Mortality from diseases, conditions and injuries where alcohol is a necessary cause in the Americas, 2007–09

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ABSTRACT

Aims   To describe mortality from diseases, conditions and injuries where alcohol was a necessary cause in selected countries in the Americas. **Design**   A descriptive, population-based study. **Setting**   The data come from 16 countries in North, Central and South America for the triennium 2007–09 (latest available data). **Participants/Cases**   A total of 238 367 deaths were analyzed. **Measurements**   We calculated age-adjusted and age-specific mortality rates by sex and country using the Pan American Health Organization (PAHO) mortality database. **Findings**   The annual average of deaths where alcohol was a necessary cause in the 16 countries was 79 456 (men comprised 86% and women 14%). People aged 40–59 years represented 55% overall. Most deaths were due to liver diseases (63% overall) and neuropsychiatric disorders (32% overall). Overall age-adjusted rates/100 000 were higher in El Salvador (27.4), Guatemala (22.3), Nicaragua (21.3) and Mexico (17.8) and lower in Colombia (1.8), Argentina (4.0) and Canada (5.7). The age groups at the highest risk were 54–59 to 64–69 years in most countries. In Guatemala, El Salvador and Nicaragua the rates increased earlier, among those aged 30–49 years. Male rates were higher than female rates in all countries, but the male : female ratio varied widely. **Conclusions**   Diseases, conditions or injuries where alcohol is a necessary cause are an important cause of premature mortality in the Americas, especially among men. Some countries show high risk of dying from this group of causes.

Keywords   Alcohol consumption, alcohol-induced disorders, death rate, inequity, mortality.

INTRODUCTION

Alcohol consumption has been an important cause of disease world-wide. Systematic literature reviews have shown evidence of a causal relation of average volume of alcohol consumption and chronic and infectious major diseases such as liver cirrhosis, tuberculosis, some cancers, diabetes mellitus, various cardiovascular diseases and psychiatric disorders [1]. According to the *2010 Global Burden of Diseases* (GBD) [2], alcohol use is the fifth leading risk factor for the global burden of disease, an increase compared to 1990, when alcohol ranked as the eighth risk factor. Countries of the Americas experience a problem of higher magnitude than the global average. For example, estimations from the 2010 GBD showed that alcohol use in Ecuador, El Salvador and Guatemala topped the list of risk factors

across all age groups. At the same time it was the leading risk factor in 27 of the 34 countries among people aged 15–49 years [3].

According to the World Health Organization (WHO; 2003–05 data), the average per capita consumption in the Americas among people aged 15 years and above was 8.7 liters of pure alcohol per year, higher than the global average of 6.1 liters per year [4]. In the majority of countries in the region, the most consumed alcoholic beverages were beer (55% of total consumption), wine (12%) and spirits (33%) [4].

Alcohol consumption is also related to overall mortality and higher mortality risk among those with alcohol use disorders [5–9]. In the *International Statistical Classification of Diseases and Related Health Problems*, 10th revision (ICD-10) alcohol is a causal factor in more than 60 major types of diseases and injuries and a component

cause for more than 200 codes [1,4]. A component cause means that alcohol has a significant relation to the disease [1] or is one among other components [4]. As a necessary component, the outcome would not have occurred in the absence of alcohol consumption, such as in alcoholic liver cirrhosis; conversely, alcohol is just one causal component among several leading to road traffic deaths. Global estimates showed that approximately 2 735 511 deaths were caused by alcohol in 2010 [8]. WHO estimated 347 000 deaths caused by alcohol in the Americas in 2004 [9].

Traditionally, mortality information is available for the majority of countries in the Americas and has been used as a basic indicator of health. However, to date, no analysis has been published on specific causes of death by alcohol from countries in the region. Such information could provide direct evidence of the impact of alcohol nationally and regionally, and policy options could also be revised/implemented using such information. Alcohol-related mortality and morbidity at the country level is one of the indicators of the framework for monitoring the prevention and control of non-communicable diseases (NCDs) proposed by WHO [10]. This paper presents mortality data from diseases, conditions and injuries where alcohol is a necessary cause in 16 selected countries in the Americas for the triennium 2007–09.

