Years of Life Lost (YLL) attributable to alcohol consumption in Mexico City

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Abstract *The aim of this study was to estimate the YLL attributable to alcohol consumption in Mexico City from 2006 – 2012. Vital statistics on mortality attributable to alcohol consumption from the INEGI (Instituto Nacional de Estadística y Geografía) were used to determine YLL as well as the average age of death in relation to different age ranges by sex. A total estimate of 168,607 YLL was obtained, with an average loss of 18.32 years being observed for men and 17.54 years for women. Men accounted for a higher proportion of the YLL than women. According to the ICD-10 (Tenth Revision of International Classification of Diseases), liver disease attributable to alcohol consumption was found to be responsible for more than 80% of the total YLL. There was a cyclical trend in YLL from 2006 to 2012. The YLL attributable to alcohol suggest that alcohol consumption is a public health problem that involves losses in productivity and economic costs, and the decline in YLL could be explained by the decrease in income caused by the economic crisis of 2008, just as the increase could be explained by economic improvement in 2012.*

Key words *Years of life lost, Alcohol consumption, Cost of illness, Mortality*

Introduction

According to data from the World Health Organization (WHO)[1], alcohol consumption is a causal factor in 60 different diseases at a global level, including liver cirrhosis, cardiovascular problems and polyneuritis, among others. It is also the direct cause of accidents and injuries, such as car accidents, falls and violence, and it is responsible for approximately 4% of all deaths worldwide, a figure that is higher than the deaths due to the human immunodeficiency virus (HIV / AIDS) or tuberculosis. International agencies have reported a relationship between alcohol consumption and losses in productivity (such as employee turnover due to premature death) as well as high economic costs[2] that impact families, society and government. In 2000 alone, alcohol consumption in the Americas was the main risk factor for disease burden, corresponding to 13,883,000 disability-adjusted life years (DALYs), equivalent to 9.7% of all DALYs in the region[3]. In Mexico, alcohol consumption is considered the fourth leading cause of mortality in the country[4]. Furthermore, alcohol consumption generates the greatest health problems compared with other drugs. According to the National Survey of Addictions (Encuesta Nacional de Adicciones - ENA)[5] performed in Mexico in 2011, the problems caused by alcohol consumption increased greatly because the percentage of dependence in the total population (12 to 65 years old) increased from 4.1% in 2002 to 6.2% in 2011, and the percentage of risky consumption was 32.8% during the same period. Additionally, nearly 27 million Mexicans (32.8%) drink with a risky pattern of consumption (five drinks or more on a single occasion for men and four drinks or more for women)[6], a situation that further worsens the problem .

Mexico City is Mexico's second most populated state and the world's second most populated city (with more than eight million inhabitants), accounting for 7.87% of the country's population[7]. The prevalence of alcohol consumption in the last year in Mexico City was 52.8%, while that of alcohol dependence was 4.4%[5]. Given the geographic, social, cultural and migratory conditions that exist in Mexico City, the assessment of Years of Lives Lost (YLL) is important for understanding the dynamics of public health related to alcohol consumption in our country.

YLL is defined as the number of deaths multiplied by the standard life expectancy[8]. Thus, YLL is a measure of years lost associated with each death at a given age[9] compared with the years that one should have lived, based on the argument that all countries should have this standard life expectancy[10]. The estimation of YLL allows us to better analyze the health conditions in a population and provides a basis for cost-effectiveness analysis[11]. Additionally, as a measure used for the evaluation of health policies and programs, it gives weights to certain quality of life characteristics [12].

Therefore, the aim of this study was to estimate the YLL for diseases that are directly attributable to alcohol[13,14], which according to the Tenth Revision of the International Classification of Diseases by the WHO (ICD-10) [15], are those diseases in which alcohol consumption inevitably contributes to the development of the disease[16]. This analysis seeks to understand the dynamics of the effects of alcohol consumption in our country in the period between 2006 and 2012.

Methods

Sources of Information

This article is a secondary analysis of mortality records obtained from civil death records in the Mexican Republic, which represent a direct estimate of mortality. These data are published annually by the National Institute of Statistics, Geography and Informatics (Instituto Nacional de Estadística y Geografía - INEGI)[17]. The data corresponding to Mexico City between 2006 and 2012 were analyzed. The records were divided by sex, age and the detailed cause of death[15] (ICD-10). For the analysis, the following causes of death directly attributable to alcohol were considered:

(F101) Mental and behavioral disorders due to alcohol use/harmful use; (F102) Mental and behavioral disorders due to alcohol use/dependence syndrome; (F103) Mental and behavioral disorders due to alcohol use/withdrawal state; (F104) Mental and behavioral disorders due to alcohol use/withdrawal state with delirium; (F105) Mental and behavioral disorders due to alcohol use/psychotic disorder; (F106) Mental and behavioral disorders due to alcohol use/amnesic syndrome; (F107) Mental and behavioral disorders due to alcohol use/residual and late-onset psychotic disorder; (F109) Mental and behavioral disorders due to alcohol use/mental and behavioral disorder/unspecified; (K700)

