accounts for 2.25% of the total number of deaths[8]; and 2.4 million individuals die annually due to other accidents, accounting for 4.41% of the total number of deaths.[9]

Deaths related to external causes affect the population as a whole; however, their impact is greater on individuals within the age group of 15-49 years. For this age group, external causes are the main cause of deaths all over the world.[1,5,7] Another point to highlight is that, in addition to the five million individuals who die annually due to external causes, a great additional number of individuals suffer non-fatal injuries as a consequence of external causes.[5] The WHO estimates that thousands of individuals are victims of external causes on a daily basis, and because the victims get injured, sometimes severely, they require medical or psychological care, or rehabilitation,[8] which implies social and economic costs amounting to billions of dollars.[1,5,7]

In Mexico, the level of proportional participation of deaths due to external causes, in the total number of deaths, has increased in the last few years.[8,10,11] Over 64,000 individuals died in 2013 due to this type of cause; in that same year, homicides were the sixth cause of death at the national level; other accidents were the eighth cause of death; traffic accidents were the tenth cause of death; and suicides were the fifteenth cause of death.[12] With regard to homicides, their number has increased in the last few years, after a period of decreasing trend.[10,13] Based on vital statistics, the number of homicides registered between 2000 and 2007 did not vary significantly; however, from 2008 onwards, there was a significant increase in the number of homicide deaths.[12] Every year, an average of 16,500 Mexican individuals die in traffic accidents. Nonetheless, it should be noted that these 16,615 individuals who died in 2011 represent a minor percentage of the 412,087 total traffic accidents reported.[8] In connection with suicides, although their share in the number of deaths due to external causes is the lowest in the country,[14] its number has increased steadily in the previous four decades.

Given that mortality due to external causes represents a complex public health concern and that it is possible to know, in broad terms, the health condition of the Mexican population through the study of the causes of death,[15] the main purpose of this study is to analyze the impact of deaths due to external causes in Mexico, through the index of years of life lost (YLL), and the contribution of these death causes to the change in life expectancy between 2000 and 2013, at national level, by sex and age groups.

MATERIALS AND METHODS

Data came from the mortality vital statistics of the National Institute of Statistics and Geography (INEGI) [*Instituto Nacional de Estadística y Geografía*], for the period between 2000 and 2013. The deaths taken into consideration for this study were those due to external intentional causes (homicides and suicides) and external unintentional causes (traffic accidents and other

accidents), following the line of several other research studies.[1,6,16,17] The causes of death were selected based on the criteria of the International Classification of Diseases (ICD-10), in the chapter referring to "External Causes of Morbidity and Mortality" under the following codes: traffic accidents (V00-V99); other accidents (W00-X59); homicides (X85-Y09, Y87.1); suicides (X60-X84, Y87.0). It should be noted that the section "Events of Undetermined Intent" of the ICD-10 was not considered in this study; nonetheless, in order to eliminate possible biases resulting from underestimating the death causes included here, the death trend classified as undetermined intent lesions (Y10-Y34) was also analyzed.

In order to distribute the number of unspecified deaths within the remaining age groups, a pro rata allocation was conducted. Only those deaths occurring inside Mexico were taken into consideration in this study, excluding: 1) deaths occurring outside Mexico (1,273 records); 2) deaths recorded without specifying sex (1,230 cases); 3) to calculate YLL, deaths of individuals older than 100 years old (55,253 total cases). Based on these exclusions, 0.76% of the total records was not considered for YLL calculation.

The method proposed by Arriaga, E. was used to calculate the average number of years of life lost between 2000 and 2013 as a result of deaths due to external causes of individuals under 100 years old. That is to say, this study tried to determine the number of additional years the individuals who died due to external causes before turning 100 years old should have lived. Thus, the age groups selected were analyzed using the null mortality hypothesis between the two selected ages, which assumes that the deceased individuals should have lived up to 100 years old. This assumption has the advantage of standardizing the results of the comparison between the estimated mortality and the hypothetical null mortality.[18] Another important assumption of this method is based on the fact that the distribution per cause of death in the mortality table is equal to the distribution observed in registered deaths. One of the

possible disadvantages of this assumption is the fact that it is limited to the highest ages, therefore, it is advisable to take in all cases the highest possible age, and this limitation is not significant when the age under analysis is very advanced[19] as in the case of this study. This technique is one of the principal tools used to measure the changes in the mortality rate and help interpret and understand the study of mortality per cause of death,[18,19] as it shows the changes and impact that these external causes of death have on the population's health.