METHODS

Source of mortality data

We extracted data from the Pan American Health Organization (PAHO) Regional Mortality System for the Americas, which comprises deaths registered in national vital registration systems and reported annually by national authorities [11]. This data set was corrected for under-registration of deaths and ill-defined causes using a methodology detailed in another publication [12]. We analyzed mortality data from 16 countries in North, Central and South America with good mortality data available for 2007, 2008 and 2009. The exception was Peru, which included data for 2007 and 2009 but not for 2008, as the data were not available at the time of the study; this did not affect the country analysis. We used triennium data to minimize possible fluctuations in the annual number of deaths.

Case definition

A disease, condition or injury where alcohol is a necessary cause means that it would not exist in the absence of alcohol consumption. In the literature [1,5], it is also called a disease or condition fully attributable to alcohol consumption or a wholly alcohol-attributable health condition. To select deaths we used all codes in the ICD-10

that have alcohol in the name of the categories (three digits) or subcategories (four digits), and according to the relevant literature [1,13,14]. The codes in Chapter XIX (S00-T98) are related to the nature of the injury, and according to the rules for coding morbidity and mortality (ICD-10 vol. 2) [15] they should not to be included in mortality studies. The codes for external causes (V01–Y89) are used as the underlying cause of death in the death certificate instead of those in Chapter XIX. Therefore, a total of 72 codes were included, as follows:

- Alcohol-induced pseudo-Cushing's syndrome (E24.4)
- Mental and behavioral disorders due to use of alcohol (F10.0–F10.9)
- Degeneration of nervous system due to alcohol (G31.2)
- Alcoholic polyneuropathy (G62.1)
- Alcoholic myopathy (G72.1)
- Alcoholic cardiomyopathy (I42.6)
- Alcoholic gastritis (K29.2)
- Alcoholic liver diseases (K70.0–K70.4 and K70.9)
- Alcohol-induced acute pancreatitis (K85.2)
- Alcohol-induced chronic pancreatitis (K86.0)
- Maternal care for (suspected) damage to fetus from alcohol (O35.4)
- Fetus and newborn affected by maternal use of alcohol (P04.3)
- Fetal alcohol syndrome (dysmorphic) (Q86.0)
- Finding of alcohol in blood (R78.0)
- Accidental poisoning by and exposure to alcohol (X45.0–X45.9)
- Intentional poisoning by and exposure to alcohol (X65.0–X65.9)
- Poisoning by and exposure to alcohol, undetermined intent (Y15.0–Y15.9)
- Evidence of alcohol involvement determined by blood alcohol level (Y90.0–Y90.9)
- Evidence of alcohol involvement determined by level of intoxication (Y91.0–Y91.9)

Data analysis

First we accessed the whole mortality data set (all causes) to extract a subdata set with 238 367 deaths due to a disease, condition or injury where alcohol is a necessary cause. Population figures available from the United Nations Population Division [16] were used to calculate age-specific crude rates, and age-adjusted mortality rates were obtained by direct standardization to the World Standard Population [17]. For the purposes of this analysis the codes above were combined into four groups: (i) liver diseases (K70); (ii) neuropsychiatric disorders (F10, G32.1 and G62.1); (iii) poisoning/intoxication (X45, X65, Y15, Y90 and Y91); and (iv) other diseases (all other codes). The age groups used were: <30, 30–39, 40–49, 50–59, 60–69 and 70 years and above. To classify the

overall age-adjusted rates in high, medium and low rates we used the tercile distribution; the rates were arranged from lowest to highest and distributed into three groups containing approximately one-third of the countries included in this study. These analyses were carried out using Tableau version 6.0 software and SPSS statistics version 17.0.

Because this study analyzed anonymous secondary data on mortality, no ethics approval was required.

