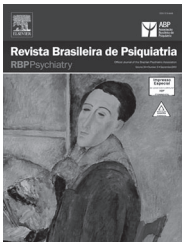
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ORIGINAL ARTICLE

Regional differences associated with drinking and driving in Brazil

Raquel De Boni,[1] Lisia von Diemen,[1] Paulina do Carmo Arruda Vieira Duarte,[2] Daniela Benzano Bumaguin,[1] Juliana Balbinot Hilgert,[3] Mary Clarisse Bozzetti,[3] Anne Sordi,[1] Flavio Pechansky[1]

[1] Center for Drug and Alcohol Research of the Hospital das Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Brazil
[2] Secretaria Nacional de Políticas sobre Drogas (Brazilian Secretariat for Drug Policies), Brazil
[3] Postgraduate Program of Epidemiology, Universidade Federal do Rio Grande do Sul, Brazil

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DESCRIPTORS
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Abstract
Objective: To evaluate regional differences and similarities associated with drinking and driving (DUI) in the five Brazilian macro-regions. *Method:* A roadside survey was conducted in the 27 Brazilian state capitals. A total of 3,398 drivers were randomly selected and given a structured interview and a breathalyzer test. To determine the predictors of positive blood alcohol concentration (BAC) in each region, a MANOVA was performed, and 3 groups were used as follows: 1) North and Northeast, 2) South and Midwest, and 3) Southeast. A Poisson robust regression model was performed to assess the variables associated with positive BAC in each group. *Results:* Of all surveyed drivers, 2,410 had consumed alcohol in the previous 12 months. Most were male, with a median age of 36. Leisure as the reason for travel was associated with positive BAC in all 3 groups. Low schooling, being older than 30, driving cars or motorcycles and having been given a breathalyzer test at least once in their lives predicted DUI in at least two different groups. *Conclusions:* Factors , especially low schooling and leisure as a reason for travel, associated with drinking and driving were similar among regions, although certain region-specific features were observed. This information is important for aiming to reduce DUI in the country.

Corresponding author: Raquel De Boni. Centro de Pesquisa em Álcool e Drogas. Hospital das Clínicas de Porto Alegre – Universidade Federal do Rio Grande do Sul. Rua Ramiro Barcelos 2350/2201A, 90035-003, Porto Alegre, Brazil. Phone/fax: (55 51) 3359-7480.
E-mail: raqueldeboni@msn.com

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DESCRITORES:
Consumo de bebidas alcoólicas;
Acidentes de trânsito;
Localizações geográficas.

Diferenças regionais entre os fatores associados ao beber e dirigir no Brasil

Resumo
Objetivo: Avaliar diferenças e similaridades em relação a beber e dirigir (DUI) nas cinco macro-regiões brasileiras. *Método:* Um *roadside survey* foi realizado nas 27 capitais brasileiras. Foram selecionados aleatoriamente 3.398 condutores que responderam a uma entrevista estruturada e foram testados com uso de etilômetro. Para a construção de modelos preditivos de alcoolemia positiva (BAC), as regiões foram agrupadas de acordo com sua similaridade, obtida por MANOVA, em: 1) Norte e Nordeste; 2) Sul e Centro-Oeste; 3) Sudeste. Em cada grupo foi realizado um modelo de regressão robusta para estimar as variáveis associadas a BAC. *Resultados:* Dentre os condutores, 2.410 ingeriram bebidas alcoólicas nos 12 meses anteriores, sendo a maioria composta por homens com idade mediana de 36 anos. A única variável associada a BAC em todos os grupos foi ter lazer como motivo da viagem. Baixa escolaridade, idade > 30 anos, dirigir carros/motos e ter realizado teste de bafômetro previamente foram associadas a BAC em ao menos dois grupos. *Conclusões:* Os fatores associados a DUI foram semelhantes nas regiões, especialmente o motivo da viagem e a escolaridade, embora algumas especificidades regionais tenham sido observadas. Estas informações são estratégicas para políticas públicas destinadas a redução do DUI.

