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Segmented regression analysis of interrupted time series data to assess outcomes of a South American road traffic alcohol policy change



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ABSTRACT

Background: In Chile, a new law introduced in March 2012 decreased the legal blood alcohol concentration (BAC) limit for driving while impaired from 1 to 0.8 g/l and the legal BAC limit for driving under the influence of alcohol from 0.5 to 0.3 g/l. The goal is to assess the impact of this new law on mortality and morbidity outcomes in Chile.

Methods: A review of national databases in Chile was conducted from January 2003 to December 2014. Segmented regression analysis of interrupted time series was used for analyzing the data. In a series of multivariable linear regression models, the change in intercept and slope in the monthly incidence rate of traffic deaths and injuries and association with alcohol per 100,000 inhabitants was estimated from pre-intervention to postintervention, while controlling for secular changes. In nested regression models, potential confounding seasonal effects were accounted for. All analyses were performed at a two-sided significance level of 0.05.

Results: Immediate level drops in all the monthly rates were observed after the law from the end of the prelaw period in the majority of models and in all the de-seasonalized models, although statistical significance was reached only in the model for injuries related to alcohol. After the law, the estimated monthly rate dropped abruptly by -0.869 for injuries related to alcohol and by -0.859 adjusting for seasonality ($P < 0.001$). Regarding the postlaw long-term trends, it was evidenced a steeper decreasing trend after the law in the models for deaths related to alcohol, although these differences were not statistically significant.

Conclusions: A strong evidence of a reduction in traffic injuries related to alcohol was found following the law in Chile. Although insufficient evidence was found of a statistically significant effect for the beneficial effects seen on deaths and overall injuries, potential clinically important effects cannot be ruled out.

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Introduction

In 2004, road traffic incidents ranked ninth in the world's leading causes of death and burden of disease, being responsible for 1.3 million deaths and 41.2 million years lost due to premature mortality and disabilities globally. If this scenario already shows that road traffic incidents are a major public health issue worldwide, the future projections are of greater concern, as road traffic fatalities are estimated to increase to 2.4 million in 2030, due primarily to the economic growth attributed to low- and middle-income regions.^{1,2} According to World Health Organization (WHO) reports, traffic incidents are among the main reasons for public health damage; in the fifth place in undeveloped countries, and in the 10th place in developed countries.^{2,3}

It is widely acknowledged that a high blood alcohol concentration (BAC) is the leading risk factor for automotive incidents. However, there is still disagreement as to what constitutes a dangerously high BAC, e.g. 0.02 g/dl in Sweden, 0.03 g/dl in Japan, 0.05 g/dl in Germany, and 0.08 g/dl in the United States. Even within the United States, illegal BAC limits have varied from state to state and have changed over the years.^{4–10}

In 2008, the WHO clearly recommended institution of BAC limits of <0.05 g/dl in all drivers, with a stricter <0.02 g/dl limit for young/novice drivers. Despite the fact that 33% of WHO member states in the Americas have laws that meet or exceed the WHO recommendations, alcohol-associated incident rates remain extremely high in Central/South America and Mexico.^{2,11,12}

The mortality due to road traffic incidents in Chile has been increasing progressively in the last few years, being in 2005 28.8 per 100,000 men (15+) and 5.6 per 100,000 women (15+). In 1990, the mortality due to traffic incidents was more than three times than in USA, Australia, and the UK. Between 2001 and 2009, 8.1% of all traffic incidents, 10.2% of road injuries, and 20.6% of road fatalities were associated with alcohol.¹³

With an intensification of street controls and a TV campaign to sensitize drivers about the alcohol risks while driving, the law 20.580, popularly known as zero tolerance, was published in the Official Diary of Chile and became effective on March 15th, 2012 nationwide in Chile.

The three main effects of the new law are: (1) reduce the legal limit of alcohol in blood while driving; (2) implementation of a new test for measuring the level of alcohol, the evidential alcohol test; and (3) increase the penalties for violating the law.

The new law decreases the legal BAC limit for driving while impaired from 1 to 0.8 g/l and the legal BAC limit for driving under the influence of alcohol from 0.5 to 0.3 g/l. The law is called zero tolerance because it doesn't allow you to have any alcohol and operate a vehicle. This new law is not retroactive.

The previous procedure included the breath test and another test that consists of a blood test (blood alcohol level) for the cases where the breath test shows that the driver is driving under the influence of alcohol. With the new law this is maintained, but also adds the possibility of substituting the blood test with an equivalent breath test, called evidential breath test. Both tests, the blood alcohol test and the

evidential breath test will have the same value as evidence. This new test is more effective as it gives the result in 2 min and does not require the driver to be transported to a health facility. This would increase the number of alcohol controls, accelerating the process, and helping to reduce demand at the health facilities. At the same time, there will be ambulances for the first time in the location where the controls take place.

The new law does not affect prison terms but is focused on increasing the length of license suspension. The new sanctions include:

1. Driving under the influence of alcohol (>0.3 g/l) and first offense: 3 months suspension.
2. Driving while impaired (>0.8 g/l) and first offense: 2 years suspension (previously from 6 to 12 months).
3. Driving while impaired and second offense: 5 years suspension.
4. Driving while impaired and third offense: license cancellation.
5. Driving while impaired and caused severe injuries or death: permanent revocation.

In case 4, only after 12 years it is possible to apply for reinstatement of license.

In Brazil, A new law introduced in 2008 lowered the BAC limit for drivers from 0.06 to 0.02. A study was conducted to analyze the proportion of adults who drive under the influence of alcohol in Brazil. This remained between 1.8% and 2.2% in the eight months preceding the law, decreased in the month following its establishment, and increased again two months later, reaching a maximum of 2.6% by the end of 2008 and returning to the initial levels in the first months of 2009.^{8,14–16}

Akgur et al. obtained data about alcohol use in traffic cases in Turkey. Alcohol was detected in the blood of about 54.4% of the traffic cases. It was observed that in 17.4% of the traffic incidents, the blood alcohol level was 0.05, the legal limit in accordance with Turkish laws, or less.¹⁷

A study assessed the relation between the strength of graduated driver licensing (GDL) laws and motor vehicle (MV) injury burden in the US. This study examined injury mortality, hospitalizations, and related charges for 15- to 17-year olds by strength of GDL legislation. Total MV occupant mortality was 14.6% lower after enactment of GDL with greater improvement observed in the strictest law category (26.0%). All GDL law categories were protective for MV driver injury in 16-year olds.¹⁸

This represents the first rigorous investigations on the effectiveness of the new law in Chile, with the goal of analyzing the overall road traffic mortality and morbidity associated with alcohol. It may inform similar countries where scientific data on this issue have not advanced. Furthermore, this study would support or question the utility of lowering the legal driving limit for alcohol in the United States.

Methods

A retrospective review of national databases in Chile was conducted from January 2003 to December 2014 to evaluate total traffic deaths and injuries due to alcohol before and after the

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