Information regarding alcohol consumption indicators from WHO [3] and life expectancy at birth [18] for the selected countries are included as Supporting information as useful data to the readers.

RESULTS

During the triennium 2007–09, the annual average number of deaths where alcohol was a necessary cause was 79 456 (men accounted for 86% of cases and women were 14%) in the 16 selected countries in North, Central and South America, representing 1.4% of all-cause mortality. Of note, alcohol liver diseases represented 0.6% of all deaths. Table 1 summarizes the descriptive analysis by country. The average annual deaths varied widely among countries, from 235 in Costa Rica to 25 793 in the United States, reflecting the differences in population size of each country. Regarding sex distribution, males were 84.2% of deaths and females were 15.8%; in all countries the majority of deaths occurred among men. The distribution of these deaths by group of causes for all countries showed that liver diseases caused 63% of deaths and neuropsychiatric disorders 32%. However, these proportions varied by country. In the majority of countries the leading cause of death was liver disease, except in El Salvador and Guatemala, where neuropsychiatric disorders accounted for the highest proportion of cases. In Argentina, Brazil, Cuba, Guatemala and Nicaragua neuropsychiatric disorders were responsible for about half of alcohol-related deaths. Compared to other countries, the percentage of alcohol deaths due to poisoning/intoxication was higher in Guatemala (17%), Peru (16%), Costa Rica (14%), Ecuador (14%) and Colombia (11%).

According to the distribution in terciles of the overall age-adjusted mortality rates, countries with lower rates (<6.0/100 000) in the study period were Colombia (1.8), Argentina (4.0), Costa Rica (5.8), Venezuela (5.5) and Canada (5.7). The countries showing middle rates (6.0–11.9/100 000) were Cuba (6.2), United States (6.7), Peru (6.8), Paraguay (7.1/100 000) and Chile (11.6). Among countries with higher rates (12.0/100 000 and above) were Brazil (12.2), Mexico (17.8), Guatemala (22.3), Nicaragua (21.3) and El Salvador (27.4). In all countries male rates were higher than for females.

However, the ratio male/female varied widely. The risk of a man dying from disease, condition or injury where alcohol was a necessary cause in El Salvador was 27.8 times higher than that of a woman: 18.9 in Nicaragua and 14.8 in Cuba, but 3.2 in Canada and the United States and 4.3 in Peru.

Regarding the age groups more affected, people aged 40–59 years old accounted for 55% of deaths (50–59: 29%; 40–49: 26%), followed by the 60–69 years age group (18%). Table 2 shows age-specific rates for both males and females in each country. In all countries the rates increased with age. However, differences among countries regarding the age groups with the highest rates were found. In Argentina, Canada, Costa Rica, Cuba, Paraguay and the United States of America the highest rates were seen among those aged 50–69 years. In Brazil, Ecuador and Venezuela, the rates started increasing among those in the 40–49 years age group, remained stable and dropped among those aged 70 and above. Guatemala, El Salvador and Nicaragua the rates increased earlier, among the 30–49-year age group. Conversely, Mexico showed a different pattern; the curve reached a peak among people aged 70 and above (128.9/100 000 among males).

DISCUSSION

The literature has shown gender differences regarding patterns of drinking; men are more likely to be drinkers and women abstainers [2,5]. A national survey conducted in Brazil regarding patterns of alcohol consumption showed that the proportion of men was 2.1 times higher than women for usual consumption and 3.1 times higher for excessive consumption [19]. In the United States in 2005, mortality data for people aged 15–64 years showed that men had a higher proportion of deaths and potential years of life lost compared to women [7]. Our results consistently highlighted differences between men's and women's mortality rates in all countries. Conversely, the ratio male/female varied among countries. For example, in El Salvador, Nicaragua and Cuba the ratio male/female was higher than in Canada and the United States. These gender differences might reflect differences in levels of alcohol consumption and patterns of drinking in men and women, stigma attached to alcohol consumption by gender, gender inequities in access to health care systems as well as socio-economic inequities for men and women or under-reporting. Similarly, the findings regarding differences in risk of dying among age groups are consistent with the literature [5].

