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Analysis of the impact of mortality due to suicides in Mexico, 2000-2012

Análisis del impacto de la mortalidad por suicidios en México, 2000-2012

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ABSTRACT The objective of this study was to analyze the burden of disease due to suicide in Mexico using years of life lost (YLL) between 2000 and 2012 by sex, age group (for those under 85 years of age) and jurisdiction. Vital statistics on mortality and population estimates were used to calculate standardized mortality rates and years of life lost due to suicide. Between 2000 and 2012 a sustained increase in the suicide mortality rate was observed in Mexico. The age group with the highest rate was 85 years of age or older for men, and 15-19 years of age for women. The highest impact in life expectancy due to suicide occurred at 20 to 24 years of age in men and 15 to 19 years of age in women. The states with the highest mortality due to suicide were located in the Yucatan Peninsula (Yucatan, Quintana Roo and Campeche). Mortality due to suicide in Mexico has increased continually. As suicides are preventable, the implementation of health public policies through timely identification, integral prevention strategies and the detailed study of associated risk factors is imperative.

KEY WORDS Mortality; Suicide; Mortality Rate; Years of Life Lost; Mexico.

RESUMEN El objetivo del presente artículo es analizar la carga de la mortalidad por suicidios en México, a partir del indicador de años de vida perdidos (AVP), entre 2000 y 2012, por sexo, grupos de edad (para menores de 85 años de edad) a nivel nacional y por entidad federativa. Se emplearon estadísticas vitales de mortalidad y estimaciones de población para calcular tasas estandarizadas de mortalidad y los años de vida perdidos por suicidios. Entre 2000 y 2012 se dio un incremento sostenido de la tasa de mortalidad por suicidios. En hombres, el grupo de edad con las mayores tasas fue el de 85 años y más; para mujeres el de 15-19 años. El mayor impacto en la esperanza de vida se dio entre los 20 y 24 años en hombres y entre los 15 y 19 años para mujeres. Los estados con la mayor mortalidad se ubican en la península de Yucatán (Yucatán, Quintana Roo y Campeche). La mortalidad por suicidio en México se ha incrementado de manera constante. Los suicidios son prevenibles, por lo que es fundamental implementar políticas públicas en salud a través de acciones de identificación oportuna, estrategias integrales de prevención y el estudio detallado de los factores de riesgo asociados.

PALABRAS CLAVES Mortalidad; Suicidio; Tasa de Mortalidad; Años de Vida Perdidos; México.

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

INTRODUCTION

Suicide is defined as the intentional, self-inflicted act of causing one's own death deliberately and self-consciously. Three stages are successively implied in this act, which are jointly named *suicidal process*: suicidal desire, suicidal ideation and suicidal act.[1] The act is as old as humanity itself and its characteristics are dynamic and vary largely according to cultural,[2] temporal, geographic, personal and contextual circumstances.[3] At the population level, suicide has been addressed from anthropological, psychological, sociological and epidemiological approaches.[4]

The World Health Organization (WHO)[5] establishes that suicide is considered a very important public health problem worldwide that, though largely preventable, causes half of all violent deaths in men and 70% of women deaths, representing almost a million of victims yearly, with economic costs totalizing billions of dollars. In 2000, 815,000 suicides were reported worldwide. This figure accounted for an annual death rate of 14.5 suicides per 100,000 inhabitants;[6] whereas, in 2012, a slight decrease was observed and the world suicide annual rate was 11.4 per 100,000 inhabitants approximately (15.0 for men and 8.0 for women).[5] In 2012, suicide represented 1.4% of all deaths worldwide and was the fifteenth leading cause of death. It has been estimated that every 40 seconds, an individual commits suicide somewhere in the world and that out of these deaths, a great percentage occurs in young populations, so much so that at a worldwide level, suicide is the second leading death cause of death in the age group aged from 15 to 29.[5] Among adults aged 30 to 49, suicide accounts for 4.1% of total deaths and is classified as the fifth leading cause of death worldwide; therefore, it is important to acknowledge that suicide is a serious public health concern and not only in developed countries as it was considered in the past, since most suicides are committed in low-middle income countries where resources and services for an early identification of this problem are scant and limited, and treatment and support to people in need are not enough.[5]

Another important characteristic of suicide mortality is that although suicide rates are generally higher for men, they are not homogeneous in all countries. In 2012, in high-income countries, the man/woman ratio of standardized suicide rates was 3.5, whereas in low-middle income countries, the man/woman ratio was considerably lower (1.6 male suicides per each female suicide, approximately).[5]

Compared to other regions in the world, Latin America has low suicide rates, around 6.1 suicides per 100,000 inhabitants.[5] However, over the last years, mortality due to suicide has been continuously rising, especially in Chile, Venezuela, Uruguay and Mexico.[7]

Despite the fact that mortality rates in Mexico are low, at both global and regional levels,[6] since the 1950s, a sustained and continuous increase in suicide cases has been observed, especially in young populations. Thus, suicide has become a public health concern of major relevance and great impact in Mexico.[8,9,10] In 1950, suicide mortality rates in Mexico were estimated at around 1.5 suicides per 100,000 inhabitants; by 2008 those rates had tripled reaching a level slightly higher than 4.8 suicides.[10] This increase in suicide mortality has been observed in all federal entities, a fact that accounts for the scope of this health problem and the need to analyze the trend[9] at both national and state levels. Another important characteristic of this phenomenon in Mexico is related to the fact that most of the individuals that commit suicide are men and these differences by gender have progressively increased over time.[10] Therefore it is essential to investigate this phenomenon by including the differential mortality due to suicides for men and women.

