Geographical distribution of alcohol-attributable mortality in Chile: A Bayesian spatial analysis

Álvaro Castillo-Carniglia [a,b,*], Jay S. Kaufman [c], Paulina Pino [d]

[a] Doctoral Program in Public Health, University of Chile, Av. Independencia 939, Santiago, Chile
[b] Research Department, National Service for Prevention and Rehabilitation of Drug and Alcohol Consumption (SENDA), Chile
[c] Department of Epidemiology, Biostatistics, and Occupational Health, McGill University, 1020 Pine Ave. West, Montreal, Quebec, Canada
[d] Epidemiology Division, School of Public Health, University of Chile, Av. Independencia 939, Santiago, Chile

HIGHLIGHTS

- Small-area alcohol mortality can be estimated combining data and methodologies.
- Local policies should use small-area estimates to identify populations at risk.
- More than 90% of alcohol related deaths are not attributable solely to alcohol.
- We obtain stable local estimates, while including partially attributable causes.
- Municipalities with excess mortality risk were most common in south central regions.

ARTICLE INFO

ABSTRACT

Objective: To describe the distribution of alcohol-attributable mortality (AAM) at the local level (345 municipalities) in Chile, including fully and partially attributable causes in 2009.
Methods: AAM was estimated for the population 15 years of age and older using per capita alcohol consumption combined with survey estimates. The effect of alcohol on each cause of death was extracted from the published scientific literature. We used Bayesian hierarchical models to smooth the Standardized Mortality Ratio for each municipality for six groups of causes related to alcohol consumption (total, neuro-psychiatric, cardiovascular, cancer, injuries and other causes).
Results: The percentage of municipalities with high risk for any group of causes in each region ranges from 0% to 87.0%. Municipalities with high risk were concentrated in south-central and southern Chile for all groups of causes related to alcohol.
Conclusions: AAM risk shows marked geographic concentrations, mainly in south-central and southern regions of Chile. This combination of methods for small-area estimates of AAM is a powerful tool to identify high risk regions and associated factors, and may be used to inform local policies and programs.

1. Introduction

The impact of alcohol consumption on health has been analyzed in different studies and contexts and is recognized as a global public health problem (Rehm et al., 2004). In Chile, the first study of burden of disease was published in 2008, showing the extent of the problem at the national level (9.7% of all deaths were attributable to alcohol consumption in 2004) (Ministerio de Salud y Pontificia Universidad Católica de Chile, 2008). Recently, a new study estimated deaths due to alcohol in 2009 in the population aged 15 and over and found similar results (Castillo-Carniglia, Kaufman, & Pino, 2013). However, at present no studies have yet estimated the impact of alcohol across smaller geographic areas, such as regional or municipal levels. This makes it difficult to design policies with local approaches that take account of the particular expression of the problem, as has been highlighted in the National Strategy on Drug and Alcohol and the Chilean Alcohol Strategy (Ministerio de Salud, 2010; Servicio Nacional para la Prevención y Rehabilitación de Drogas y Alcohol, 2011).

* Corresponding author at: School of Public Health, University of Chile, Av. Independencia 939, Santiago, Chile. Tel.: +56 2 5100879.
E-mail addresses: alvacasti@gmail.com (Á. Castillo-Carniglia), jay.kaufman@mcgill.ca (J.S. Kaufman), ppino@med.uchile.cl (P. Pino).

Chile is a developing country that in the last decades has experienced pronounced economic growth, with a current GDP per capita of around US$15,000 (World Bank, 2011). The economy is based primarily on mining (mostly in the northern regions), forestry, agriculture and fisheries (OECD, 2012). Chile is also a producer of wine and pisco (a distilled spirit made from grapes that contains 35–42% alcohol) that together constitute a market of more than 2.5 billion US dollars annually (Oficina de Estudios y Políticas Agrarias, 2012).

Previous studies had shown that general and cause-specific mortality is not homogeneous across the country (Icaza, Núñez, Diaz, & Varela, 2006, 2013, Icaza, Nunez, Torres-Avilés, Diaz, & Varela, 2007, Icaza et al., 2013). The volume and patterns of alcohol consumption as well as its consequences are no exception, which make it necessary to identify regions and municipalities with excess risk to facilitate targeted policy formation. The presentation in maps of the spatial distribution of health and related indicators is useful for this purpose and to identify possible hypotheses to explain the varying incidence rates and for the broad dissemination of this information (Barceló et al., 2008). This approach has been applied extensively through the elaboration of mortality atlases for various causes and geographic areas with different sizes around the world (Casper et al., 2003; Ocaña-Riola et al., 2008). However, no previous studies in developing countries have examined the distribution of alcohol-attributable mortality at regional or municipal levels. Furthermore, of the studies in different parts of the world that have analyzed mortality attributable to alcohol, only a few included partially attributable causes (attributable fractions < 1) or cases in which alcohol explains only a fraction of the events, such as some types of cancer (New Mexico Department of Health, 2013; New South Wales Ministry of Health, 2013). The inclusion of partially attributable causes is of great importance since they represent, in some contexts, over 90% of all deaths due to alcohol (Castillo-Carniglia et al., 2013).

The objective of this study is to describe the distribution of alcohol-attributable mortality at the local level (345 municipalities), including fully and partially attributable causes, for the year 2009 in Chile.

2. Methods

2.1. Design and population

We conducted an ecological study analyzing mortality attributable to alcohol consumption at the municipal level in Chile. The population is people 15 years and older nationwide in 2009.