For the purpose of obtaining the change in life expectancy between 2000 and 2013 several life tables were calculated. An extension of the model proposed by Andrevv[20] in other research studies[21,22] was used to calculate the contribution of the different causes of deaths by age groups to the life expectancy changes. The life expectancy change (e_0) between time 1 (year 2000) and time 2 (year 2013) was obtained as follows:

$$e_0^2 - e_0^1 = \sum_{x=0}^{\omega-5} \sum_{j=1}^{k} {}_5C_x^j$$

where:

$${}_5C_x^j = \frac{1}{2}\left[\frac{{}_5R_x^{j,2}\ln\left\{{}_5p_x^2\right\} - {}_5R_x^{j,1}\ln\left\{{}_5p_x^1\right\}}{\ln\left\{{}_5p_x^2\right\} - \ln\left\{{}_5p_x^1\right\}}\right]\left[{}_5\delta_x\right]$$

with:

$${}_5\delta_x = \left\{\left[e_x^2 - e_x^1\right]\left[{}_xp_0^1 + {}_xp_0^2\right] - \left[e_{x+5}^2 - e_{x+5}^1\right]\left[{}_{x+5}p_0^1 + {}_{x+5}p_0^2\right]\right\}$$

${}_5R_x^{j,i}$ is the proportion of the total number of deaths attributed to a specific cause j, at a specific moment i; ${}_np_x$ is the probability that a survivor in the life table of x years of age has of living n additional years; e_x^i is life expectancy at x years of age, at moment i; and indexes 1 and 2 indicate the starting year and the final year, respectively.

Both methods of analysis are complementary. The YLL method helps obtain a panorama of the moment of mortality due to external causes and its trend in the period under study; the other method is used to obtain the decomposition of the temporary life expectancy by age and the cause of death throughout the entire period under study,[11] which provides a long term perspective of the impact of mortality due to external causes in Mexico between 2000 and 2013.

RESULTS

Between 2000 and 2013, a total of 7,291,266 deaths were registered; 3.16% of which were related to traffic accidents, this being the fifth cause of death. Other accidents represented 3.78%, and were the sixth cause of death; 2.96% of deaths were homicides, this being the ninth cause of death; and suicides accounted for 0.88%, this being the nineteenth cause of death. In the male population, homicides accounted for 4.7% of the total number of male deaths in the period under study (4,063,539); traffic accidents represented 4.5%; suicides 1.3% and other accidents represented 5.1%. In the female population, on the contrary, of the total number of deaths (3,223,625), traffic accidents accounted for 1.5%; homicides 0.7%, suicides 0.4% and other accidents 2.1%, which altogether means a lower relative participation in the female epidemiologic profile. In the group of external causes of death, homicides had a relatively stable participation between 2000 and 2007 (an average of 20% for males and 11.5% for females). However, as from 2008 and until 2013 this number increased (36% for males and 20.5% for females). In the case of suicides, the relative participation was stable for males (8%), but for females, it increased gradually (from 5.3% in 2000 to 8.4% in 2013). In the case of traffic accidents, there was a growing relative participation until 2006 (32% for males and 33.5% for females), steadily decreasing thereafter (23.4% for males and 25.5% for females in 2013). In the case of other accidents, there was a

decreasing trend in the entire period for both males and females (from 37% for males and 46% for females in 2000 to 25% and 37% in 2013, respectively), except in 2007 when the trend raised significantly. Moreover, the events of undetermined intent had a relatively stable participation in the group of external causes of death (around 5% for males and 4% for females), except in 2011 when it increased for both males and females (7.6% for males and 6.2% for females).

Years of life lost (YLL)

In 2000, the external causes of deaths analyzed in this study altogether accounted for 4.53 YLL for males and 2.59 YLL for females, which means that should the mortality due to external causes be eliminated, the temporary life expectancy between 0 and 100 years would increase 4.53 years for males and 2.59 for females. In 2013, the mortality due to external causes for males increased slightly by 0.21% (4.54 years), whereas for females it decreased by 10.7% (2.31 years).

