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The impact of alcohol policies on alcohol-attributable diseases in Taiwan—A population-based study

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ABSTRACT

Background: Taiwan has some of the strictest alcohol-related driving laws in the world. However, its laws continue to be toughened to reduce the ever-increasing social cost of alcohol-related harm.
Aim: This study assumes that alcohol-related driving laws show a spillover effect such that behavioral changes originally meant to apply behind the wheel come to affect drinking behavior in other contexts. The effects of alcohol driving laws and taxes on alcohol-related morbidity are assessed; incidence rates of alcohol-attributable diseases (AAD) serve as our measure of morbidity.
Methods: Monthly incidence rates of alcohol-attributable diseases were calculated with data from the National Health Insurance Research Database (NHIRD) from 1996 to 2011. These rates were then submitted to intervention analyses using Seasonal Autoregressive Integrated Moving Average models (ARIMA) with multivariate adaptive regression splines (MARS). ARIMA is well-suited to time series analysis while MARS helps fit the regression model to the cubic curvature form of the irregular AAD incidence rates of hospitalization (AIRH).
Results: Alcoholic liver disease, alcohol abuse and dependence syndrome, and alcohol psychoses were the most common AADs in Taiwan. Compared to women, men had a higher incidence of AADs and their AIRH were more responsive to changes in the laws governing permissible blood alcohol. The adoption of tougher blood alcohol content (BAC) laws had significant effects on AADs, controlling for overall consumption of alcoholic beverages.
Conclusion: Blood alcohol level laws and alcohol taxation effectively reduced alcohol-attributable morbidities with the exception of alcohol dependence and abuse, a disease to which middle-aged, lower income people are particularly susceptible. Attention should be focused on this cohort to protect this vulnerable population.

1. Introduction

Alcohol-related harm continues to be a significant problem facing societies around the world. The World Health Organization has estimated that roughly four percent of total global mortality and four and a half percent of the global disease burden may be attributed to alcohol. According to the National Highway Traffic Safety Administration (NHTSA), there are 13,000 deaths per year due to drunk driving, accounting for one-third of the total fatal car accidents in 2007 in the United States. In Canada, almost half of all traffic fatalities involve someone who is impaired (Romelsjo, 1995; Solomon and Usprich, 1990). The burden of use of alcohol is closely related to an individual's average volume of alcohol consumption; this consumption is in turn strongly linked to alcohol attributable harms to society, e.g., traffic accidents and non-injury diseases (Holmes et al., 2012).

Alcohol-related driving policies, or driving under the influence (DUI) policies, have had a clear effect on car crashes and ever-toughening policies have greatly reduced the amount of alcohol drivers can consume before getting behind the wheel (Chang et al., 2012; Ying et al., 2013; Freeman, 2007; Young and Bielinska-Kwapisz, 2006; Benson et al., 1999; Wilkinson, 1987; Chaloupka and Laixuthai, 1997; Dee, 1999; Young and Likens, 2000; Voase et al., 2000; Asbridge et al., 2004; Asbridge et al., 2009; Wagenaar et al., 2007). The existing literature on alcohol deterrence policies focusses on the relationships between driving policies and traffic accidents, as well as price and taxation of alcohol and alcohol-related harms. Negative effects of such policies have been demonstrated on different outcome measures such as decreased alcohol-related morbidity and mortality from both injury health outcome (Markowitz, 2005; Markowitz and Grossman, 2000; Markowitz et al., 2003; Pridemore and Snowden, 2009) and non-injury health outcomes (Henderson et al., 2004; Ponicki and Gruenewald, 2006; Skog and Melberg, 2006; Wagenaar et al., 2007). In general, raising alcohol prices and/or taxes dampens alcohol consumption (Anderson et al., 2009; Babor et al., 2003; Chaloupka et al., 2002,

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1993); with the result that alcohol related harm is reduced.

This study assumes a spillover effect of DUI laws; more specifically, we assume that these laws affect drinking behavior overall rather than just in driving contexts. The contribution of this study is to add to the existing literature about the relationships between DUI policies and people's drinking behavior, operationalized as the incidence of AADs. The toughened policies set new standards for people both mentally and even potentially socially, around alcohol and driving; these new standards and norms affect drinking behavior more generally. They create an increased consciousness about the permissible amount of alcoholic beverage when driving and this increased consciousness results in reductions in alcohol use even when driving is not necessary. Just as increases in alcohol prices or taxes affected drinking behavior (Anderson et al., 2009; Babor et al., 2003; Chaloupka et al., 2002; Maldonado-Molina and Wagenaar, 2009), so the toughening DUI laws may result in less drinking and thus lowered incidence of AADs.

Existing literature mainly focuses on two major relevant topics in the past: the impacts from DUI laws on traffic accidents and the effects of price and taxation of alcohol on alcohol-related harms. Summing the above-mentioned previous studies, only alcohol prices and taxes have been studies for non-injury harms. The impact of alcohol deterrent driving policies on non-injury alcohol-related health outcomes, has not been elucidated. The extent to which DUI policies and alcohol taxation can improve non-injury health outcome is an open question. This study conducts an analysis using data from the National Health Insurance Research Database (NHIRD) from 1996 to 2011 in order to understand the impact of relevant policies on hospitalizations for alcohol-attributable diseases (AADs). In particular, alcohol tax and DUI laws will be discussed and their impacts on the reduction of AADs will be analyzed.

Impaired driving legislation is firmly grounded in the deterrence model. Impaired driving laws are the foundation of modern deterrence-based approaches as applied to the prevention of drunk-driving collisions and fatalities (Gibbs, 1975; Ross, 1984; Asbridge et al., 2004).