Within this framework, the main objective of this article is to analyze the mortality burden due to suicides in Mexico, based on the Years of Life Lost (YLL) indicator, between 2000 and 2012, by sex, age groups (for individuals under 85 years of age), by federative entity and at national level.

MATERIAL AND METHODS

A transversal and descriptive study was carried out. Deaths data were obtained from the *Instituto Nacional de Estadística y Geografía (INEGI),* provided by the Health Department *[Secretaría de Salud (SSA)],* for the 2000-2012 period. Population estimates at the national level and by

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

federal entity as well as the *state marginalization index*[a] were obtained from the *Consejo Nacional de Población* (CONAPO). Deaths due to suicides were included in accordance with the standards of the International Classification of Diseases, 10th revision, included in the section "Other external causes of mortality" (codes X60-X84), and an apportionment was conducted to distribute the deaths of individuals whose ages were not specified among the rest of the age groups.

For the purpose of this analysis, only the deaths due to suicide committed in the country were included, while the following cases were excluded for the calculation of YLL: 1) deaths occurring abroad (6 records); 2) deaths of individuals over 85 years of age (52 cases). Thus, 0.12% of the total deaths were deducted for the calculation of the standardized mortality rates and 1.03% for YLL calculation.

The standardized mortality rates due to suicides were calculated by sex and age groups at national level for the period between 2000 and 2012 and at state level for 2010, using the 2010 national population as a standard reference. Likewise, the YLL proposed by Arriaga[11] were calculated in order to estimate the average number of years of life lost due to suicides by individuals under 85 years between 2000 and 2012, or in other words, to determine the number of years that said dead people should have lived before reaching the age of 85.[11] A zero mortality assumption between both selected ages was used, i.e., the individuals that died should have lived up to the age of 85.[b] This hypothesis of the method has the advantage that when comparing the mortality observed to the null hypothetical mortality, the comparisons remain standardized; consequently, historical comparisons or comparisons among populations are possible.[11] The other important hypothesis of Arriaga´s method is based on the assumption that the distribution of deaths due to causes listed in the mortality table is equal to the one observed in the recorded deaths for every age group.[11][c] The age range was selected since, for this indicator, it is recommended, in all cases, to consider the highest possible age, provided that the statistics for death causes are true and accurate.[11] This technique is considered one of the main tools to measure the changes in the mortality level and mortality causes. Moreover, it is a useful indicator to relate suicide mortality to the change of temporary life expectancy among the selected ages,[10] accounting for the changes and impact of the mortality due to this cause on the health of the population.[12] Finally, an analysis was carried out on the correlation among suicides mortality rates and the state marginalization index, aiming at analyzing if there is a relation between the socioeconomic level and the mortality due to suicides, since other studies have related suicide mortality to the socioeconomic situation of countries.[5]

Limitations

The information on suicides was based on the vital statistics of mortality. In this sense, suicide recording is a complex procedure of multiple levels that covers medical and legal issues and includes several pertinent authorities.[5] In the Mexican case, records are created out of death certificates, which indicate (in each case) the data related to the presumption of whether the cause of death was due to an accident, assault or suicide, according to the initial opinion of the forensic medical examiner or coroner, a fact that is recorded in the previous pertinent finding by the Public Ministry.[8] The conclusion of said finding or, otherwise, of the criminal proceeding, ratifies or rectifies the initial presumption. At present, this result is no longer shown in the statistics prepared from the death certificates.[8] Consequently, it is highly probable that the information used in this study is underestimated. This limitation of the mortality data source is not exclusive of suicides, but given the sensitivity of this issue, there may be probably more problems regarding underregistration and wrong classification of these causes than in other causes. Furthermore, the vital statistics on mortality have another type of limitations, such as, lack of uniformity in recording definitions, inadequate coverage in less accessible regions, omission mistakes, subrecording and delay in the publication of the information.

An additional limitation is that YLL estimates are restricted because an age range has to be determined, in this particular case between individuals of 10 and 85 years of age, and therefore, the total impact on mortality is underestimated. This disadvantage is reduced considerably as the age of the open group increases. It is for that reason that the age range taken for this study was so broad, which

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

implied that most of the individuals who died due to suicide were included in this research.

RESULTS

In 2000, a total of 3,475 suicides were consummated in Mexico, out of which 84.5% were committed by men and 15.5% by women. By 2012, this figure rose to 5,550 consummated suicides (80.5% for males and 19.5% for females). With respect to the man/woman ratio of deaths due to this cause, it was observed that in 2000, this proportion was almost 5.5 male suicides per each female suicide. This figure decreased to a slightly lower value of 4.2 in 2012 (Figure 1). In relation to the trend of mortality due to suicides, a sustained increase was observed between 2000 and 2012, which was reflected in the gradual increase of the mortality rates, going from 6.2 male suicides and 1.1 female suicides per 100,000 inhabitants in 2000 to a level of 7.8 male suicides and 1.8 female suicides in 2012 (Figure 1). These changes represented an increase of 25.8% in men and 68.4% in women in the period analyzed.

Most suicides occur in individuals aged from 15 to 49, in which 77% of the total of male suicides and 79% of the total of female suicides occur. With respect to the proportion of suicides within the men's violent death category, suicide has represented between 7.4% and 9.1% of the total deaths due to these causes since 2000, whereas in the case of women an increasing trend has prevailed, going from 5.5% of the total deaths due to violent causes in 2000 to slightly more than 8.5% in 2012.