Based on different causes of death, in 2000 the highest number of YLL for males was due to other accidents (1.81 years) and traffic accidents (1.34 years), showing a decreasing trend (figure 1). In 2013, the number of YLL due to other accidents reached 1.22 and 1.16 due to traffic accidents, a drop of 32.7% and 13.3% respectively. It should be mentioned that with regard to the deaths due to other accidents, 48% of the total number of YLL falls within the 15-49 year age group, whereas in the case of deaths due to traffic accidents this percentage is higher than 66%. The scenario is different for homicides, since in 2000 a total of 1.05 years were lost and, until 2007, there was a decreasing trend (reaching up to 0.74 years). However, as from 2008, there was a significant increase in the mortality rate due to homicides, which reached up to 2.1 YLL in 2011 and later decreased to 1.74 years, which currently ranks male homicides as the leading cause of violent deaths in Mexico. The impact of mortality on male homicides falls within the

15-49 year age group, reaching 82.7% of the total YLL due to this cause. Suicides were the least influential cause of death in terms of YLL for males in the entire period under study (0.33 years in 2000 and 0.42 years in 2013). Nevertheless, suicides showed an increasing trend of 34.1% throughout the entire period studied, which sustains the increase observed since the 1970s reported in other studies. The greater impact of suicides is on the 15-49 year age group, with 76% of the total YLL due to this cause. It is remarkable that the YLL trend due to injuries of undetermined intent was relatively stable throughout the entire period under study (around 0.25% years) except in 2011, when the number increased significantly in comparison to previous years (0.38% years).

In the female population, in 2000, the highest number of YLL was due to other accidents (1.15 years) and traffic accidents (0.75 years) with a decreasing trend, as in the male population, until it reached 0.76 years for other accidents and 0.59 years for traffic accidents (a decrease of 33.5% and 20.8%,

respectively) (Figure 2). It should be noted that for other accidents, the highest number of YLL fell within the 65-84 year age group, with 26.1% in 2013 followed by the 50-64 year age group (19.5%) and then the 30-49 year age group (19.2%). For traffic accidents, most of the YLL fall within the 15-84 year age group, but they are evenly distributed among those ages (21.6% among 15-29 years, 26.5% among 30-49 years, 20.2% among 50-64 years and 19% among 65-84 years). In the case of female homicides, in 2000, 1.05 years of life were lost with a decreasing trend until 2007 (0.38 YLL). However, as from 2008, there is an increase in the mortality rate due to homicides which reaches a maximum of 0.87 YLL in 2011, and decreases to 0.76 YLL in 2013 (similarly to the case of other accidents). The highest mortality rate for the female population due to homicides falls within the 15-49 year age group, where 70% of YLL are related to this cause. Finally, suicides in the female population showed an increasing trend in the period under study, going from 0.16 YLL in 2000 to 0.20 YLL in
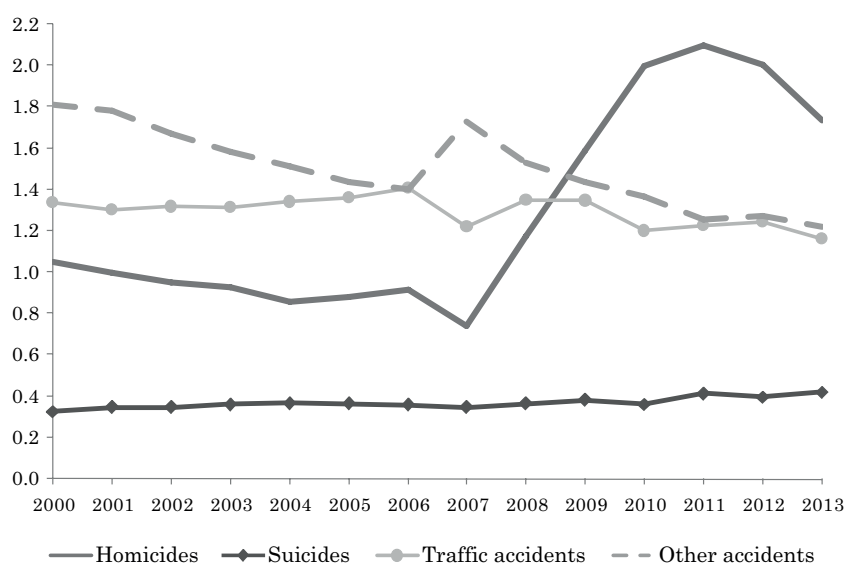

Figure 1. Years of life lost as a result of deaths due to external causes in the male population. Mexico, 2000-2013.

