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ORIGINAL ARTICLE

Have drivers at alcohol outlets changed their behavior after the new traffic law?

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Objective: In an attempt to reduce high levels of traffic crashes, a new legislation was approved in Brazil in 2008. This study aimed to assess behavioral change among drivers who had drunk at alcohol outlets (AO) after implementation of the law.
Method: A three-stage probability sampling survey was conducted in Porto Alegre, state of Rio Grande do Sul, Brazil. Individuals seen leaving AOs after drinking were approached (n=3,018). Selected drivers (n=683) answered a structured interview, were breathalyzed, and had saliva specimens collected for drug screening.
Results: Overall, 60.3% (SE 4.5) of drivers reported they did not change their behavior. Among those who reported behavioral changes, most reported drinking less as their main strategy toward safer driving behavior. Variables independently associated with behavior change included having drunk at a high outlet density area (odds ratio [OR] 1.7 [1.1-2.8]) and having a favorable opinion about the law (OR 4.3 [2.1-8.9]).
Conclusions: Our findings suggest that awareness of the law has not been enough to promote behavioral change. As most drivers had a favorable opinion of the law and this variable was found to be the strongest predictor of behavior change, efforts to better integrate education and enforcement seem to be pivotal and might be well received by the population.

Keywords: Alcohol drinking; automobile driving; traffic accidents; behavior change

Introduction

Alcohol constitutes a major public health problem worldwide[1] and, in 2010, road injuries were the fourth leading cause of years of life lost (YLL) in southern Latin America.[2] Traffic crashes (TCs) and alcohol use are closely associated, and the Brazilian literature on such themes has been growing in both number and quality in recent years.[3] The first roadside surveys carried out in Brazil have shed light on the wide discrepancies found with regard to the prevalence of drinking and driving (or driving under the influence of alcohol, DUI), ranging from 5 to 40%.[4-7] Discrepancies notwithstanding, these studies have confirmed international findings highlighting the key role of young, male drivers who consume alcohol in binges as those individuals who are more likely to drive under the influence of alcohol, a behavior that increases the chance of TCs.[8]

In an attempt to reduce TCs in Brazil, a new legislation was approved in 2008 (Federal Law 11.705/08, amended December 2012). It defines DUI with a blood alcohol content (BAC) of up to 2 dg/L as a misdemeanor, and driving with a BAC equal to or greater than 6 dg/L as a felony. The first survey to assess the putative impact of the new legislation used data from a national telephone-based survey and showed no discernible impact of the new law on driving after binge drinking.[9] On the other hand, a subsequent study[10] analyzed data from a time series (2001-2010) and found a 7.2% reduction in the number of fatal TCs and a modest reduction (1.8%) in the number of traffic injuries in the city of São Paulo after the law.

The approval of this law represents a major change in Brazilian policies on alcohol, which remain fragmentary and insufficient with respect to proper control of alcohol advertising and taxation of alcoholic beverages. Furthermore, alcohol is widely available in the urban areas of Brazil, especially because alcoholic beverages can be sold throughout the country without a liquor retail license.[11,12] Alcohol availability, as measured by the density of alcohol outlets (AO), has already been associated with DUI, especially in studies conducted in high-income countries.[13-15]

A previous study carried out by our research group showed a 56.3% prevalence of DUI among drivers who have drunk at AOs in the city of Porto Alegre, state of Rio Grande do Sul.[16] Such findings are of great concern and speak in favor of the pressing need to better understand which drivers change their behaviors in response to such

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legislative measures and which do not, as well as the broader underlying reasons associated with behavioral change or absence thereof, as pivotal inputs for the formulation and evaluation of public policies aiming to reduce alcohol-related harms.

The present paper estimates the prevalence of behavioral change after the implementation of the new DUI legislation in Brazil, benefiting from interviews obtained in the context of the abovementioned survey (which targeted a representative sample of drivers recruited at ''on-premises'' AOs), and assesses the underlying reasons for such changes according to respondents who reported a change in their drinking and driving behaviors.

Methods

A three-stage probability sampling survey was conducted in Porto Alegre, Brazil. The inclusion criteria were age 18 years or older, current residence in Porto Alegre, having driven a motor vehicle in the previous 12 months, and having been drinking on the premises of an AO at the time of interview. As described in detail elsewhere,[16] a total of 3,118 individuals who were leaving AOs were approached for the survey, 683 of whom met the inclusion criteria and were interviewed. The refusal rate was 5.6% (n=41). Data were collected between April and December 2009.

Variables

The main outcome – change in DUI behavior after implementation of the law – was defined by the question: ''Did you change your behavior after the implementation of the 'Dry Law' [as the law is known in Brazil]?''