The present study points out important variations in the risk of dying from an alcohol-attributable disease or condition in the region. Countries in Central America (El Salvador, Guatemala and Nicaragua), Mexico and Brazil

Table 1 Descriptive analysis of mortality where alcohol was a necessary cause in selected countries in the Americas, triennium 2007–09.[a]

Country	Death annual average			Group of causes				Mortality rates/100 000						
								Total		Female		Male		Ratio male/female
	Total	Female	Male	Liver diseases	Neuropsychiatric disorders	Poisoning	Other diseases	Adjusted	Crude	Adjusted	Crude	Adjusted	Crude	
Argentina	1652	189	1463	54%	45%	0%	1%	4.0	4.2	0.8	0.9	7.7	7.5	8.1
Brazil	22 186	2533	19 653	54%	42%	0%	3%	12.2	11.6	2.7	2.6	22.8	20.8	8.0
Canada	2682	650	2032	53%	26%	9%	12%	5.7	8.0	2.8	3.9	8.9	12.3	3.2
Chile	2067	284	1782	77%	14%	4%	5%	11.6	12.3	3.0	3.3	21.3	21.5	6.4
Colombia	649	90	559	85%	2%	11%	3%	1.8	1.4	0.5	0.4	3.4	2.5	6.4
Costa Rica	235	25	211	78%	4%	14%	4%	5.8	5.2	1.2	1.1	10.6	9.2	8.3
Cuba	875	57	818	47%	42%	3%	9%	6.2	7.8	0.8	1.0	11.7	14.4	14.1
Ecuador	666	82	584	50%	36%	14%	0%	5.9	4.7	1.4	1.2	10.6	8.3	7.1
El Salvador	1298	57	1241	5%	95%	0%	0%	27.4	21.2	2.1	1.8	59.6	42.5	23.8
Guatemala	1869	194	1676	18%	52%	17%	13%	22.3	13.7	4.4	2.8	42.9	25.1	9.1
Mexico	16 128	1611	14 517	80%	17%	2%	1%	17.8	14.6	3.4	2.9	33.6	26.6	9.3
Nicaragua	809	43	766	51%	47%	1%	1%	21.3	14.4	2.2	1.5	42.0	27.4	18.0
Paraguay	317	33	284	68%	16%	15%	0%	7.1	5.1	1.5	1.1	12.6	9.0	8.4
Peru	1501	299	1203	80%	1%	16%	3%	6.8	4.2	2.6	2.1	11.3	5.6	2.7
United States	25 793	6401	19 392	57%	25%	8%	10%	6.7	8.5	3.3	4.1	10.5	12.9	3.1
Venezuela	1227	70	1157	89%	8%	1%	2%	5.5	4.4	0.6	0.5	10.7	8.2	16.4

[a]Except Peru, data for which are from 2007 and 2009.

Table 2 Mortality where alcohol was a necessary cause: age specific mortality rates/100 000 by sex and country. Selected countries in the Americas, 2007–09.[a]