Alcoholic fatty liver; (K701) Alcoholic hepatitis; (K702) Liver fibrosis and cirrhosis/alcoholic; (K703) Alcoholic liver cirrhosis; (K704) Alcoholic liver failure; (K709) Alcoholic liver disease/unspecified; (G312) Degeneration of the nervous system due to alcohol; (I426) Alcoholic cardiomyopathy; (K292) Alcoholic gastritis; (K852) Alcohol-induced acute pancreatitis; and (K860) Alcohol-induced chronic pancreatitis.

Data Analysis

As in Dávila et al.[18], records that were unspecified in terms of age and sex were eliminated from the analysis, as were deaths occurring outside the region. The studied sample was grouped into intervals of five years (from 0 to 84 years, leaving open the interval between 85 years and the last age of living individuals) and by sex. The mean age of death was obtained for each interval.

To estimate YLL, the methodology proposed by Velázquez-Valdivia[10] was used, applying the following formula:

$$ILL_a = \int Cxe^{-Bx} e^{-r(x-a)} dx$$

The solution of this integral is given by[19]:

$$ILL = \frac{KC\, e^{ra}}{(r+\beta)^2} \left[e^{-(r+\beta)(L+a)} \left[-(r+\beta)(L+a) -1 \right] - \right.$$

$$e^{-(r+\beta)a}[-(r+\beta)a-1]] + \frac{1-k}{r}(1-e^{-rL})$$

This solution was obtained in Microsoft Excel[20], using the following parameters:

a: age at death
β: age weighting parameter (β = .04)
C: age weighting fit with constant (C = .1658)
r: discount rate (r = 3%)

L: standard life expectancy related to age at death, where the average values are compared with the West 26[21] standard life expectancy.

In vital statistics, coverage error commonly refers to systematic underreporting. In Mexico, according to ECLAC (Economic Commission for Latin America and the Caribbean)[22], the coverage of vital statistics in Mexico has undergone substantial improvements, as in 1970-1975, the relative difference between estimated deaths and recorded deaths was 91.5, while in 2000-2005, this difference was barely 4.7. Additionally, for 2009, ECLAC estimated the occurrence of recorded deaths with poorly defined causes to be approximately 2%, and the estimated underreporting by PAHO (Pan American Health Organization)/ WHO[23] was approximately 0.5%. Therefore, given that this study is based on the analysis of vital statistics, the authors did not consider it necessary to correct for underreporting.

Results

For the study period, a total of 9,233 deaths directly attributable to alcohol consumption were recorded, with a high prevalence of the problem being observed among males, which accounted for 8,451 (91.5%) deaths, while the female sex only accounted for 782 (8.5%) deaths. Comparing deaths directly attributable to alcohol consumption in relation to the total recorded deaths in Mexico City, we found that, in males, the former category accounted for an average of 3.9% of all deaths between 2006 and 2012; in contrast, the percentage of deaths attributable to alcohol consumption in females was not higher than 0.4%. Comparisons by year are shown in Table 1.

In Table 2, we can see that when the pattern of YLL is analyzed by gender, it exhibits an early peak in males, indicating that it begins in the age 15 to 19 group and reaches its maximum in the age 45 to 49 group. In women, the peak starts from age 20 to 24 and reaches its maximum point between age 50 and 54. We also found that alcohol consumption was related to an average loss of years per person of 18.32 for men and of 17.54 for women.

In the comparison of YLL according to the cause of death, it could be observed that degeneration of the nervous system due to alcohol, alcoholic cardiomyopathy, alcoholic gastritis, alcohol-induced acute pancreatitis and alcohol-induced chronic pancreatitis (G312, I426, K292, K852, K860. ICD-10) contributed fewer years to the total (with 2008 being the year in which the greatest number of YLL was recorded and 2006 being the year with the least YLL), while liver diseases (K700 – K709. ICD-10) accounted for the vast majority of YLL [with 2010 being the year with the fewest YLL and 2006 being the year with the greatest number of YLL (Graphic 1)].

Finally, Graphic 2 shows the total annual YLL directly associated with alcohol consumption, revealing a downward trend equating to a decrease of 11.92% in 2010 compared with 2006, followed by an increase of 5.01% from 2010 to 2012. The observed trend in annual YLL is best described by a sine function given by y = 24463.0434+1488.3396 sin (0.6481x + 2.6325), with a very good fit (R = 0.9459).