Source: Own elaboration based on data from vital statistics on mortality.[12]
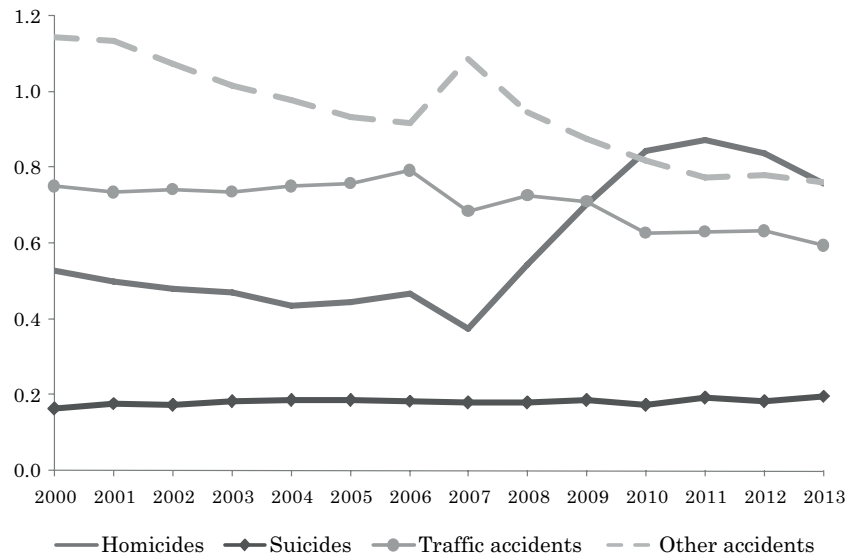
Figure 2. Years of life lost related to deaths due to external causes in the female population. Mexico, 2000-2013.

Source: Own elaboration based on data from vital statistics on mortality.[12]

2013 (an increase of 20.1%), and as in the case of homicides, the age group with the highest percentage of YLL was the group of 15-49 years, where slightly over 60% of YLL is due to suicides. It should be highlighted that in the 15-49 year age group, the number of YLL due to external causes of death was about 2 to 3.3 times higher in the male population than in the female population. Similarly to the case of males, the number of YLL related to injuries of undetermined intent for females was about 0.14 years in the entire period under study but in 2011, there was also a significant increase (reaching 0.19 years).

Contribution to the change in life expectancy

The life expectancy rate showed an increase of 1.3 years between 2000 and 2013 for both males and females: it increased 1.2 years for males (from 70.5 to 71.7 years), whereas for females, the change was 1.3 years (from 76.1 to 77.4 years). The age groups that contributed the most to this change were the 0-4 year age group (0.79 and 0.62 years for males and females, respectively) and 50-64 year group (0.25 for males and 0.23 for females). Conversely, the mortality rate for the 15-29 year group showed an increase that contributed negatively to the life expectancy rate: 0.11 years for males and 0.01 years for females.