One characteristic of suicide mortality between sexes is related to the differential impact by age. To exemplify this behavior, standardized suicide rates by age groups were analyzed for men and women at national level for the year 2010 (Figure 2). In the case of men, the standardized suicide rate by age has a particular behavior, since it reached a high value in the age group from 20 to 24 years and then descended gradually to 65 years of age. From this age onward, the rate rose to its maximum value in the age group of 85 or more. In the case of women, the situation is different since once the mortality rates reach their maximum value in the age group from 15 to 19 years, a steady downward trend was observed in all age ranges (Figure 2).

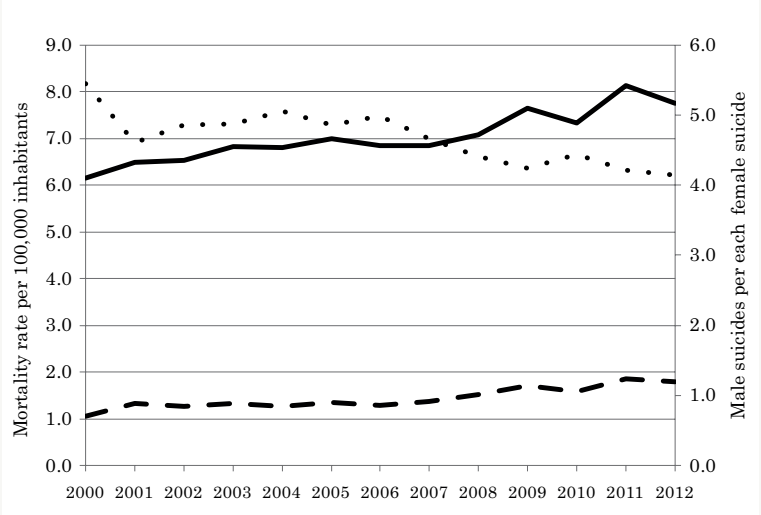

Figure 1. Mortality rate trend for consummated suicides by age and sex. Mexico, 2000-2012.

Source: Own elaboration based on mortality vital statistics provided by the Instituto Nacional de Estadística y Geografía (INEGI) and population projections 2010-2030 of the Consejo Nacional de Población (CONAPO).

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

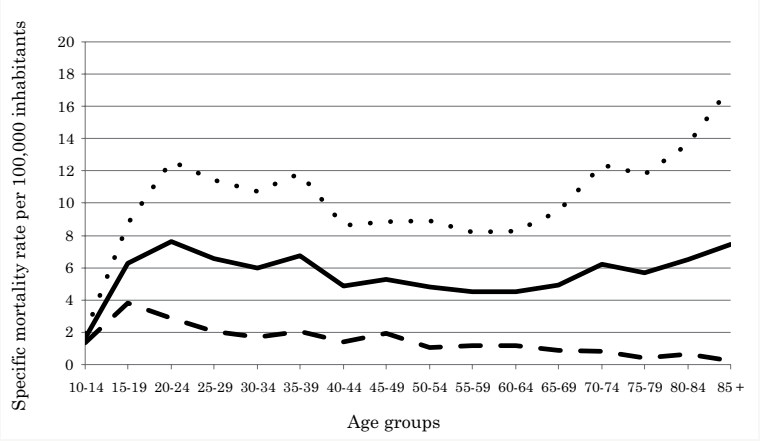

Figure 2. Standardized mortality rate for consummated suicides by age and sex. Mexico, 2010.

Source: Own elaboration based on mortality vital statistics provided by the Instituto Nacional de Estadística y Geografía (INEGI) and population projections 2010-2030 of the Consejo Nacional de Población (CONAPO).

Regarding the federal entities of the country, in 2010, those presenting the highest male standardized mortality rates were Yucatán, Tabasco, Quintana Roo and Campeche (with rates of 16.8; 15.6; 15.5 and 13.1 suicides per 100,000 men respectively) (Figures 3 and 4); whereas for female rates the states with the highest rates were Yucatán, Quintana Roo and San Luis Potosí (reaching rates of 3.5; 3.0 and 2.6 suicides per every 100,000 women respectively).

This is interesting because both for men and women, the region of the country with the highest suicides rates was the Yucatán Peninsula. Moreover, with respect to men, the states having the lowest mortality rates due to this cause were Chiapas, Guerrero, Morelos, Hidalgo and Tlaxcala (with figures of 3.5; 3.7; 4.0; 4.0 and 4.3 suicides respectively); whereas, in the case of women, Chiapas, Baja California Sur, Zacatecas, Hidalgo and Baja California (with suicides rates of 0.4; 0.6; 0.7; 0.7 and 0.9 respectively) (Figure 5). Results obtained from the correlation analysis between suicide mortality rates and the state marginalization index showed a negative correlation coefficient (-0.25) which was not statistically significant ($p > 0.16$), indicating that there is a non-linear relationship between the socioeconomic level of the federal entities and the mortality rates due to suicides at state level.