Areas of high AO concentration were defined through kernel density estimation, as described in detail elsewhere.[12]

Demographic data were obtained from the responses to a structured questionnaire. Age and educational attainment were categorized into three groups: 18-29, 30-44, and 45 or older; and primary education, secondary education, and higher education respectively. Family income was categorized into two groups – below/equal to and above the median income estimated for the survey population. The day and time of the interview were categorized into weekday or weekend and 9 p.m.-9 a.m. or 9 a.m.-9 p.m., respectively.

In view of the inclusion criterion of having driven in the last 12 months, all respondents were asked if they had a driver's license.

Driver destination was assessed through the following question: ''Where are you going now?'' and the answer was categorized as home (own, of family or friends), work (including school), or bar/restaurant/party.

Intention to drive was assessed through the question ''Are you going to drive in the next 60 minutes?''

Any previous DUI situations were assessed through the questions ''In the last 12 months, did you drive after drinking any alcohol beverage?'' and ''Have you ever been a passenger of a DUI driver in your lifetime?''

Any previous TCs were probed with the question ''Were you involved in any TC that required any kind of medical assistance in your lifetime?''

Perceptions associated with DUI were evaluated as follows: 1) whether or not the subject had been ever stopped for random breath testing; 2) the respondent's opinion of the law (in favor of, against it, or don't know – the latter meaning the respondent is neither opposed nor in favor of the law); 3) whether the respondent thinks DUI is dangerous (yes/no/don't know).

Understanding of the law was assessed by asking whether individuals knew the new BAC limit established by the law as punishable by imprisonment (yes/no). Those who claimed to know it were also asked about the limit defined by the law. Individuals who answered BAC 0.06 or breath alcohol concentration = 0.03 were defined as understanding the law.

Alcohol abuse and/or dependence were assessed by the Alcohol Use Disorders Identification Test (AUDIT). Binge drinking was evaluated by asking ''In the last year, did you drink five or more drinks (male) or four or more drinks (female) within the space of about 2 hours?''

BAC was assessed using a breathalyzer and results were dichotomized as below 0.06% and equal to/above 0.06%.

The use of any other drug was assessed through enzyme-linked immunosorbent assay (ELISA) testing of saliva specimens for cocaine, benzodiazepines, tetrahydrocannabinol (THC), and ecstasy.

Ethical aspects

Informed consent was provided verbally, as approved by the institutional review board in charge of evaluating the study (protocol no. 06-012).

Data analysis

Analyses were carried out in the R open source software environment, using its survey library.[17] Prevalence and corresponding standard errors (SE) for respondents who changed or did not change their DUI behavior were calculated using domain estimation. Pearson's chi-square homogeneity test with the Rao-Scott adjustment was used to test the homogeneity of distributions across the two groups.

A logistic regression was carried out considering as outcome the report of having changed DUI behavior. All variables with $p < 0.20$ in bivariate analysis were included in the model, as were sex and age, and the most parsimonious model was selected.

Results

Overall, 60.3% (SE 4.5) of drivers reported they did not change their behavior after the law was passed. No statistically significant differences in terms of correct understanding of the law and intention to drive after drinking were found among individuals who reported having changed their behaviors and those who did not, as

shown in Table 1. The sample was composed mostly of 30-to-44-year-old males with a median monthly income of R$ 2,500.00 (IQR 1,500.00-5,043.70).

When asked how they had changed their behaviors, most respondents (49.8%) reported they had been drinking less after the implementation of the new law, whereas decreasing proportions of the sample reported adoption of other measures, such as use of public transportation (31%), having a designated driver (17.4%), not driving after drinking (13.9%), or going less frequently to bars and restaurants (7.1%).

On logistic regression, a favorable opinion of the ''zero tolerance'' law (odds ratio [OR] 4.32, 95% confidence interval [95%CI] 2.1-8.9) was strongly associated with behavioral change, as shown in Table 2.