Country	Total						Female						Male					
	<30	30–39	40–49	50–59	60–69	70+	<30	30–39	40–49	50–59	60–69	70+	<30	30–39	40–49	50–59	60–69	70+
Argentina	0.1	1.2	6.1	13.1	15.6	11.4	0.0	0.2	1.4	2.8	3.1	2.4	0.1	2.2	10.9	23.9	30.2	26.5
Brazil	1.1	13.4	29.1	32.8	28.9	18.9	0.3	2.9	6.4	6.7	6.2	4.8	1.9	24.4	53.3	61.5	55.4	38.1
Canada	0.2	1.6	7.0	15.5	20.4	15.7	0.2	1.0	4.5	7.6	9.3	7.4	0.2	2.2	9.5	23.3	31.0	21.7
Chile	0.2	5.5	16.9	31.3	48.5	39.1	0.1	1.3	3.3	8.8	14.3	16.5	0.4	9.7	30.3	52.8	78.6	54.4
Colombia	0.1	0.7	2.5	5.2	6.6	6.8	0.0	0.2	0.7	1.8	1.5	2.2	0.2	1.1	4.0	8.2	11.0	10.1
Costa Rica	0.2	3.6	11.1	17.7	19.2	15.0	0.1	1.4	3.2	2.9	2.1	2.3	0.3	5.9	18.8	32.2	37.1	30.2
Cuba	0.1	2.9	11.6	20.7	21.3	14.8	0.0	0.6	1.3	2.5	2.5	2.3	0.2	5.1	22.1	39.9	41.2	28.9
Ecuador	0.4	4.4	11.6	15.6	18.5	16.6	0.1	0.8	2.9	4.2	4.2	3.9	0.8	8.0	20.4	27.3	33.6	31.6
El Salvador	4.3	39.9	57.0	60.0	59.8	40.4	0.3	2.3	4.0	7.2	3.6	10.4	8.3	69.5	98.3	102.0	105.2	63.6
Guatemala	2.3	31.0	46.9	50.1	48.3	45.3	0.3	7.0	10.3	12.0	8.9	9.4	4.2	50.6	77.5	84.5	85.2	77.9
Mexico	0.7	11.2	29.8	46.1	59.0	65.1	0.1	1.5	5.2	8.7	12.5	15.5	1.4	21.3	56.0	85.4	108.1	128.9
Nicaragua	1.6	24.5	44.5	51.5	51.7	47.0	0.1	2.0	5.6	4.2	5.7	6.3	3.0	48.8	85.8	102.9	100.8	96.3
Paraguay	0.6	3.7	11.3	22.6	25.5	16.2	0.1	0.9	2.1	3.8	7.0	4.9	1.0	6.5	20.3	40.6	43.9	29.6
Peru	0.3	2.9	9.4	18.0	30.4	34.3	0.2	0.6	2.3	5.0	11.5	25.7	0.5	5.2	16.4	30.7	48.0	41.3
United States	0.3	3.6	12.7	20.7	18.6	9.9	0.2	2.0	7.4	10.0	8.3	5.8	0.5	5.2	17.8	30.9	28.0	12.7
Venezuela	0.1	2.0	8.8	18.3	21.6	22.0	0.0	0.1	1.1	2.3	3.6	4.6	0.2	3.9	16.3	34.1	38.6	36.3

[a]Except Peru, data for which are from 2007 and 2009.

showed the highest risk. This is consistent with the Global Burden of Disease Study 2010, in which alcohol use was the leading risk factor for the burden of disease in El Salvador and Guatemala, the third in Nicaragua and Brazil and fourth in Mexico [3]. In addition, according to data from WHO (see Supporting information Table S1), all the countries above showed hazardous patterns of drinking scores classified as 3 or 4, where 1 is the least detrimental and 4 is most detrimental [4].

Conversely, the total per-capita consumption (liters of pure alcohol, including unrecorded consumption) [4] among people aged 15 years and older was higher in countries with lower mortality rates, such as Argentina, Canada and the United States. This indicates that despite average higher levels of per capita consumption compared to other countries, the distribution of such consumption is more widespread among a higher percentage of drinkers in those countries, while in countries with more hazardous patterns of drinking score the volume of consumption is distributed among a much smaller proportion of the population; a higher volume of drinking per drinker, in turn, is expected to relate to alcohol specific outcomes, including alcohol use disorders and alcohol fully attributable mortality. A systematic review showed the higher risk of death among people with alcohol use disorders [5]. It is important for each country to conduct surveys on alcohol consumption in the general population on a regular basis, so that trends in mortality could be related to consumption over time. With regard to the age group most affected, the peak of mortality occurred earlier than the average life expectancy in all countries. This means that alcohol is a contributor to premature mortality (see Supporting information Table S1) [18].