Years of life lost

In 2000, YLL presents a level of 0.226 and 0.037 years for men and women respectively, which implies that if the suicide mortality is eliminated, the temporary life expectancy for individuals under 85 years of age would rise 0.226 years for men (Table 1) and 0.037 for women (Table 2). In 2012, these figures increased to 0.252 and 0.063 for men and women, which represent a relative change of 11.7% and 69.6% respectively. It is important to note that, although the trends of the mortality rates and female YLL are analogous, in the case of men there is not a continuous increase for the YLL, in contrast with what is observed in the rates. The YLL rose until 2005, then starts to decrease to its minimum value in 2010 and from 2010 starts to increase again. This phenomenon can be explained because during the whole period, the increase in suicide mortality was observed mainly in older individuals; whereas in younger individuals, where YLL has a greater burden, a slight decrease in mortality was observed between 2005 and 2010.

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

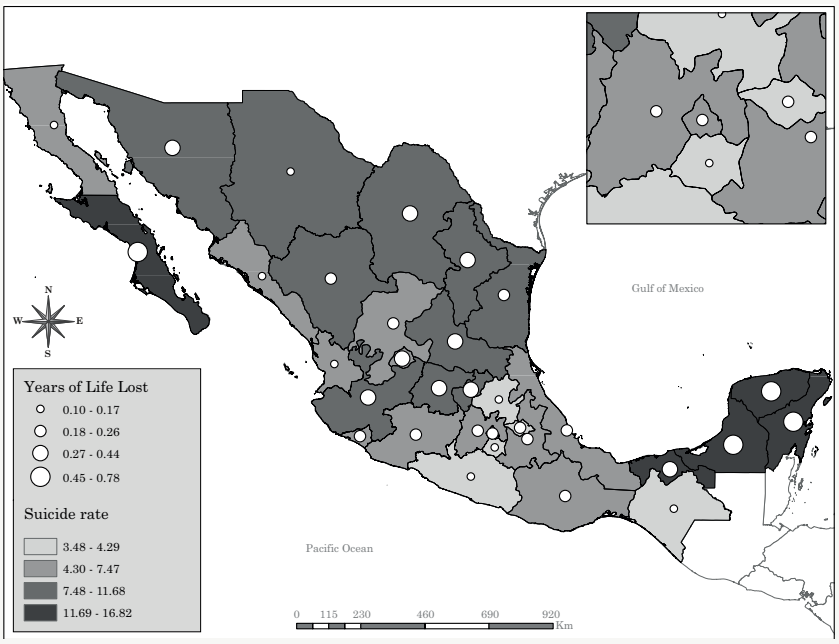

Figure 3. Mortality rates and years of life lost due to male suicides. Mexico, 2010.

Source: Own elaboration based on mortality vital statistics provided by the Instituto Nacional de Estadística y Geografía (INEGI) and population projections 2010-2030 of the Consejo Nacional de Población (CONAPO).

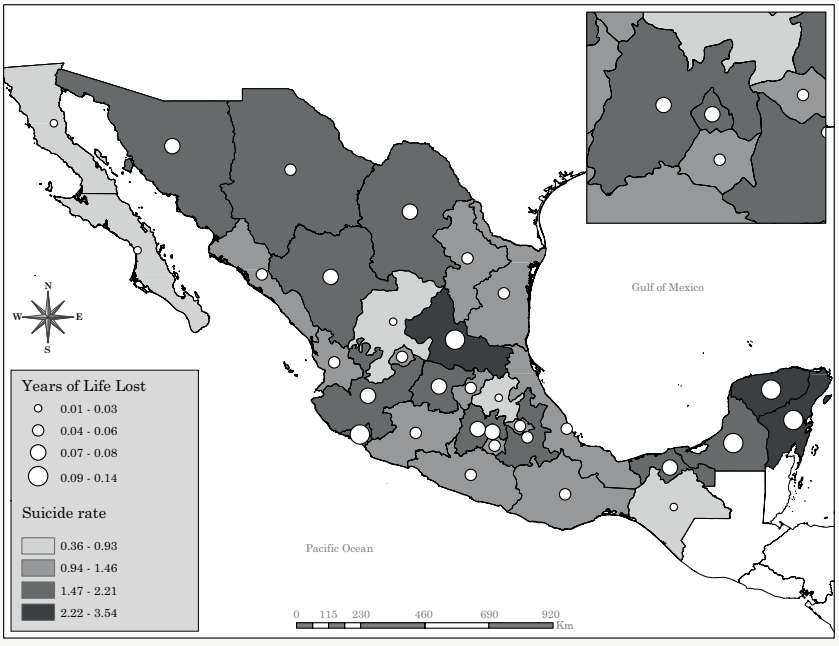

Figure 4. Mortality rates and years of life lost due to female suicides. Mexico, 2010.

Source: Own elaboration based on mortality vital statistics provided by the Instituto Nacional de Estadística y Geografía (INEGI) and population projections 2010-2030 of the Consejo Nacional de Población (CONAPO).

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

Table 1. Years of life lost due to suicides in men by age. Mexico, 2000-2012.