Rogers (1995), Hingson et al. (1996), and Carpenter and Harris (2005) found compelling evidence that a reduction to 0.08 g/dL in blood alcohol concentration (BAC) reduced alcohol-related traffic fatalities.[1] However, Freeman (2005, 2007), applying difference-in-difference estimators to evaluate the negative relationship between traffic fatalities and BAC laws, found that a BAC level of 0.08 did not significantly reduce alcohol-related fatalities in the United States. In Taiwan, maximum permissible BAC laws and administrative license revocation (ARL) were first instituted in March of 1997. The severity of penalties and the maximum legal BAC has been changed a few times over the past decades. Therefore, the first goal of the research is to explore if such changes had appreciable impacts on AAD health outcomes in Taiwan.

Turning now to policies that impact the price of alcohol, taxes on alcoholic beverages directly relate to alcohol-related mortalities. Many economists, including Saffer and Grossman (1987), Chaloupka et al. (1993), Walsh (1987), Cook (1981), Evans et al. (1991), and Ruhm (1995, 1996), agree that a negative relationship exists between beer taxes and alcohol-related fatalities, though some have questioned if this relationship holds among youth (Dee, 1999; Mast et al., 1999; Young and Likens, 2000). Epidemiological studies have suggested that moderate drinking is associated with reduced risk of mortality from heart disease and stroke (Corrao et al., 2000; Rostron, 2012). Higher alcohol prices and taxes could limit alcohol affordability and thus these potential benefits. This tradeoff could account for the relative stability in alcohol taxes compared to tobacco taxes in the U.S. (Sloan and Justin, 2004). This notwithstanding, taxes on rice wine in Taiwan have fluctuated over the past decade due to Taiwan's World Trade Organization accession. These fluctuations permit us to examine the subsequent changes in the incidence of alcohol-related diseases.

[1] Using a sample from 1986 to 1990, the Research and Evaluation Association (1994) found that a 0.08 BAC limit may have reduced alcohol-related fatalities in California by 12%. Rogers (1995) reported comparable results for a 7% reduction in alcohol-related fatalities in California when the state government enacted a 0.08 BAC limit. The NHTSA (1994) has argued that a 0.08 BAC limit would significantly reduce alcohol-related traffic fatalities in California, Maine, Oregon, Utah, and Montana.

2. Data and variables

2.1. Data sources

Taiwan launched a single-payer National Health Insurance Program (NHIP) in March of 1995. The NHI program was mandatory, and covered over 99% of the Taiwanese population of close to 24 million residents. The data adopted in this study, Longitudinal Health Insurance Dataset 2010 (LHID2010), were obtained from the National Health Insurance Research Database (NHIRD), managed by the Taiwanese National Health Research Institutes (NHRI). NHIRD is one of the largest nationwide population-based databases in the world, and many scientific studies have used its data.

Two datasets were retrieved from LHID2010. The "Monthly Claims Summary for Inpatient Claims" (Claims dataset) contained medical claims data for one million randomly sampled patients from all NHIP beneficiaries from 1996 to 2011. The "Registry for Beneficiaries' (ID) data sets contained registration and demographic data for those one million sampled patients. According to the NHRI, there are no statistical differences in age and sex between the sampled group and the larger dataset of all enrollees. To verify the accuracy of claim data, the Bureau of National Health Insurance (BNHI) performs quarterly expert reviews on a random sample of every 50 to 100 ambulatory and inpatient claims in each hospital and clinic. False reports of diagnoses result in a severe penalty from the BNHI. Primary diagnoses for each admission in the NHIRD database were assigned a code based on the International Classification of Diseases, Ninth Revision, i.e., an ICD-9 code. Because the LHID2010 comprises secondary data (that cannot be used to identify patients), and is released to the public for research purposes, this study was exempt from full review by the Institutional Review Board. Population and economic variables were obtained from the Statistics Bureau of Taiwan Executive Yuan. Alcohol consumption measured by liters per capita was from National Treasure Administration, Ministry of Finance of Taiwan.

2.2. Variables

A monthly incidence rate was calculated for all AADs combined and, for some diagnoses, for individual AADs. The selection of AADs was based on comprehensive reviews of the literature (Rehm et al., 2009; Shultz et al., 1991; Wagennar et al., 2009; Amin-Esmaeili et al., 2017). The following diseases were counted as AADs in our analyses: alcoholic liver disease (ICD code: 571.0 to 571.3), alcohol psychoses (291.0 to 291.9), alcohol abuse, alcohol dependence syndrome (303, 305.0), alcoholic polyneuropathy (357.5), alcoholic cardiomyopathy (425.5), alcoholic gastritis (535.3), and acute alcohol poisoning (980.0). All patients with any of these diagnoses were counted in the calculation of the incidence rates. Almost all patients in Taiwan with severe alcoholic disorders were included in the data due to the easy accessibility of care here.

For cohort analyses, the data were stratified by sex, age, and income level. Patients were classified into three age groups: young people (age 20 and younger), adults (age 21 to 65), and elderly (age 55 or older). The entire sample size of one million was used as the denominator to calculate the age- and sex-specific monthly incidence rate of hospitalization from 1996 to 2011. To control for changes in health policy and hospital service volume, the one-month lag of the monthly AAD incidence rate of hospitalization (AIRH) was included in the model. An additional benefit to the inclusion of this lagged dependent variable is that it captures the dynamic effects in the time-series analyses (Keele and Nathan, 2006).