Table 1. Comparison of overall mortality and mortality directly attributable to alcohol in Mexico City, 2006-2012.

| | Deaths | | | | | |
| | Men | | | Women | | |
Year	Overall	Mortality directly attributable to alcohol	Percentage	Overall	Mortality directly attributable to alcohol	Percentage
2006	28,818	1,310	4.5%	27,572	109	0.40%
2007	29,495	1,230	4.2%	28,187	124	0.44%
2008	30,304	1,234	4.1%	29,144	123	0.42%
2009	30,672	1,186	3.9%	29,596	98	0.33%
2010	31,925	1,137	3.6%	30,064	104	0.35%
2011	31,405	1,152	3.7%	29,300	113	0.39%
2012	32,779	1,202	3.7%	30,295	111	0.37%
Total	215,398	8,451	3.9%	204,158	782	0.38%

Table 2. Mortality and years of life lost due to illnesses associated with alcohol consumption by gender, 2006-2012.

| | Men | | | Women | | | Total | | |
Age Group	Deaths	YLL	% YLL	Deaths	YLL	% YLL	Deaths	YLL	% YLL
0-14	0	0	0.0	0	0	0.00	0	0	0.00
15-19	11	310	0.20	0	0	0.00	11	310	0.18
20-24	45	1,237	0.80	4	112	0.82	49	1,349	0.80
25-29	179	4,755	3.07	7	190	1.39	186	4,945	2.93
30-34	438	11,116	7.21	16	416	3.03	454	11,582	6.87
35-39	792	19,264	12.44	37	930	6.78	829	20,194	11.98
40-44	992	22,667	14.63	58	1,371	9.99	1,050	24,038	14.26
45-49	1,188	25,259	16.31	95	2,117	15.43	1,283	27,376	16.24
50-54	1,135	22,068	14.25	104	2,137	15.58	1,239	24,205	14.36
55-59	976	16,985	10.97	91	1,709	12.46	1,067	18,694	11.09
60-64	843	12,741	8.23	112	1,863	13.58	955	14,604	8.66
65-69	690	8,800	5.68	91	1,303	9.50	781	10,103	5.99
70-74	517	5,304	3.42	74	882	6.43	591	6,186	3.67
75-79	331	2,658	1.72	43	403	2.94	374	3,061	1.82
80-84	200	1,210	0.78	26	187	1.36	226	1,397	0.83
85+	114	465	0.30	24	98	0.71	138	563	0.33
Total	8,451	154,889		782	13,718		9,233	168,607	

Discussion

YLL is an important health parameter that allows us to define the state of a population's health and obtain information about temporary changes in premature mortality and differences in mortality attributable to various subpopulations, in addi-tion to helping to evaluate the effectiveness of interventions[24]. YLL is a measure that allows us to determine how many more years people who have died as a result of alcohol consumption[25] should have lived.

In Mexico City, among the 9,233 deaths di-rectly related to alcohol consumption during the

AVPs

| | K700-K709 | F100-F109 | G312, I426, K292, K582, K860 |
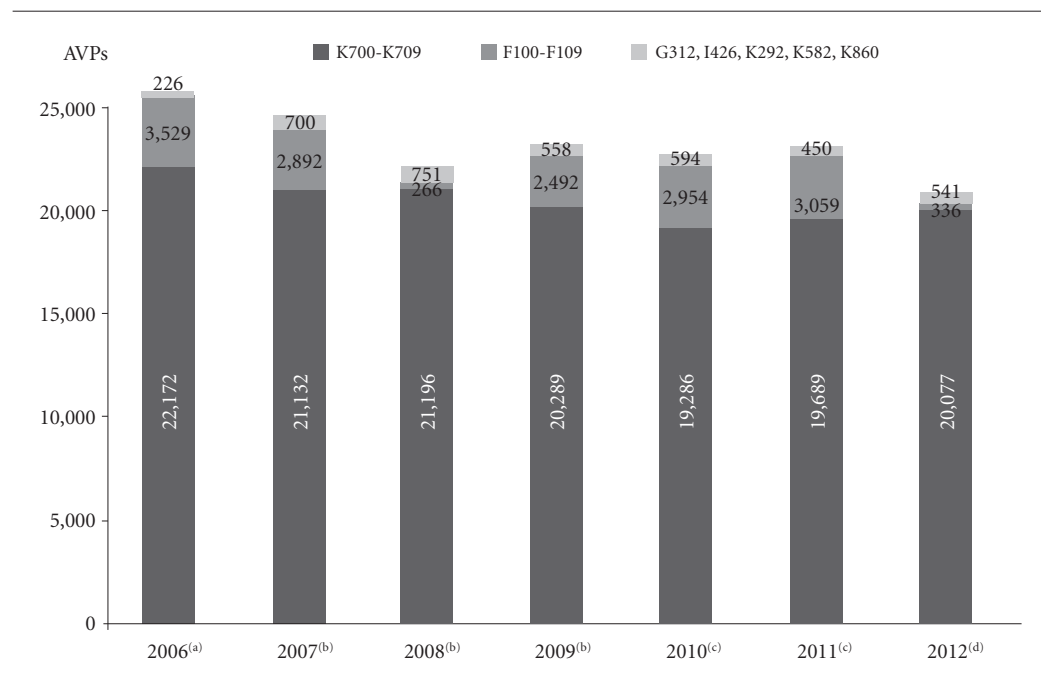
Graphic 1. YLL due to alcohol consumption according to the ICD-10, 2006-2012.