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0-4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5-9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10-14	0.00398	0.00449	0.00569	0.00536	0.00618	0.00612	0.00691	0.00529	0.00719	0.00656	0.00701	0.00932	0.00817
15-19	0.02845	0.03104	0.02889	0.03170	0.03270	0.03085	0.03005	0.02918	0.02960	0.02934	0.02827	0.03498	0.03522
20-24	0.04402	0.04638	0.04824	0.05143	0.05061	0.04933	0.04842	0.04642	0.04344	0.03889	0.03744	0.04336	0.04101
25-29	0.03793	0.03793	0.03787	0.04083	0.04234	0.04439	0.04209	0.04073	0.03780	0.03485	0.03084	0.03508	0.03613
30-34	0.02669	0.03210	0.03070	0.03319	0.03257	0.03425	0.03350	0.03513	0.03101	0.02958	0.02599	0.02817	0.02963
35-39	0.02148	0.01914	0.02180	0.02252	0.02641	0.02584	0.02732	0.02575	0.02571	0.02614	0.02590	0.02494	0.02623
40-44	0.01294	0.01507	0.01656	0.01832	0.01806	0.01953	0.01592	0.01878	0.01832	0.01877	0.01665	0.02101	0.02004
45-49	0.01336	0.01413	0.01323	0.01348	0.01408	0.01473	0.01542	0.01453	0.01429	0.01760	0.01462	0.01667	0.01447
50-54	0.01063	0.01164	0.01084	0.01077	0.01102	0.01233	0.01223	0.01150	0.01142	0.01293	0.01245	0.01329	0.01182
55-59	0.00829	0.00827	0.00853	0.00955	0.00984	0.00944	0.01042	0.00750	0.00818	0.01069	0.00911	0.00971	0.00904
60-64	0.00604	0.00758	0.00655	0.00701	0.00729	0.00603	0.00635	0.00650	0.00847	0.00787	0.00700	0.00863	0.00820
65-69	0.00478	0.00584	0.00524	0.00614	0.00637	0.00495	0.00600	0.00689	0.00685	0.00564	0.00575	0.00631	0.00558
70-74	0.00444	0.00338	0.00416	0.00348	0.00320	0.00430	0.00419	0.00473	0.00349	0.00443	0.00467	0.00460	0.00403
75-79	0.00172	0.00322	0.00232	0.00300	0.00272	0.00238	0.00222	0.00210	0.00189	0.00261	0.00216	0.00236	0.00201
80-84	0.00093	0.00100	0.00062	0.00068	0.00055	0.00087	0.00065	0.00063	0.00063	0.00052	0.00061	0.00059	0.00057
Total	0.22567	0.24113	0.24431	0.25746	0.26394	0.26497	0.26168	0.25564	0.24828	0.24641	0.22845	0.25902	0.25214

Source: Own elaboration based on mortality vital statistics provided by the Instituto Nacional de Estadística y Geografía (INEGI) and population projections 2010-2030 of the Consejo Nacional de Población (CONAPO).

With respect to the age groups, it was observed that for men, the age group with the highest deaths rates and YLL figures was the 20-24 age group in all the years studied (with an average of 0.045 years), whereas for women the age group was 15-19 (average 0.012). It is important to highlight that during the studied period more than 81% of YLL in men, in the referred age range, occurred in individuals aged 15 to 49; whereas in women this percentage increased to 79%.

At the state level, the highest suicide mortality in 2010 was observed in the federal entities that make up the Yucatán Peninsula, in both sexes; i.e., the three entities that form it (Yucatán, Quintana Roo and Campeche) are included within the five jurisdictions with the highest YLL figures in the country (0.78; 0.59 and 0.53 years respectively in men and 0.14; 0.12 and 0.10 years respectively in women) (Figures 3 and 4). The other states that present high YLL in the case of men were Baja California Sur (0.54 years) and Tabasco (0.44 years); and in women were Colima (0.10 years) and San Luis Potosí (0.10 years). Furthermore, the states with the lowest YLL figures were Guerrero, Chiapas, Morelos and Baja California for men, and Chiapas, Zacatecas, Hidalgo and Baja California for women, with levels inferior to 0.13 years in men and 0.025 years in women (Figure 6). As in the case of the mortality rates, the correlation coefficient among the YLL of the states and the state marginalization index was calculated. The result of this analysis is a negative correlation coefficient (-0.19), which is not statistically significant ($p > 0.28$), showing that no linear relationship exists among the socioeconomic level of the states and the YLL due to suicides at state level.

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

Table 2. Years of life lost due to suicides in women by age. Mexico, 2000-2012.

Age	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
0-4	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
5-9	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
10-14	0.00277	0.00395	0.00404	0.00327	0.00347	0.00376	0.00399	0.00358	0.00475	0.00516	0.00497	0.00729	0.00564
15-19	0.00950	0.01157	0.01155	0.01259	0.01064	0.01168	0.01278	0.00977	0.01169	0.01467	0.01285	0.01608	0.01476
20-24	0.00726	0.00739	0.00696	0.00782	0.00653	0.00766	0.00756	0.00928	0.01025	0.00689	0.00890	0.01150	0.01095
25-29	0.00391	0.00472	0.00426	0.00449	0.00566	0.00606	0.00471	0.00614	0.00615	0.00680	0.00607	0.00842	0.00622
30-34	0.00263	0.00415	0.00343	0.00342	0.00465	0.00398	0.00406	0.00482	0.00444	0.00500	0.00452	0.00512	0.00633
35-39	0.00223	0.00308	0.00261	0.00355	0.00307	0.00352	0.00344	0.00352	0.00422	0.00375	0.00477	0.00423	0.00442
40-44	0.00175	0.00223	0.00285	0.00281	0.00203	0.00294	0.00229	0.00341	0.00354	0.00326	0.00290	0.00342	0.00383
45-49	0.00227	0.00268	0.00251	0.00229	0.00242	0.00250	0.00205	0.00304	0.00284	0.00338	0.00344	0.00275	0.00368
50-54	0.00140	0.00213	0.00238	0.00238	0.00208	0.00217	0.00222	0.00232	0.00184	0.00214	0.00164	0.00205	0.00208
55-59	0.00095	0.00147	0.00091	0.00160	0.00164	0.00162	0.00107	0.00096	0.00199	0.00204	0.00143	0.00154	0.00177
60-64	0.00076	0.00104	0.00118	0.00099	0.00138	0.00067	0.00101	0.000956	0.00103	0.00127	0.00109	0.00081	0.00129
65-69	0.00077	0.00091	0.00081	0.00090	0.00104	0.00062	0.00075	0.00054	0.00052	0.00062	0.00060	0.00120	0.00084
70-74	0.00038	0.00037	0.00035	0.00028	0.00045	0.00054	0.00049	0.00051	0.00015	0.00049	0.00037	0.00047	0.00065
75-79	0.00034	0.00019	0.00027	0.00017	0.00039	0.00020	0.00012	0.00041	0.00025	0.00017	0.00010	0.00000	0.00020
80-84	0.00004	0.00012	0.00004	0.00004	0.00003	0.00006	0.00008	0.00000	0.00004	0.00000	0.00004	0.00005	0.00003
Total	0.03697	0.04598	0.04415	0.04660	0.04547	0.04798	0.04662	0.04927	0.05397	0.05562	0.05369	0.06492	0.06270