As per causes of death, the life expectancy of the male population increased, or decreased in mortality, to other accidents (0.37 years) occurring mainly in the 15-49 year age group, and due to traffic accidents (0.11 years) in the 30-64 year age group (Table 1). By contrast, the mortality rate due to homicides and suicides showed an increase and a consequent decrease in life expectancy of 0.42 years and 0.06 years respectively. These changes were observed in the 15-49 year age group, both for homicides and suicides (Figure 3), indicating that the increase in life expectancy resulting from the decrease in mortality due to traffic accidents and other accidents equaled the amount contributed by to homicides and suicides. Therefore, it is important to highlight that the increase of male
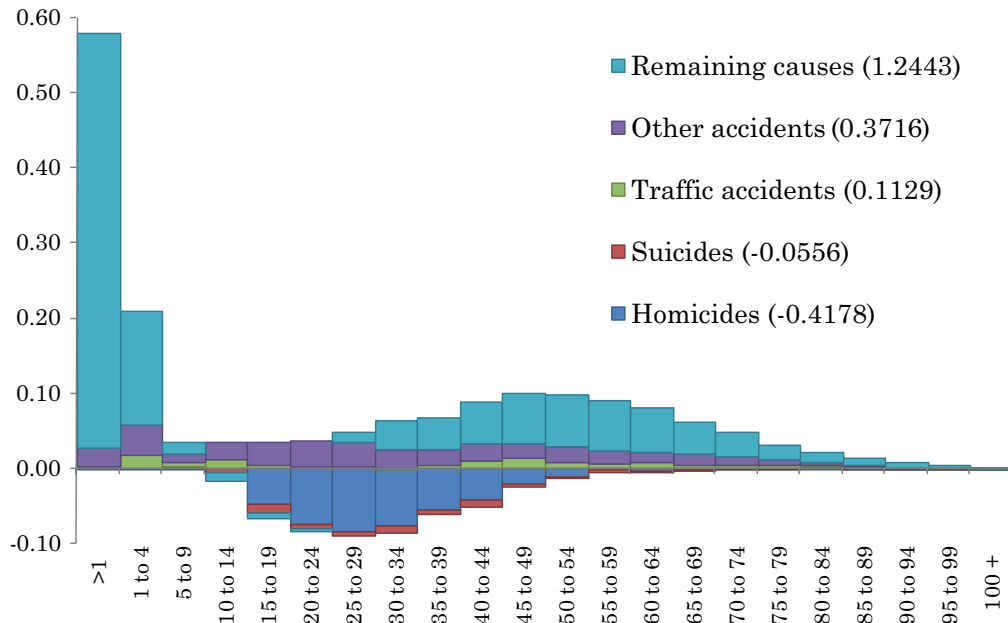
Figure 3. Contribution of external causes of death to the change in life expectancy in the male population. Mexico, 2000-2013.

Source: Own elaboration based on data from vital statistics on mortality.[12]

Table 1. Contribution of deaths due to external causes to the change in life expectancy according to gender. Mexico 2000-2013.

Sex	Age	Homicides	Suicides	Traffic accidents	Other accidents	Remaining causes	Total
	0 to 4	0.0023	0.0000	0.0165	0.0660	0.7053	0.7901
	5 to 14	0.0021	-0.0044	0.0185	0.0325	0.0034	0.0522
	15 to 29	-0.2077	-0.0210	0.0078	0.0990	0.0033	-0.1186
Males	30 to 49	-0.1963	-0.0261	0.0282	0.0857	0.2080	0.0997
	50 to 64	-0.0168	-0.0038	0.0233	0.0500	0.1969	0.2496
	65 to 84	-0.0016	-0.0001	0.0152	0.0355	0.1081	0.1571
	85 +	0.0001	-0.0004	0.0035	0.0029	0.0193	0.0254
	0 to 4	0.0001	0.0000	0.0063	0.0426	0.5686	0.6176
	5 to 14	-0.0011	-0.0018	0.0064	0.0107	0.0112	0.0253
	15 to 29	-0.0329	-0.0146	-0.0019	0.0113	0.0331	-0.0051
Females	30 to 49	-0.0231	-0.0076	0.0099	0.0184	0.1961	0.1936
	50 to 64	-0.0015	-0.0026	0.0094	0.0113	0.2145	0.2312
	65 to 84	-0.0007	-0.0001	0.0073	0.0044	0.1636	0.1746
	85 +	0.0006	0.0001	0.0020	0.0007	0.0286	0.0320