[a] No deaths for K582, K860. [b] No deaths for K292. [c] No deaths for I426. [d] No deaths for I426, K292.
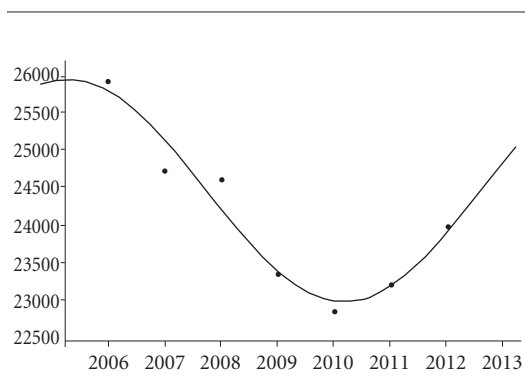
Graphic 2. Annual YLL associated with alcohol consumption, 2006 – 2012.

study period, a total of 168,607 YLL were determined, with an average loss of 18.32 years for men and 17.54 years for women. The age 45 to 49 group accounted for the most YLL, which could be related to the cumulative effect of alcohol consumption. It was also observed that liver diseases accounted for the greatest number of YLL among the total and that, within the study period, there was a downward trend in the number of YLL from 2006 to 2010, followed by an increase in 2011 and 2012.

We also observed differences in YLL between men and women. When we compared the mortality attributable to alcohol versus overall mortality, we found that in the men, the former category was responsible for 3.9% of deaths, while in women, it was responsible for 0.38%. This difference corresponds to the fact that in Mexico, men tend to consume alcohol more frequently and in greater quantities. Nevertheless, in recent years, alcohol consumption in women has risen globally in an ongoing manner, increasingly closing the gap in differences in alcohol consumption between men and women[26]. In the population of 12- to 65-year-olds in Mexico, 62.6% of women consumed alcohol at some point in their lives; 19.3% of women consumed alcohol with a pattern of risk (four drinks or more on a single occasion); and 1.8% of women showed symptoms of alcohol dependence[5]. This speaks to the need

to develop comprehensive prevention and treatment strategies directed toward women.

One limitation of this study was that using the data available from official sources, it was not possible to calculate DALYs related to alcohol consumption in Mexico City. This information was of particular interest because many of the diseases attributable to alcohol are not fatal[27]. Another limitation was that there were no available data on mortality attributable to alcohol for Mexico. Having this information would have allowed us to better approximate the magnitude of the problem, as YLL associated with deaths that are not directly related to alcohol, such as traffic accidents, violence or suicides[28], could have been estimated.

One question that arises from this study is related to the cyclical trend of annual YLL, which could be explained by the crisis suffered by the Mexican economy in 2009 as well as the recovery between 2010 and 2012. A clear example of this scenario is provided by the decrease in the consumption of alcoholic beverages within the home in 2008 and 2010 compared with 2006, according to the National Household Income and Expenditure Survey[29]. This study again shows a higher prevalence of alcohol consumption by men, even though recent data[3] suggest that this difference could decrease due to new trends of consumption (last month) among female adolescents. We emphasize the need to conduct longitudinal studies that allow us to understand the relationship between income and diseases such as liver cirrhosis. For example, a study by Bajaj et al.[30] showed that income level is related to overall health according to variables such as quality of life and access to medical services and treatment. It is also important to establish the pathophysiological role of alcohol in the development of these diseases. For example, scientific evidence shows that the effect of excessive alcohol consumption exhibits a causal relationship with liver cirrhosis through three mechanisms[31]: the production of acetaldehyde, the production of free radicals and the depletion of antioxidants.

Finally, total YLL is a figure that should serve as a warning regarding the problem of alcohol consumption in Mexico City. Thus, it should inform the continued implementation of strategies for prevention, treatment and public policies aimed at reducing alcohol consumption.

Collaborations

E Pérez-Pérez participated in the data collection, data analysis and preparation of the manuscript. EL Cruz-López and NF Hernández-Llanes participated in the data analysis and interpretation of the results. A Gallegos-Cari participated in the interpretation of the results and preparation of the manuscript. RE Camacho-Solís participated in the preparation of the manuscript. MA Mendoza-Meléndez participated in the study design, interpretation of the results, preparation of the manuscript and data analysis.

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