Source: Own elaboration based on mortality vital statistics provided by the Instituto Nacional de Estadística y Geografía (INEGI) and population projections 2010-2030 of the Consejo Nacional de Población (CONAPO).

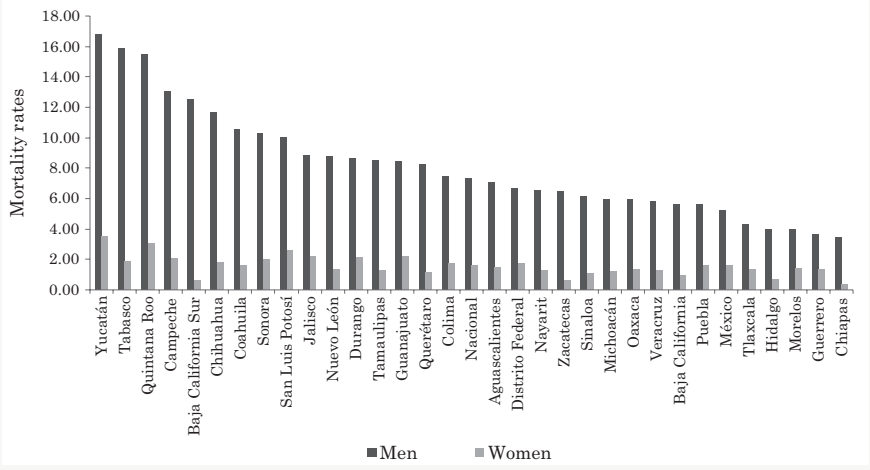

Figure 5. Suicide mortality rates by sex and federal entities. Mexico, 2010.

Source: Own elaboration based on mortality vital statistics provided by the Instituto Nacional de Estadística y Geografía (INEGI) and population projections 2010-2030 of the Consejo Nacional de Población (CONAPO).

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

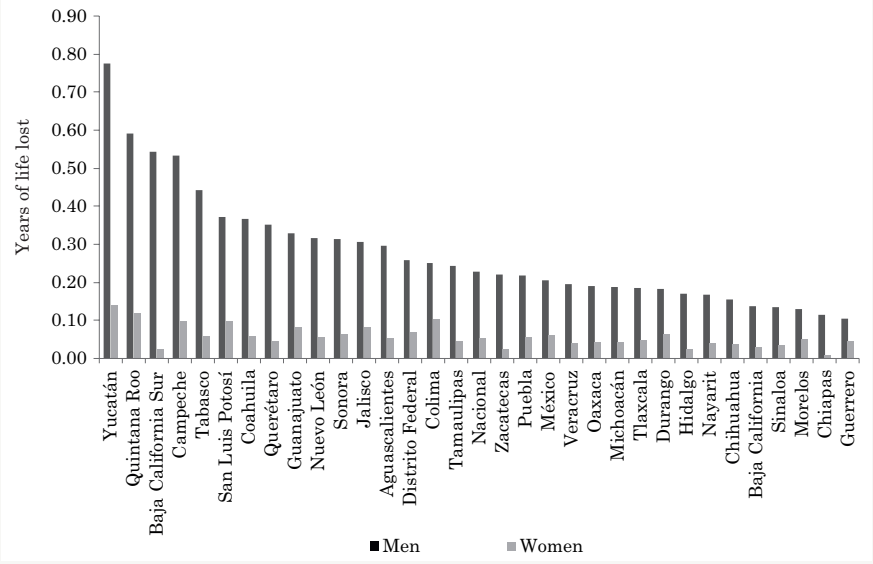

Figure 6. Years of life lost by sex and federal entity. Mexico, 2010.

Source: Own elaboration based on mortality vital statistics provided by the Instituto Nacional de Estadística y Geografía (INEGI) and population projections 2010-2030 of the Consejo Nacional de Población (CONAPO).