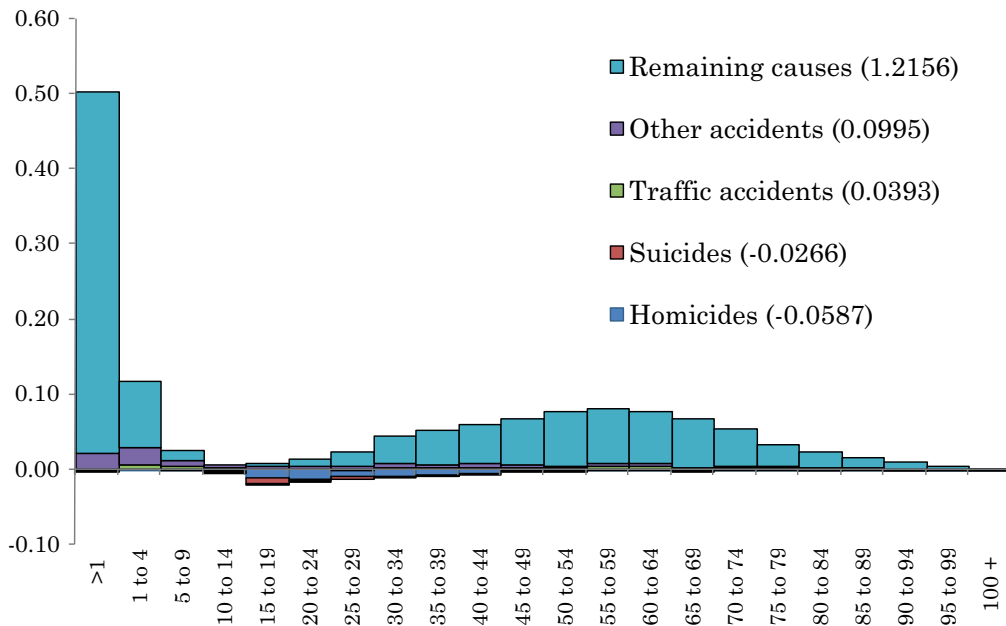Source: Own elaboration based on data from vital statistics on mortality.[12]

Figure 4. Contribution of the external causes of death to the change in life expectancy in the female population. Mexico, 2000-2013.

Source: Own elaboration based on data from vital statistics on mortality.[12]

life expectancy is focused on the remaining causes of death that were not considered in this study (1.24 years), mainly between the 0-4 year age group (0.71 years) and the 30-49 year age group (0.21 years).

The case of life expectancy for females is similar, as both other accidents and traffic accidents contributed positively (0.1 years and 0.04 years, respectively). Unlike in males, the contributions were visible in almost all female age groups (0-64 years for other accidents and 0-14 and 30-84 years for traffic accidents) (Table 1). With regard to homicides there was an increase in mortality in the 15-49 year age group by 0.06 years. Similarly, there was an increase in suicides in the 15-29 year age group by 0.03 years. (Table 4). The contributions due to traffic accidents and other accidents were almost canceled out by the increase in mortality due to homicides and suicides, which means that the change in life expectancy for females was due to other causes of death, including the remaining causes (1.22 years), mainly in the

0-4 year age group (0.57 years) and the 50-64 year age group (0.21 years).

DISCUSSION

Mortality due to external causes is one of the main public health concerns in Latin America and it can be regarded as an indicator of deprivation, both in the access to and quality of health care as well as in the mechanisms of control and prevention that are the responsibility of the population and of the State and that could reduce the exposure to accidents and aggressions.[23]

The results of this study help verify the impact of mortality due to external causes on the population's health,[17,24,25] and also show its differential behavior due to causes of death, age and sex. Mostly, the deaths occur in young males and male adults aged 15-49 years.[11,26] Mortality due to external causes in males remained relatively constant

and decreased slightly in females. In 2000, traffic accidents and other accidents caused the highest YLL for both males and females. Nonetheless, mortality due to these causes decreased until 2013, as shown in other research studies.[1,8] This decrease was also reflected in the positive contribution of these causes of death to life expectancy. There was a significant increase in mortality due to homicides as from 2008 and a gradual increase of suicides, which has continued for more than 40 years,[14,27] and, therefore, the positive contribution of traffic accidents and other accidents to life expectancy was practically canceled out by the increase in mortality due to homicides and suicides. It should be noted that in 2011 – the year with the greatest mortality rate due to homicides in Mexico's recent history – there was an unusual increase in undetermined intent injuries, which can be an indicator of certain underestimation of the impact of mortality due to the external causes addressed in this study (especially homicides) on Mexico's life expectancy. It is advisable that this situation be deeply analyzed in future research studies on the subject.

