Drug and Alcohol Dependence 137 (2014) 129–136

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Small area associations between social context and alcohol-attributable mortality in a middle income country☆

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ARTICLE INFO

Article history:
Received 24 September 2013
Received in revised form 28 January 2014
Accepted 29 January 2014
Available online 12 February 2014

Keywords:
Mortality
Alcohol
Income
Education
Bayesian hierarchical models

ABSTRACT

Background: Little is known about the association between alcohol-attributable mortality and small area socioeconomic variables when considering causes both wholly and partially attributable to alcohol.
Methods: An ecological study was conducted of the entire Chilean population aged 15 and older in 345 municipalities nationwide between 2004 and 2009. Deaths were attributed to alcohol consumption either wholly or partially, along with the estimated attributable fractions for each specified cause. Each municipality was characterized according to its average income and educational attainment. Estimates of the ecological associations were produced using a hierarchical Bayesian model, separating out deaths caused by alcohol and dividing them into seven groups of causes.
Results: Alcohol-attributable mortality risk showed an inverse association with income and education at the ecological level. A one-quintile increase in income was associated with an average decrease in risk of 10% (CI 95%: 10–20%) for cardiovascular deaths, 8% (6–10%) for intentional injuries and 7% (3–11%) for unintentional injuries. No associations were found between deaths due to cancers and other causes with income and education.
Conclusions: Municipalities with lower income and education have higher risk of alcohol-attributable mortality in Chile.

1. Introduction

Globally, alcohol consumption is responsible for 3.8% of all deaths, 4.6% of lost disability adjusted life-years (DALY's), and is a leading risk factor for morbidity and mortality in developing countries (Rehm et al., 2009; World Health Organization, 2009). In Chile, alcohol consumption represents the third most important cause of avoidable death and the principal cause of loss of DALY's, corresponding to 12.4% of the national total (Ministerio de Salud, 2008). While these figures provide a general picture of the problem, they offer little information about the differential impact within countries and the relationship between alcohol consumption and social and economic factors, particularly in countries with low- to middle-income levels.

Most of the currently available information refers to the level and pattern of consumption and their associations with various socioeconomic characteristics. Studies have shown that at higher socioeconomic levels, there is a greater prevalence of alcohol consumption (Substance Abuse and Mental Health Services Administration (SAMHSA), 2008; van Oers et al., 1999), a correlation that has also been observed at an ecological level with respect to the volume of alcohol consumed in countries and their per capita incomes (World Health Organization, 2011b). However, when the focus is on patterns of consumption with negative health and social consequences, it is those sectors with lower socioeconomic levels that show the highest intensity of consumption (Cerdá et al., 2010; Le et al., 2010; SAMHSA, 2008; van Oers et al., 1999). An example is the study by Bloomfield et al. (2006) which analyzed information from 10 countries (8 European and 2 Latin American) and revealed that the rate of current consumption (in the last month) is lower in those sectors with lower socioeconomic development, while the opposite occurs for indicators of high consumption and hazardous consumption.

Similarly in Chile, the prevalence of any alcohol consumption in the last month is 12 percentage points higher in the

☆ Supplementary material can be found by accessing the online version of this paper. Please see Appendix A for more information.

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http://dx.doi.org/10.1016/j.drugalcdep.2014.01.020
0376-8716/

highest socioeconomic stratum compared with the lowest, whereas the prevalence of probable abuse is two percentage points lower in the group with the highest income. This finding is consistent across the sequence of nationally representative surveys in Chile (Servicio Nacional para la Prevención y Rehabilitación del Consumo de Drogas y Alcohol, 2010).

With respect to the consequences of alcohol consumption, including hazardous consumption patterns, studies have consistently observed higher rates of negative health consequences in the most vulnerable sectors. (Kovacs, 2008; Mulia and Karriker-Jaffe, 2012). Mäkelä (1999) and Mäkelä and Paljarvi (2008) studied mortality as it relates to alcohol consumption as a basic or underlying cause along with socioeconomic variables at the individual level. They identified a clear gradient—differentiated by gender—according to education level, income, and job category: men in the lowest income decile had a risk of mortality up to eight times higher than those in the highest decile, while for women the risk was five times higher. Other studies have also shown a similar relationship with these and other socioeconomic indicators at both individual and ecological levels (Erskine et al., 2010; Harrison and Gardiner, 1999; Hemstrom, 2002; Huisman et al., 2005).

The studies described above used the number of deaths directly or wholly attributable to alcohol consumption as their indicator of alcohol-related mortality, i.e., the description of their ICD code includes the word "alcohol". Nevertheless, other studies have estimated attributable mortality using indirect methods as well (Grant et al., 2009; Rehm et al., 2007; Schneider et al., 2007; Shield et al., 2012); in other words, including causes partially attributable to alcohol consumption (Rehm et al., 2010a). These methods have the advantage of including among the causes of death certain types of cancer, cardiovascular disease, diabetes or epilepsy, for which alcohol had not previously been considered a contributing factor. This is especially important for ecological level analyses because, unlike the individual level, partial causation can be readily incorporated in mortality estimates. This could make a huge difference depending of the magnitude of the population attributable fractions for the different causes. In Chile, for example, only 6% of alcohol-attributable deaths are the result of causes defined as completely attributable (Castillo-Carniglia et al., 2013a).