Discussion

Our findings clearly show that most respondents did not actually change their behaviors after the enactment of Law 11,705/08, despite the fact that over 70% reportedly considered DUI a dangerous and harmful behavior. Such conflicts between information, attitudes, and actual behaviors have been largely explored by the literature on cognitive dissonance and seem to be pervasive in various areas of human behavior. The international

Table 1 Demographic data and factors associated with DUI among drivers leaving alcohol outlets, stratified by self-reported change in DUI behavior after enactment of the Brazilian ''zero tolerance'' DUI law, Porto Alegre, 2009

	Total estimated survey population	Self-reported change in DUI behavior		p-value*
		Yes, % (SE)	No, % (SE)	
Male sex	115,239	71.5 (3.3)	79.0 (2.0)	0.319
Age				0.521
18-29 years	48,618	27.3 (2.3)	35.2 (1.5)	
30-44 years	58,410	34.4 (4.2)	41.2 (3.1)	
45 years or older	44,546	38.2 (3.4)	23.6 (3.0)	
Educational attainment				0.021
Primary education	43,106	17.9 (4.9)	35.4 (5.4)	
Secondary education	41,255	27.9 (4.1)	26.8 (4.7)	
Higher education	67,212	54.3 (5.6)	37.8 (6.6)	
Has a driver's license	136,718	95.6 (1.9)	86.6 (3.1)	0.025
AO concentration				0.174
High AO concentration area	34,270	31.6 (3.7)	16.7 (1.6)	
Low AO concentration area	117,304	68.4 (3.7)	83.3 (1.6)	
Time of interview				0.951
9:00 a.m. to 9:00 p.m.	86,107	56.5 (5.1)	57.0 (8.1)	
9:00 p.m. to 9:00 a.m.	65,466	43.5 (5.1)	43.0 (8.1)	
Weekend	65,655	54.3 (4.6)	36.1 (4.3)	< 0.001
Destination				< 0.001
Home	113,930	85.5 (3.2)	68.1 (4.3)	
Bar/restaurant/party	13,432	8.8 (3.0)	8.9 (2.5)	
Work	24,212	5.4 (2.3)	22.9 (2.5)	
BAC				0.999
< 0.06	96,817	66.0 (3.8)	66.0 (6.3)	
$\geqslant 0.06$	49,788	34.0 (3.8)	34.0 (6.3)	
Binge drinking in last 12 months	101,107	78.5 (3.9)	58.9 (7.7)	0.015
AUDIT score				0.360
0-7	80,821.6	54.6 (5.4)	52.5 (7.0)	
8-15	53,964.6	38.1 (4.5)	33.9 (6.4)	
16-19	4,850.7	3.2 (1.1)	3.2 (1.4)	
20 or more	1,936.5	4.1 (2.0)	10.3 (3.1)	
Any other drug	11,808	9.01 (3.2)	11.6 (4.3)	0.663
Intends to drive in next 60 min	85,345	54.9 (4.3)	57.2 (2.8)	0.990
DUI in last 12 months	132,211	84.8 (3.0)	88.8 (2.5)	0.279
DUI-related crash, lifetime	30,051	19.5 (4.3)	20.0 (4.4)	0.919
Passenger of a DUI driver	132,660	85.4 (3.7)	88.9 (1.7)	0.350
Breathalyzed, lifetime	12,324	7.6 (2.1)	8.5 (2.6)	0.768
Thinks DUI is dangerous				< 0.001
Yes	116,210.4	88.3 (3.0)	69.1 (3.8)	
No	28,509.5	8.8 (2.6)	25.4 (4.1)	
Does not know	6,853.3	3.0 (1.1)	3.0 (1.1)	
Claims to understand the BAC limits defined by the law	55,915	43.6 (6.2)	32.4 (4.8)	0.150
Actually understands the BAC limits defined by the law	20,634	10.8 (3.8)	15.4 (2.3)	0.363
Opinion of the ''zero tolerance'' law				< 0.001
In favor	99,209	82.6 (4.4)	54.2 (6.1)	
Against	41,745	14.3 (3.4)	36.3 (5.5)	
Does not know	10,620	3.2 (1.9)	9.5 (3.0)	

AO = alcohol outlet; AUDIT = Alcohol Use Disorders Identification Test; BAC = blood alcohol content; DUI = driving under the influence of alcohol; SE = standard error.
* Pearson's chi-square homogeneity test with Rao-Scott adjustment.

Table 2 Factors associated with a self-reported change in DUI behavior among drivers leaving alcohol outlets, as analyzed by logistic regression. Porto Alegre, 2009

	Crude OR (95%CI)	Adjusted OR (95%CI)
Male sex	0.66 (0.4-1.1)	0.71 (0.4-1.3)
Age		
18-29 years	1	1
30-45 years	1.07 (0.6-1.8)	0.99 (0.5-1.7)
45 years or older	2.08 (1.2-3.4)	2.47 (1.3-4.8)
Educational attainment		
Primary education	1	1
Secondary education	2.06 (0.9-4.4)	2.62 (0.9-4.6)
Higher education	2.84 (1.3-6.1)	2.45 (1.2-5.8)
High AO concentration area	2.30 (1.3-4.0)	1.74 (1.1-2.8)
Weekend	2.1 (1.2-3.6)	1.78 (1.01-3.1)
Destination		
Home	1	1
Bar/restaurant/party	0.78 (0.3-1.9)	1.0 (0.3-3.5)
Work	0.18 (0.07-0.5)	0.22 (0.1-0.6)
Binge drinking in last 12 months	2.54 (1.3-4.9)	3.46 (1.8-7.9)
Opinion of the "zero tolerance" law		
Against	1	1
In favor	3.8 (1.8-8.1)	4.32 (2.1-8.9)
Does not know	0.84 (0.2-3.4)	0.54 (0.1-2.6)