Introduction

Driving under the influence of alcohol (DUI) is a significant public health problem worldwide.1 Some factors associated with DUI are similar across cultures, such as being male and being young,[2] as patterns of alcohol use, especially binge drinking (i.e., more than five doses in one occasion).[3] The risk for traffic accidents increases for drivers under 40 years of age, when driving at night, and driving on less crowded roads. The risk also seems to be associated with consumption of beer in younger drivers.[4,5] Environmental factors, such as socio-economic status, political and legal issues, and the density of alcohol outlets, also play a role in the DUI scenario.[6-8]

Laws that focus on the reduction of alcohol drinking by drivers can be as effective as individualized interventions for alcohol users who already put themselves at risk.[9] However, most laws are implemented at a national level, and there is a scarcity of information about how regional differences influence the efficacy of those public measures in most countries or how to use such regional demographic information to provide feedback for policymakers. Studies show that the reduction in traffic accidents related to DUI is higher in places where the law is properly applied and enforced.[10,11] A Swedish study showed that the consumption of alcoholic beverages is higher in regions that are closer to the European continent, most likely because of political measures related to the price of the products, the control of alcohol intake and the availability of alcohol and other drugs.[12] Furthermore, a study conducted in Europe concluded that differences in alcohol consumption patterns did not vary significantly across the regions studied.[13]

In Brazil, there were 36,611 deaths related to traffic accidents in 2005,[14] and studies have estimated that the prevalence of positive blood alcohol concentration among traffic accident victims varies from 8% (non-fatal victims) to 50% (fatal victims).[15] Factors associated with DUI in Brazil have shown similarities with previous studies, for instance, in a higher proportion of male drivers.[16] However, the prevalence of drinking and driving is approximately 20% to 30% in studies conducted in Porto Alegre, Diadema and Salvador.[17-19] Because Brazil is a vast country and important cultural and economic differences exist among its states, we expect that variations in the prevalence of drinking and driving, as well as its associated factors, would reflect this demographic heterogeneity. For example, in the First Alcohol Brazilian Household Survey, the number of people who drank alcohol was higher in the North, Northeast and Midwest regions. The type of drink was different among regions as well, with the highest consumption of spirits occurring in the Northeast. Beer was the favorite drink in all places.[20]

The risk of DUI varies according to alcohol consumption patterns,[21] and there are no regional comparisons of the prevalence of DUI after the implementation of the 2008 law number 11.705, which defined the legal blood alcohol concentration (BAC) as 0.2 g/L in the country. Knowledge about these regional patterns is key to the implementation of enforcement efforts, and it also functions as a theoretical framework to potentially understand particular risk factors that cannot be deduced from a general prevalence rate. In addition, such particularities allow for the implementation of public policies specific to each region.Therefore, the objective of this study was to evaluate regional characteristics of Brazilian drivers related to drinking and DUI and their associated risk factors.

Materials and Methods

Geographical area and sampling

In a cross-sectional design, 3,398 drivers were selected from among drivers on federal highways that crossed the metropolitan area of 27 Brazilian capital cities. The sample was stratified by type of vehicle - cars, motorcycles, buses and trucks - with random selection in proportion to the fleet size of each state.* For geographical and logistic reasons,

collection sites were mapped for all state capitals, with a distance no larger than 50 km from the geographical center of each capital.

Data collection

Data were collected between August 2008 and September 2009, on Fridays and Saturdays, from 12 p.m. to 12 a.m. These limits were necessary because of the strict budget allotted to the project, as well as security issues in roads after midnight in some areas of the country. Regional, local, and national holidays were excluded.

Data collectors were trained alongside a federal police officer and three senior members of the federal highway patrol because law enforcement officers were responsible for ensuring that the team of data collectors would produce consistent data for each highway stop. Additional training for local police officers was scheduled at each state capital.

Each selected vehicle was stopped by a police officer. Drivers who agreed to participate were interviewed by trained data collectors after giving informed consent, in a parking lot away from the road. Interviews were conducted with a Personal Digital Assistant connected to online database. After the interview, the police officers would administer a breathalyzer test to each driver as part of their routine operations. If a police officer found a reason to prevent the driver from returning to the road (e.g., a suspended driver's license, driving an unregistered vehicle, or intoxication), appropriate police procedures would follow. Ninety individuals (2.7%) refused to take part in the study or were excluded.

Inclusion criteria

We included individuals aged 18 or older who were driving on federal highways and were stopped by police officers. All participants consented to take part in the study and professed to have consumed alcohol at least once in the 12 months prior to data collection (n = 2,410).