2.2. Sources of information

To estimate alcohol-attributable mortality, information was collected from the following sources:

- Global Information System on Alcohol and Health of the World Health Organization to determine the volume of alcohol per capita consumed in Chile. This was used as a benchmark to estimate the volume of alcohol by sex, age and region from the Eighth National General Population Drug Survey (Consejo Nacional para el Control de Estupefacientes, 2008).
- The effect of alcohol consumption (expressed as relative risks) for each cause of death related to alcohol consumption, drawn from different meta-analyses published in the scientific literature (see Additional File 1).
- Mortality statistics from the Ministry of Health of Chile of 2009 and corresponding codes from the 10th revision of the International Classification of Diseases (ICD-10) to identify the causes of alcohol-related deaths (see Additional File 1).

2.3. Estimation of alcohol-attributable mortality

The details of the estimated mortality attributable to alcohol have been described previously (Castillo-Carniglia et al., 2013). In short, to estimate alcohol consumption in the Chilean population we triangulated the volume of alcohol per capita consumption in Chile, estimated

Table 1
Population, area, density and number of high-risk municipalities, by region of Chile [a,b].

	Regional demographic information				High-risk municipalities by group of causes and region. N (%)						
	Population [c]	(Municipalities population range)	Area (Km²) [d]	Density (Pop./km²)	Municipalities by region [d]	Total causes	Neuro-psychiatric	Cardiovascular	Cancer	Injuries	Other causes
Arica y Parinacota	186,147	(1,242–181,932)	16,873	11.0	4 (1.2)	0 (0.0)	1 (25.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (25.0)
Tarapacá	307,426	(1,053–184,838)	42,225	7.3	7 (2.0)	0 (0.0)	1 (14.3)	0 (0.0)	0 (0.0)	0 (0.0)	1 (14.3)
Antofagasta	568,432	(251–360,743)	126,049	4.5	9 (2.6)	0 (0.0)	2 (22.2)	0 (0.0)	0 (0.0)	0 (0.0)	2 (22.2)
Atacama	278,515	(4,839–158,081)	75,176	3.7	9 (2.6)	2 (22.2)	2 (22.2)	2 (22.2)	0 (0.0)	3 (33.3)	2 (22.2)
Coquimbo	708,369	(3,923–206,094)	40,579	17.5	15 (4.3)	5 (33.3)	1 (6.7)	3 (20.0)	8 (53.3)	6 (40.0)	1 (6.7)
Valparaíso	1,739,876	(817–291,760)	16,396	28.6	38 (11.0)	1 (2.6)	9 (23.7)	14 (36.8)	1 (2.6)	2 (5.3)	2 (5.3)
Metropolitana	6,814,630	(4,636–770,290)	15,403	442.7	52 (15.1)	8 (15.4)	11 (21.2)	6 (11.5)	1 (1.9)	11 (21.2)	5 (9.6)
O'Higgins	874,806	(3,191–242,833)	16,387	130.6	33 (9.6)	4 (12.1)	12 (36.4)	1 (3.0)	0 (0.0)	2 (6.1)	6 (18.2)
Maule	999,685	(4,076–238,817)	30,296	33.0	30 (8.7)	9 (30.0)	8 (26.7)	0 (0.0)	1 (3.3)	14 (46.7)	4 (13.3)
Biobío	2,022,995	(3,503–227,768)	37,068	54.6	54 (15.7)	38 (70.4)	28 (51.9)	47 (87.0)	29 (53.7)	26 (48.1)	36 (66.7)
Araucanía	962,120	(5,449–298,376)	31,842	30.2	32 (9.3)	16 (50.0)	13 (40.6)	7 (21.9)	11 (34.4)	19 (59.4)	5 (15.6)
Los Ríos	378,193	(5,083–158,626)	18,429	20.5	12 (3.5)	2 (16.7)	3 (25.0)	0 (0.0)	0 (0.0)	6 (50.0)	1 (8.3)
Los Lagos	825,830	(1,665–230,885)	48,583	17.0	30 (8.7)	10 (33.3)	13 (43.3)	2 (6.7)	1 (3.3)	15 (50.0)	1 (3.3)
Aisén	103,738	(610–57,349)	108,494	1.0	10 (2.9)	4 (40.0)	1 (10.0)	0 (0.0)	1 (10.0)	5 (50.0)	2 (20.0)
Magallanes	158,016	(365–124,624)	132,297	1.2	10 (2.9)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (10.0)
Country total	16,928,778	(251–770,290)	756,102	22.4	345 (100)	99 (28.7)	105 (30.4)	82 (23.8)	53 (15.4)	109 (31.6)	70 (20.3)
Population in low risk areas [e]						3,596,333	7,519,105	6,641,706	3,001,721	3,056,056	4,630,565
Población in high risk areas [f]						2,154,122	2,983,107	2,826,963	1,921,704	2,239,115	2,718,288

[a] Ordered from north to south, according to the political–administrative division of 2009.
[b] Number of municipalities with RME > 1.3 by region. The percentage is relative to number of municipalities by region.
[c] Population estimated by the National Statistical Institute (INE) using 2002 Census records.
[d] Excludes overseas islands and Chilean Antarctic Territory.
[e] Population of 15 years of age and over (Chile = 13,066,156) living in municipalities with low risk (Standardized Mortality Ratio < 0.71) of alcohol attributable mortality.
[f] Population of 15 years of age and over (Chile = 13,066,156) living in municipalities with high risk (Standardized Mortality Ratio > 1.30) of alcohol attributable mortality.