95%CI = 95% confidence interval; AO = alcohol outlet; DUI = driving under the influence of alcohol; OR = odds ratio.

literature has documented that actual behaviors can be in partial or absolute dissonance with available information, and results have sometimes indicated that health knowledge was a less important predictor of driving behavior than health experience.[18]

However, it is important to underscore that less than half of drivers claimed to understand the law, and less than 20% actually gave accurate answers when asked about the BAC limits defined by the law as punishable by imprisonment after DUI. These results are similar to previous findings of surveys conducted in federal highways, where 34% of drivers reported to know the limits punishable by imprisonment and only 8% actually gave a correct answer.[19] These findings highlight the need for interventions to increase public awareness of the law.

A previous Brazilian study by Campos et al.[20] documented a decrease in the prevalence of DUI in the city of São Paulo, Brazil, after enactment of the law. The Campos et al. study and ours are not strictly comparable due to differences in methodology, including the fact that Campos et al. recruited interviewees from major entertainment areas and during the weekends, whereas our sampling strategy comprised both high- and low AO concentration areas and our interviews were conducted both on weekends and on weekdays. These differences notwithstanding, our findings highlight the association between behavioral change and alcohol intake in the context of a high density of outlets and/or on the weekends, underlining the relevance of key areas and periods as targeted by Campos et al. Such findings may be associated with the impact of thorough enforcement of the law in these contexts and/or periods of time.

Our study is the first Brazilian investigation to take advantage of a population-based, probability sampling strategy to fully integrate the use of questionnaires and actual measurement of BACs. The full integration of subjective and objective assessment methods, as well as the use of a probability sample, seems to be the optimal research strategy for implementation and monitoring of evidence-based policies. Integrated assessments constitute the best strategy for exploring the complex combination of individual-level variables (e.g., driver behaviors) and contextual-level variables (e.g., density of AOs).

Behavioral change toward safer behaviors was found to be associated with older age (45+ years) and higher education. Adolescents and young adults are more likely to DUI and seem to be more prone to TCs.[21-23] Achieving actual changes in this scenario remains a challenge worldwide.[24] The literature has shown that investments in prevention policies and programs can effectively improve the health of young people, reducing alcohol-related harm and TCs.[25] Individuals with a better educational background tend to be better informed, which does not exclude the need to reinforce and support behavioral change. Obviously, college graduates should not be the exclusive focus of preventative actions, particularly in a country where access to education remains far from optimal. In this sense, a wide gamut of preventative initiatives should be tailored to individuals with the most diverse educational backgrounds.

The choice of "drinking less" as the first alternative in terms of behavioral change seems to be an auspicious finding and might speak in favor of an informed decision, as less consumption of alcohol may translate into an increased chance of having BACs under the levels defined as criminal behavior by the legislation.

Our findings should be viewed with the necessary caution and should not be extrapolated to other urban areas in Brazil, where driver behavior may be similar (or not), but contextual variables (e.g., quality of roadworks, e.g., pavement and proper signs) may differ. Different contextual variables related to traffic flow and safety are necessarily specific to each urban area and setting, as are enforcement policies.

Another limitation concerns the use of self-reported information, which may be subject to different biases. At any rate, individual perceptions and attitudes toward laws, rules, and standards are a necessary component of any valid assessment of public policies. From the perspective of a putative social desirability bias, our data should underestimate actual high-risk behaviors (i.e., it is unlikely that drivers who intend to drive after drinking would tend to overestimate behaviors defined as misdemeanors/crimes).

In conclusion, although the majority of drivers did not report any change in their behaviors toward safer ones, most voiced support for the new law. As a favorable opinion of the law was found to be associated with behavioral change in the present study, these findings may suggest that additional changes toward safer behaviors might be forthcoming – due to the fact the legislation is relatively recent and information tends to be

progressively disseminated and consolidated over time – and/or that a comprehensive effort to promote safer driving and enforce the law might be well received by drivers and the population at large.

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Disclosure

The authors report no conflicts of interest.

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