Measures

The following variables were included in the analyses:
a) Demographics: Gender, age (categorized as under or over 30 years old,)[16] schooling and family income (in Brazilian currency - Real) were measured by means of a structured interview.
b) Type of vehicle: Vehicle category (truck, bus, car or motorcycle type) was obtained by visualization of the vehicle. Buses and trucks where considered in the same category for statistical analysis.
c) Time of collection: Variables were categorized as "before 8 p.m." (12 a.m. to 8 p.m.) or "after 8 p.m." (8:01 p.m. to 12 p.m.).
d) Place of origin: Options for place of origin before driving (Where are you coming from on this trip?) were collapsed into two categories to separate places where individuals usually drink alcoholic beverages from other places. The two categories were as follows:1) Restaurant/ bar/ club/ gas station/ hotel/home and 2) home/ work/ school/ church/ store/ shopping.

* Detailed at www.obid.senad.gov.br/portais/OBID/biblioteca/documentos/Publicacoes /alcool_transito/328287.pdf

e) Reason for traveling: Options for travel motivation were categorized into1) work and 2) leisure/other.
f) Favorite drink: Options for favorite drink were categorized into 1) beer and 2) others because previous research has indicated that a preference for beer can be associated with drinking and driving.[22]
g) Binge: The variable *binge drinking* (i.e., episodic consumption of alcohol) was assessed by the following question: "In the previous year, did you drink more than 5 doses (men) or 4 doses (women) on one occasion?"[23]
h) Alcohol consumption pattern: Alcohol consumption pattern was established as described in the NESARC[24] study. The usual frequency of alcoholic beverage consumption (e.g., the number of times when beer was consumed) was multiplied by the volume of drinks taken on each occasion. In this way, the annual volume of each type of alcoholic beverage consumed by the driver was obtained. We then calculated the total quantity of ethanol consumed in a year for each type of beverage, and this value was divided by 365 days. Then, the quantity of daily ethanol intake for each type of beverage consumed by the driver was added to obtain an estimate of the total daily ethanol amount. To facilitate data analysis, the total daily amount of alcohol was converted into standard doses of alcohol as follows: 1) light, less than 3 doses per week; 2) moderate, between 3 and 14 doses/week for a man or 3 and 7 doses/week for a woman; and 3) heavy, more than 2 doses/day for men or more than 1 dose/day for women.
i) DUI (12 months): Obtained by the question, "In the past 12 months, did you drive after you had consumed any alcoholic beverage?"
j) Breathalyzer (lifetime): Measured by the question: "Have you ever been stopped to be given a breathalyzer?"
k) Positive Blood Alcohol Concentration (BAC): Considered to be any measure above 0.01%; estimated from breath samples obtained using calibrated Alco-Sensor IV by Intoximeters, Inc (St Louis, MO, USA).
l) Previous DUI accidents: Measured by the following question: "in your life, have you ever had accidents after drinking?"

Ethics

The study was approved by the Institutional Review Board and Ethics Committee of the Hospital das Clínicas de Porto Alegre. All participants provided written informed consent.

Statistical Analysis

At initial data collection, regarding the available proportion of certain vehicles calculated for each state, some states showed an unacceptably low number of vehicles. Because it would be impossible to generate the necessary posterior stratified statistical analyses for these regions, we instead obtained the minimum number of vehicles for each state and converted this number into a proportion for the type of selected vehicle. For statistical purposes, it was necessary to weight each vehicle, in to preserve the original proportions in the population. Weights were calculated by dividing the real probability of each vehicle in the state by the probability of each vehicle in our sample. For example, for the state of Amapá (AP), the probability that a vehicle belongs to this state in our population is 0.002. The probability of a vehicle being a bus in AP is 0.12, and thus the probability of the vehicle being a bus from AP was 0.002 * 0.12 = 0.00024.

The probability of the vehicle being a bus in our sample is 13/3,397 = 0.004 (in AP, there were 13 buses collected from 3,397 in total). Thus, the weight for buses in AP would be 0.00024/0.004 = 0.06.