In connection to sex, it was verified that the mortality due to external causes was higher in males than in females, as shown in other research studies on the subject.[6,11,24] It was also verified that the highest impact of mortality due to external causes in males, as well as the greatest changes in life expectancy, was observed in the 15-49 year age group. In females, the impact of mortality due to traffic accidents and other accidents was distributed among the different age groups, whereas the greatest mortality due to homicides and suicides and the main decreases in life expectancy occurred in the 15-49 year age group. This phenomenon which occurs mainly among adolescents, youth and young adults (especially among males) is one of the factors that determine that these external causes of death are one of the main sources of YLL in the Mexican population.[1,11,24]

This situation is relevant because deaths due to external causes, in addition to being tragic human losses,[3] imply high economic and social costs,[1] cause physical damage, disabilities and/or psychological sequelae, a great number of YLL, and a decrease in life expectancy.[25] Similarly, it is a way of representing the deterioration in the population's quality of life.[24] Studying violence from a public health's perspective helps conduct a comprehensive analysis of its associated factors, as well as of the negative effects that they have on society and on the population's health.[28,29,30] In this respect, mortality due to external causes, and particularly, due to intentional causes (homicides and suicides) has been related to structural factors such as unfavorable socioeconomic conditions which promote the population's social, economic and health inequality,[29,31,32,33] or to cohesion and social capital.[34,35] In Mexico, there are other factors that are closely related to these causes such as the high impunity rate which constitutes part of an ongoing process that has permeated the entire Mexican society and reflects an increasing inability of the State to enforce their own laws.[36,37] The likelihood of a person who committed a crime of being arrested, sentenced or of completing a sentence is quite low.[38] This is reflected by the fact that 93% of crimes are unpunished and almost 99% do not receive any type of punishment.[36]

In turn, it was verified that males, mainly adolescents and young adults,[39] are three times more exposed to dying due to external causes than females. In many cases, the differential mortality related to this type of cause among males and females is not explained by physiological differences, but it is associated to the behavior of these subjects which may result from a differentiated social learning process through the construction of gender identity.[40,41] It is argued that the differential dynamic of morbidity and mortality due to this type of cause for males and females is a consequence of male behavior patterns, socialization processes, the models of masculine identity, and the gender roles assigned by society.[42] In this sense, the masculinity to which this study refers comprises expected patterns of behavior (such as competition, risk, control and adventure) towards

the different situations that males have to face every day. Male children learn to take risks and internalize the behavior associated with masculinity,[42] which is mostly manifested during adolescence and young adulthood. The intentional exposure to risk situations during these ages becomes the expected social behavior that legitimates them as men, although in the process they may risk their health and well-being and even, in some cases, encounter death.[43,44] Therefore, many of the deaths occurring due to external causes may be the result of an intentional exposure to risk situations arising from a behavior related to masculinity. For these reasons, the main factors associated with mortality due to external causes are sex and age, which means that the primary demographic factor associated with this phenomenon is the very fact of being male[42,43] and particularly, a young male.

Another important aspect related to violence and accidents is the abuse of substances such as drugs and alcohol,[45,46] which is more frequent in males, thus exposing them to a greater risk of dying due to these causes.[47] The predominance of males in the consumption of alcohol and drugs has been associated with a social learning process by which, through substance abuse, males legitimate their deliberate exposure to risk scenarios related to the masculine behavior.[42,47]

Furthermore, while the total number of deaths due to traffic accidents has increased in the last few years,[8] the situation changes after analyzing its impact on life expectancy and the number of YLL due to an decrease in mortality caused by traffic accidents in the Mexican population between 2000 and 2013. Mortality due to traffic accidents occurs mainly in young adults, especially men,[8,48] and the most affected ones are vulnerable subjects,[48] that is to say, pedestrians, followed by motorcyclists and cyclists. One of the main risk factors associated with traffic accidents is the increase in the number of circulating vehicles,[8] as well as risky behaviors such as excessive speed, substance abuse (alcohol or drugs), not wearing the safety belt, disobeying traffic signals, and using distracting devices (such as mobile phones) while driving, among many others.[39,43]