DISCUSSION

Suicide is an important public health problem due to its impact on society, both in connection with premature mortality, which implies a huge economic, social and psychological burden for the individuals, families and society in general[5] and the fact that suicidal attempts leave serious, and perhaps permanent sequelae in the affected individual, whose effects on the population health can be of great magnitude. In fact, it can be argued that much of the importance of this problem is related to the question of whether suicide incidence might be a reflection of the poor living conditions of the population.[13]

The suicide mortality rate in Mexico has increased steadily over the last 40 years,[10,14,15] which has been corroborated in this research since this upward trend continues in the period under analysis; however, when the impact of suicide mortality is analyzed through YLL, a slightly different situation is observed. While there is an increase of this indicator from 2000 to 2005, in 2005 the trend changes since mortality descends until 2010 and increases again from 2010 onwards. This happens because the increase in mortality is mainly observed in the older individuals in the age range analyzed and it's not generalized. While the absolute number of deaths due to suicide is higher in younger individuals during the period, higher suicide rates were observed in adults aged 80 or more. Nevertheless, in some years, the YLL decreased because of this cause, in contrast with the rate trend. This is the reason why the analysis of mortality must be carried out using different indicators,[10] as the ones used in this analysis, in order to obtain a better overview of the behavior of the phenomenon.

The differential behavior of suicide mortality by sex was verified in comparison with the one found in other research works on the issue in Mexico.[10,14,15] In the case of men, the highest rates were observed in adults aged 80 or more; however, upon analyzing the YLL because of this cause, the maximum impact of mortality due to male suicides was observed in the 20 to 24 age group. With respect to women, Hernández-Bringas and Flores-Arenales, when analyzing the trend of suicides in Mexico, found that the highest levels of suicides occur in the 15 to 24 age groups,

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

both in relative and absolute terms,[10] a fact that is consistent with the results obtained in this research, with regard to both indicators used.

There are several explanations regarding the difference among men and women suicide rates that were found in this research and in others in the same context,[10,14,15] a fact that has been associated with the "gender paradox" (a concept that describes the evidence that women's suicidal attempts are more frequent than men's, though men and not women are the ones who finally consummate suicide).[16] This fact can be based on gender differences, mainly because the suicidal behavior has different meanings for each gender.[6,17,18] Among the main causes are dissimilarities between men and women with respect to the socially accepted methods of coping with certain situations, such as stress and conflict. This implies that men are more worried about the social disapproval concerning their suicidal thoughts and behavior, which leads to the fact that non-fatal suicidal behavior is less masculine and may exacerbate the gender difference in the suicides rates,[19] as it is observed in this study. Another characteristic refers to the difference in the methods/ways used to commit suicide, being deadlier in the case of men, and not depending only on the possibility of accessing the method, but on cultural, religious and social values.[20,21] This latter aspect should be remarked,[15] since men resort to methods such as hanging or firearms, which are used in 78% and 13% of all suicides respectively[8,22]; whereas women prefer to use different methods, such as poisoning by gases, steams, alcohol or pesticides,[8,15,22-24] which might be a factor associated with the differences in suicide mortality between men and women observed in this research. Furthermore, it was suggested that, alcohol and drug consumption are perceived as masculine, whereas non-fatal or self-harming suicidal behaviors are considered feminine;[25] which leads us to conclude that these cultural meanings may influence the suicidal behavior of men and women.[25,26] Thus, it may be an additional factor related to the difference between genders in the suicide mortality observed in this study.

Another factor in connection with the difference in suicide rates between men and women is the link among the suicidal behavior and several psychiatric disorders, which is also related to the difference between genders regarding psychopathologies.[19] In this sense, depression is identified as one of the most important risk factors leading to suicidal ideation and occurring unequally between men and women.[27] In this context, it is worth mentioning that an impulsive, hostile and aggressive personality associated with several psychiatric disorders prevails in men and substantially increases the suicide risk.[28,29] Moreover, although a clear difference exists between male and female suicide mortality, the data analyzed in this research and in other studies on suicide mortality in Mexico – such as the one carried out by Martínez[15] and Hernández-Bringas and Flores-Arenales[10] – show that rates for women have been increasing across the country for some years, which forces to conduct further research in order to find out the causes that place women in these increasingly risky situations.[15]

Furthermore, an analysis at state level was conducted because both the mortality rate and YLL at national level are indicators that provide an initial approximation to the issue; however, in order to obtain a more detailed overview on the phenomenon, data disaggregated by federal entities needs to be analyzed as well. We verified that the states with higher incidence of suicides for both sexes are Yucatán, Quintana Roo and Campeche,[13,15,30] and for men, Baja California Sur and Tabasco were also added. In the case of women, Colima and San Luis Potosí are states that also have high levels of suicide mortality. These results per state suggest a specific risk area which consists of the states that form the Yucatán Peninsula (Figures 3 and 4).[22] Among the states having low levels of suicide mortality, with respect to both sexes, Chiapas, Hidalgo and Baja California stand out. In accordance with the results of this research, it seems that there is no relation among the socioeconomic level of the states (approximated with the state marginalization index) and suicide mortality. This can be related to the upward trend in mortality observed since the 1950s across all the states of the country;[10] therefore, it is unlikely that the processes of economic crisis in the country had had a significant influence on the increase of suicide mortality. This analysis was carried out because it has been argued that the incidence of suicide might be associated with the deficient living conditions of the population.[13]