To test for predictive models of positive BAC in each region, it was necessary to group the regions. For this, we tested regional similarities in type of vehicle, schooling, gender, age, and family income through MANOVA. We found the following 3 groups: 1) North and Northeastern, 2) South and Midwest, and 3) Southeast. A Poisson regression model using robust variance was performed to assess the association between predictor variables and blood alcohol concentration, the main outcome, in Brazilian geographic regions. All analyses were performed using SPSS 16.0 software (SPSS Inc., Chicago, IL, USA). All independent variables showing association with $p < 0.20$, as well as those with clinical epidemiological relevance (except for those that presented co-linearity with other variables) according to the literature, were included in the multivariable model for each Brazilian region (Southeast, South/Midwest and North/Northeast). Variables that did not contribute significantly to the model ($p > 0.25$) were eliminated, and a new model was calculated. In the Southeast region, there was co-linearity between the variables drinking and driving in the past 12 months, beer as a favorite drink, and binge drinking, as well as between binge drinking and beer as a favorite drink, drinker and binge drinking, beer as a favorite drink and drinking and driving in the past 12 months. In the Midwestern and Southern region, there was co-linearity between drinking and driving in the past 12 months and binge drinking, binge drinking and beer as a favorite drink, drinker and binge drinking, beer as a favorite drink and drinking and driving in the past 12 months. In the North and Northeast regions, there was co-linearity between drinking and driving in the past 12 months and binge drinking, binge drinking and beer as a favorite drink, drinking and driving in the past 12 months.

All statistical models were adjusted for age, gender, schooling, and type of vehicle, except for the Northern and Northeastern regions, where there was only one woman with a positive BAC. Because of the co-linearity between variables in each regional model, the lowest Akaike Information Criterion (AIC) was used as criterion. Adjusted prevalence ratios (PR) are shown with 95% confidence intervals (95% CIs).

Results

There were no statically significant differences in the proportion of refusals between the three studied regions, with 2.7% refusal in the Southeast, 3.6% in the South-Midwest and 2.0% in the North-Northeast regions ($p = 0.187$). Table 1 shows that individuals who refused were younger in two of the studied regions (South-Midwest and North- Northeast).

The sample comprised 2,410 drivers who had taken at least one dose of alcohol in the past 12 months. The median age was 36 (inter-quartile range 28-46 years old). Most individuals were male (93.4%) with a median family income of R$2,500 per month** (inter-quartile range R$40 and R$170), and had completed high school (66.3%). There were no significant statistical differences in age, having been stopped for a breathalyzer test, and history of previous accidents after drinking between regions (Table 2).

In the North/Northeastern region, lower schooling (PR = 15.6; 95% CI 1.9-127.8), DUI 12 months prior (PR = 2.7 (95% CI 1.3-5.8), and leisure as the reason for traveling (PR = 3.2; 95% CI 1.4-7.0) were associated with positive blood alcohol concentration. In the South/Midwest region, positive blood alcohol concentration was associated with being older than 30 (PR = 1.9; 95% CI 1.1-3.2), driving cars (PR = 3.4; 95% CI 1.6-7.3), and driving a motorcycle (PR = 4.0; 95% CI 1.9-8.7), as well as having been given a breathalyzer test at least once previously (PR = 2.5; 95% CI 1.5-4.1), having beer

** The equivalent of US $1,470.

Table 1 Characteristics of individuals who refused or participated by region

		North and Northeast regions			South and Midwest regions			Southeast region		
		Refused n = 35	Accepted n = 1,631	p*	Refused n = 30	Accepted n = 801	p*	Refused n = 25	Accepted n = 965	p*
		%	%		%	%		%	%	
Male		100.0	95.8	0.999	94.4	93.0	0.999	86.0	92.1	0.116
Age	<18 years	7.7	-	0.001	2.7	-	0.001	-	-	0.001
	18-34 years	30.8	48.7		51.4	51.5		40.4	46.9	
	35-49 years	53.8	43.7		24.3	41.1		48.1	42.3	
	≥ 50 years	7.7	7.6		18.9	7.0		7.7	10.8	
Type of vehicle	Car	63.6	50.8	0.696	56.8	52.2	0.722	71.2	56.3	0.053
	Bus	9.1	11.6		5.4	7.0		-	10.3	
	Truck	-	9.4		8.1	14.2		7.7	8.1	
	Motorcycle	27.3	28.2		29.7	26.6		21.1	25.3	
Interview after 8 p.m.**		25.0	35.6	0.553	41.7	36.3	0.626	21.2	28.8	0.295

*Chi-square test.