With regard to homicides, the recent trend showed a significant mortality increase as from 2008, with a greater prevalence of males between 15-49 years. At a micro level, this has been associated with gender issues[49] and, at macro level, with social, economic, and political conditions in Mexico – such as economic backwardness, poverty, social inequality, social and educational exclusion, and exclusion from the labor market; arbitrary and unequal distribution of wealth which causes inequality and marginalization[50]; a weak State; impunity and corruption; the youth's difficulty in finding a job; the access to firearms[51]; the breach of traditional social regulations by family and school; fast unplanned urbanization; new life conditions; rapid demographic changes; and governmental strategies to face organized crime.[52]

Finally, mortality due to suicides maintained the increasing trend reported in the 1970s, showing important differences by age and sex.[12] This increase, along with the disparity between males and females, has been associated with factors that vary according to the age group and, in some cases, to sex.[53,54] Among the young individuals, the main factors are depression and other behavioral disorders,[49] and the increase in the consumption of alcohol and drugs. Among older adults, the main factors are depressive disorders related to physical or mental disability and to the natural deterioration resulting from the aging process – especially in men – along with isolation and loss of self-esteem arising from the retirement from activities socially regarded as productive[55]; and in both males and females, related to the increase in chronic-degenerative diseases which may cause great pain to those suffering from them.[54] An additional factor that explains the difference of the mortality rate due to suicides in both sexes is based on the method selected to terminate their life, as males usually use more lethal means[56] although suicidal ideation and attempts are more frequent in females.[25]

Mortality due to external causes can be mostly prevented by interventions specifically

designed to modify and reduce its effects. For that purpose, it is necessary to obtain as much knowledge as possible[5] about the subgroups of population on which mortality has a greater impact to determine the high-risk groups,[25] the associated factors that intervene in these types of deaths, and the changes observed over time with the aim of designing, executing, surveilling and assessing the interventions,[5] programs and prevention strategies and timely treatment.[6] Prevention programs should consider that it is possible to reduce the number of traffic accidents by restricting the consumption of alcohol, reducing the speed limits, using mandatory seat belts, and respecting the traffic signs.[48] Additionally, programs should consider using early detection and timely treatment of psychopathological causes associated with mortality to help reduce the number of suicides and, violence prevention programs[17] to reduce the number of homicides.

Given that this phenomenon has multiple causes, all actions aimed at preventing violence, accidents and their consequences should take into account the age groups on which the phenomenon has greater impact (adolescents and young adults), while following a gender perspective,[42,43] and including the participation of "all areas of society using a multidisciplinary and intersectoral approach."[1 p.104] Based on the results of this research study and considering the impact that deaths due to external causes have had on the epidemiological profile of Mexico, it can be deduced that it is necessary to rely on accurate information that helps monitor the incidence of these deaths and, in turn, to develop multidisciplinary research studies focused on the dynamics of the multiple factors associated with mortality due to external causes.

Limitations

Currently, there is scarce information about violence as a social phenomenon.[13] In this research study, the information focused on mortality data, given that it is usually recorded and more broadly available.[5] However, it is essential to highlight that the information system of vital statistics on mortality may have an important under-report of deaths occurring due to violent acts and accidents, whether because those deaths occurred during an armed confrontation or were homicides perpetrated by illegal groups and could not be recorded due to different reasons (thus remaining unrecorded in the national mortality records) or, in the case of suicides, because of the social stigma around them or the reluctance to classify suicides as such when the surrounding circumstances are quite unclear.[57] Furthermore, vital statistics have other types of limitations, such as the lack of heterogeneity of definitions in the records, the inadequate coverage in hard-to-access regions, and, in some cases, errors of omission.

An additional limitation was that this research study was focused on deaths due to external causes and was not able to take into account the various non-fatal incidents occurring for each death, as they represent only a small percentage of violence[24] and accidents taken as a whole. Not all acts of aggression cause injuries severe enough to record their occurrence. Therefore, there are no accurate national or international estimations regarding their prevalence,[5] and it is likely that the data used is underestimated. Although the mortality due to external causes is only the tip of the iceberg which has multiple causes and severe consequences, the conclusions drawn from official figures are substantially correct.[58]

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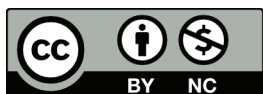
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