In most countries, liver diseases were the major cause of alcohol mortality; in some, however, neuropsychiatric disorders were the most prevalent cause. These differences might be related to variations in diagnostic accuracy and coding practices. According to the literature, the proportion of liver diseases among these deaths is almost three times that of neuropsychiatric disorders [5]. Consequently, countries such as El Salvador might have under-reported liver disease deaths, and countries such as Colombia, Cuba, Mexico and Venezuela might have under-reported neuropsychiatric disorder deaths. Cirrhosis is associated with heavy drinking but it is also affected by factors such as diet, type of alcoholic beverage, the presence of infectious diseases, etc. [20]. Infectious diseases are more prevalent in countries with fewer resources and increase the risk of heavy drinkers to developing cirrhosis. It is known that excessive alcohol use can cause or exacerbate a range of mental or nervous system disorders. Among them are alcohol dependence syndrome, affective disorders, depression, anxiety, psychotic episodes and peripheral neuropathy [20]. It is

possible that unrecorded alcohol consumption may also be a source of contamination from methanol or heavy metals [21], which could be related to higher rates of cirrhosis or other diseases.

This analysis has both limitations and strengths. First, the mortality rates found in this study reveal the tip of the iceberg of a broader problem. The range of diseases and conditions linked to alcohol use and heavy drinking includes tuberculosis, some cancers, ischaemic heart disease, stroke, epilepsy, gastrointestinal diseases, falls, suicides, neurological disorders, transport-related injuries and interpersonal violence, among others [20,22–24]. This study does not intend to measure the whole impact or burden of alcohol consumption, which will need other factors or variables, including the relative contribution of alcohol to mortality and morbidity for all conditions associated with alcohol. Secondly, the mortality data could be affected by differences among countries regarding registering a disease or condition attributable to alcohol as an underlying cause of death on the death certificate. Among well-known problems that potentially affect the accuracy of cause-specific mortality data are that a segment of the population faces difficulties in accessing medical care; therefore, physicians do not have sufficient information to complete the death certificate accurately [12]. And, sensitive diagnoses, such as suicide or HIV/AIDS, are more likely to be under-reported because of social and cultural barriers. Depending on the country, these problems might contribute to the under-reporting of a death due to an alcohol disease or condition because of the stigma and low access to medical care.

At the same time, mortality information has better quality and coverage in the majority of countries in the region, and has been traditionally used to assess the impact of public health policies [12]. Additionally, the quality of mortality data has improved in most countries in the Americas in recent years. Therefore, among the strengths of this study is to demonstrate a feasible and comparable indicator which could be used by countries to monitor and control alcohol-related problems with fewer additional resources. Training on the accurate certification of death could also improve the quality of the data. Additionally, countries should carry out regular analyses of the data, as this can help to identify additional sources of error or missing data which can be corrected.

Alcohol-related deaths are preventable through interventions and policies to minimize alcohol drinking. A wealth of research world-wide has indicated consistently that restrictions on the availability of alcohol beverages, increased prices through taxation policies and marketing control are the most cost-effective interventions to reduce the harmful use of alcohol [23]. Currently, most countries in the Americas have weak policies to respond to the problem.

In conclusion, mortality data from ICD-10 codes where alcohol is a necessary cause is an important indicator and feasible to monitor alcohol consumption and the effectiveness of policy interventions at the country level. We showed that the risk of men dying from an alcohol-related disease is disproportionally higher compared to women in most countries of the Americas; we identified countries with high mortality rates, and these deaths occurred prematurely considering the corresponding life expectancy. As these high rates have shown a major public health problem, countries should increase their efforts to improve the quality of information, monitor the problem and implement more effective policies to reduce alcohol availability and consumption at national levels.

Declaration of interests

Acknowledgements

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site:

Table S1 Alcohol consumption indicators (average of 2003–05) and life expectancy at birth by country (2009). Selected countries in the Americas.