Separating out the mortality estimates and other health indicators by geographic zone or region means we can compare one indicator in different contexts and generate or test explanatory hypotheses about why these differences occur (Icaza et al., 2007; Ocaña-Riola and Mayoral-Cortes, 2010). In the case of alcohol mortality, there are a few studies that have analyzed the distribution of mortality rates in small areas; however, almost none of them included partially attributable deaths (Cayotte and Buchow, 2009; Rosicova et al., 2011).

Up to now, insofar as we are aware, there are only a few preliminary efforts towards disaggregated data on alcohol-attributable mortality in small geographic areas that have also included deaths considered partially attributable (Castillo-Carniglia et al., 2013b; New Mexico Department of Health, 2013; New South Wales Ministry of Health, 2013). All of these studies are descriptive in nature and have not included variables that could explain the concentration of risk in different areas of the country or region. Also, evidence regarding the association between alcohol and mortality and other outcomes, in relation to socioeconomic context remains scarce in Latin American and other developing countries. Existing evidence has been produced almost entirely in developed countries, where socioeconomic and cultural realities may be quite different. Since these estimated inequities are essential inputs for the planning of health and social policies, such as minimum drinking ages and taxation rates, valid and generalizable surveillance is essential.

For this reason, in the current study we estimate the association between total alcohol mortality (partially and wholly attributable) and socioeconomic variables in 345 municipalities in Chile.

2. Methods

2.1. Design and population

We used an ecological design for which the unit of analysis is the municipality in Chile, the smallest political and administrative unit of the country, between the years 2004 and 2009. Antarctic Chile was excluded because it is not a residential municipality. The Chilean population ages 15 years and older grew from 11,269,314 in 2004 to 13,066,251 in 2009 (Instituto Nacional de Estadísticas – Centro Latinoamericano y Caribeño de Demografía, 2004).

2.2. Dependent variable

Detailed calculations for the estimate of alcohol-attributable mortality can be found in a previous article (Castillo-Carniglia et al., 2013a). Briefly, we first established a definition of the causes of death wholly or partially related to alcohol consumption (Table 1); next, we defined categories of consumption based on what had been reported in similar studies (0; >0–19.9; 20–39.9 and ≥40 g of pure alcohol per day for women and 0; >0–39.9; 40–59.9 and; ≥60 for men) (Rehm et al., 2004). Alcohol consumption was estimated by triangulating the volume of alcohol consumed per capita in the country for the population aged 15 years or more (World Health Organization, 2011a) with the distribution of consumption in the Chilean population as observed in the Eighth National Study of Drugs (NSD-2008) in the General Population, 2008 (Consejo Nacional para el Control de Estupefacientes, 2008). The NSD-2008 used face-to-face interviews, with clustered random sampling in three stages (sampling strata, households, and individuals) and had a response rate of 77%. To model alcohol consumption volume by region, gender, and age category we used the methodology proposed by Rehm et al. (2010), which assumes that population volume of alcohol exposure follows a Gamma distribution. One hundred and four distributions of alcohol consumption were modelled (2 gender categories × 4 age categories × 13 regions), yielding the estimated prevalences for the four categories of consumption previously defined in each region and gender and age category in the study.

Finally, using the published scientific literature, the relative risk associated with specific volumes of alcohol consumption was assigned for each identified cause of death by gender group (Table 1).

Using the two estimates (relative risk and triangulated prevalence), the population attributable fraction due to alcohol consumption was calculated for each cause of death, region, gender and age category, according to Levin's formula as modified by Walter for multiple categories of exposure (Walter, 1976). Deaths attributable to alcohol were classified in seven groups of causes plus a group made up of all causes combined. The groups of causes were: neuropsychiatric, cardiovascular, cancer, infections, accidental injuries, intentional injuries and a group of other causes, for which liver cirrhosis represents about 98% of the national total.

2.3. Exposure variable

In order to characterize socioeconomic status at the municipal level, we used average income and education measures separately. Education includes the percentage of illiterate adults aged 24 or more, the mean years of schooling and the percentage of the population between 4 and 25 years of age attending some educational establishment (preschool, primary, secondary and post-secondary). Income includes the average per capita income of households and the average per capita income for households adjusted for poverty. The value of each of the two indices lies between a theoretical minimum of 0 and maximum of 1 (United Nations Development Programme and Ministerio de Desarrollo Social, 2006).

2.4. Ecological analysis

The Stata 13.0 statistical analysis programme was used to clean the data and generate the statistics on alcohol consumption and mortality. First we estimated the standardized mortality rate using the direct method and the expected (E) number of deaths (denominator of Standardized Mortality Ratio [SMR]) though the indirect method for each municipality, using as a reference population the annual population projections established by the National Institute of Statistics of Chile (Instituto Nacional de Estadísticas – Centro Latinoamericano y Caribeño de Demografía, 2004).

To model the SMR in each municipality in relation to the income and education indices, Bayesian hierarchical analyses were used, which take into account the spatial structure of the geographical units and the clustering of mortality by municipality. This approach produced smooth local estimates (in our case SMR), which are especially relevant in small area analysis, where the event counts are low, and therefore, the variability is high. Bayesian models assume that the unknown parameters (i.e., the effects of neighbouring municipalities) are random variables that can take values from a given (prior) probability distribution, obtained for preexisting information. The posterior distribution from which the inference are made, results from the combination of the prior distribution and the data likelihood through Bayes'