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

The results obtained in this study allow us not only to confirm the upward trend in suicide mortality in the country, which was also analyzed in other studies,[9,13,14, 22, 27] but to account for the magnitude of its differential impact per sex, age and federal entity. These socio-demographic factors can neither clarify, nor determine by themselves the suicide causes; however, they are an important guideline to identify the trend of the phenomenon and to become acquainted with certain risk factors in connection with the profile of the population or the characteristics of the places where suicides are committed.[27] In relation to this, the main risk factor detected with respect to suicides is a previous suicidal attempt.[22] However, there are other factors associated with this death cause, among which the following stand out: male sex; individuals aged over 40; unmarried individuals or individuals who are not cohabiting; low levels of education; underemployment;[13,31] high consumption of alcohol, chronic pain and diseases, as well as, suicidal family history; mental disorders, mainly depression (especially, major depression), anxiety (which combined with depression, multiplies the risk), personality disorders, bipolar disorder, schizoaffective disorder or schizophrenia;[14,32-35] and suicidal ideation, though in a lesser degree than in a previous suicide attempt.[15]

Additionally, to individual risk factors, there exist those associated with the healthcare system and society, among which the following ones stand out: a difficult access to the health system and to receive the necessary care; stigmatization of those that seek help because of suicidal behavior and the availability of suicide methods.[10] Additionally, for each consummated suicide, there are many more suicide attempts, which are estimated between 20 and 40 attempts per each consummated suicide,[10] with a highly probable underestimation of the number of attempted suicides. This situation is not trivial due to the fact that suicidal attempts are a huge social and economic burden, since each attempt may result in death or in the use of the healthcare services to treat the injuries, the psychological and social impact on the individual involved and his environment, or in a physical injury or a long-term disability leading to deep psychological suffering.[14]

The results presented in this analysis reveal a worrying scenario, not only from a the social, economic and health perspective, but also with respect to the need to establish public policies.[9] It highlights the fact that governments and decision-makers assign low priority to suicides, as it is a preventable death cause. This is a warning call in relation to the need to implement actions in a timely manner, a multi-sectoral comprehensive prevention strategy and a detailed study of the associated risk factors. Suicide prevention must be based on a set of strategies among which the following ones stand out: identification and treatment of individuals suffering from mental disorders in order to promote mental health;[22] greater access to health care services, reduction of harmful consumption of alcohol and substances; limited access to available means used to commit suicide such as fire arm control; media awareness in relation to the responsibility they have over the information they provide; community support; and improved health staff training in connection with mental disorders and substance abuse.[5]

In any event, suicide may not be considered a personal decision, but a social phenomenon that results from certain sociocultural factors existing in every society which directly influence the suicidal behavior.[27] According to Durkheim, suicide occurs in societies exhibiting disintegration, lack of group cohesion and poor coexistence between the community and institutions, and therefore, it can be considered a reflection of societies lacking social cohesion and sense of belonging.[36] Durkheim defines four types of suicides: *the egoistic, the anomic, the altruistic and the fatalistic*.[36] *The egoistic suicide* is characterized by excessive individualism resulting from a poor integration of the individual in the society he belongs to.[27,36] *The anomic suicide* is associated with a lack of social order and an absence of rules. In the case of *the altruistic suicide*, the interest of the individual is focused on what is good for society, therefore becoming indifferent to the loss of his own life to fulfill the common good. *The fatalistic suicide* occurs when there is an overregulation of society. These two latter categories of suicides are less common in today's Mexican society.[27] However, weak social ties, growing individualism, social inequality and social, economic, labor and educative exclusion[37] in today's Mexican context may become detonators for the development of psychiatric disorders,[27] which, as previously mentioned, are one of the main suicide

SALUD COLECTIVA. 2015;11(4):471-484. doi: 10.18294/sc.2015.784

risk factors. Consequently, in this context, *the egoistic* and *the anomic suicides* may be the most common types in the country and the ones presenting a higher increase in recent times.

If we accept the fact that suicide is committed as a consequence of the problems a population goes through during a given period, the upward trend in mortality due to this cause, as observed in this study, as well as the studies carried out in the Mexican context[9,13,14, 22, 27] is a parameter that indicates that a serious problem exists in the Mexican society.[10] Therefore, it is imperative that further efforts are made to prevent, study, detect and treat the suicide phenomenon.

The results of this research lead to conclude that suicide in Mexico has become a public health concern of great relevance and impact; therefore, the issue must be addressed from a multidimensional approach covering the complex interaction of biological, genetic, psychological, sociological and environmental factors of this phenomenon[10,33,35,38] in order to create policies for the prevention and timely care of suicide, with the aim of reducing the impact of this death cause on society.

ENDNOTES

a. The state marginalization index is a measure that makes possible the differentiation of entities of the country depending on the global impact of shortages suffered by the population as a result of the inaccessibility to different opportunities, goods and services. The marginalization index consists of nine socioeconomic indicators and allows an approach to the knowledge of the existing regional inequality of social opportunities.

b. The other two assumptions of the method, as defined by Arriaga (10) are: "i) assuming that between the two ages selected for the analysis, if those who die at a determined age had not died, they should have lived as much as the age average reached by a population that does not die at that age; ii) not limiting the highest age of the analysis and assuming that if those that died at a specific age had not died, they would have lived as much as the rest of the population that remained alive at that same age."

c. This implies that ${}_nd_{x,j} = {}_nd_x\ ({}_nD_{x,j} / {}_nD_x)$, where ${}_nd_{x,j}$ are the deaths among the ages x and $x+n$ due to the death cause j in the life table; ${}_nd_x$ are the deaths among the ages x and $x+n$ in the life table; ${}_nD_{x,j}$ are the recorded deaths in the vital statistics among the ages x and $x+n$ due to the death cause j; and ${}_nD_x$ are the recorded deaths in the vital statistics among the ages x and $x+n$.

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