Table 2 Demographic characteristics and risk behavior for traffic accidents among Brazilian drivers, stratified by region: 2008-2009

		North (n = 416) %	Northeast (n = 717) %	South (n = 320) %	Midwest (n = 312) %	Southeast (n = 645) %	p**
Sex	Female	3.1	3.5	7.5	5.7	7.3	0.005
Age	< 30 years old	40.2	32.2	30.8	33.0	28.5	0.104
Schooling	Incomplete/ complete college	23.7	26.1	25.3	27.0	38.1	< 0.001
	High School/technician complete/incomplete	41.2	43.9	47.3	43.6	38.4	
	Never studied up to 8th grade	35.1	30.0	27.5	29.4	23.6	
Family income *	< 1,300	31.2	30.7	16.8	24.1	14.7	< 0.001
	1,300-2,200	20.8	24.6	32.3	25.1	24.4	
	2,200-4,200	22,9	20.4	26.2	24.6	24.6	
	≥ 4,200	25.0	24.3	24.7	26.2	36.3	
Type of vehicle	Bus/truck	19.4	20.9	23.5	16.6	15.7	< 0.001
	Car	42.9	53.4	48.9	55.5	59.0	
	Motorcycle	37.8	25.7	27.6	28.0	25.3	
Time of collection	After 8 p.m.	38.1	32.6	32.7	39.8	29.5	0.022
Place of origin	Home, work, school, church, store, shopping mall	90.0	92.9	87.9	92.0	90.8	0.122
	Restaurant, home, bar, club, gas station, hotel	10.0	7.1	12.1	8.0	9.2	
Reason for travel	Work	50.5	57.2	54.0	48.3	45.7	0.01
	Leisure/other	49.5	42.8	46.0	51.7	54.3	
Favorite drink	Beer	81.4	75.8	70.7	83.5	77.5	0.001
Binge	At least once a year	71.1	62.3	57.5	64.6	52.7	< 0.001
Alcohol consumption pattern	Light	70.8	73.0	87.8	73.6	84.4	
	Moderate	21.9	19.6	6.8	17.9	12.1	< 0.001
	Heavy	7.3	7.4	5.4	8.5	3.5	
Previous DUI accident	Yes	4.1	3.9	5.7	4.3	4.2	0.659
Stopped to be breathalyzed	Yes	10.3	15.8	8.9	10.0	11.0	0.038
Positive BAC	Yes	6.1	6.1	4.4	8.1	5.5	0.389
Positive BAC or has drunk < 6h ago	Yes	10.3	9.3	7.5	13.7	10.3	0.100

*Value in Brazilian currency (Real). Equivalent to: < U$765.00 / U$765.00 - 1,294.00 / U$1,294.00 – 2,470.00 / >U$2,470.00
** Chi-square

as a favorite drink (PR = 3.5; 95% CI 1.7-7.3), leisure as the reason for traveling (PR = 2.0; 95% CI 1.2-3.2), coming from a bar/restaurant/home/club/gas station/hotel (PR = 2.0; 95% CI 1.2-3.4) and being approached after 8 p.m. (PR = 2.0; 95% CI 1.3-2.0). In the Southeast region, significant variables in the final model were as follows: being more than 30 years old (PR = 1.7; 95% CI 1.1-2.6), driving cars (PR = 2.4; 95% CI 1.2-4.7) and motorcycles (PR = 2.4; 95% CI 1.1-5.1), low schooling (PR = 2.3; 95% CI 1.5-3.6), having been given a breathalyzer test at least once previously (PR = 2.4; 95% CI 1.6-3.6), binge drinking (PR = 1.7; 95% CI 1.2-2.4), and leisure as the reason for traveling (PR = 1.9; 95% CI 1.3-2.8) (Table 3).

Discussion

This is the first Brazilian study to analyze factors associated with drinking and driving stratified by region. Most factors were similar among regions, especially low schooling and leisure as a reason for traveling.

Unlike previous international studies,6,25 but in agreement with previous Brazilian studies,[16,17,26] individuals older than 30 were more prone to DUI than those under 30, most likely because of different alcohol usage patterns in the Brazilian population. Binge drinking prevalence seems to be high even after age 30,[27] and there is a lower availability of cars for younger drivers in Brazil. Unlike other countries, where progressive licensing combined with a high median socioeconomic background allow for the licensing of drivers from the age of 16, Brazilian laws allowing for progressive licensing are recent, as are changes in the economy that allow for a young driver to

Table 3 Factors associated to positive blood alcohol concentration of drivers approached in Brazilian regions*, between 2008-2009

		North and Northeast regions			South and Midwest regions			Southeast region		
		Drank in the day (%)	p	Adjusted RP (95%CI)	Drank in the day (%)	p	Adjusted RP (95%CI)	Drank in the day (%)	p	Adjusted RP (95%CI)
Sex	Female[1]	7.1	0.999	-	5.4	0.928	1	2.2	0.085	1
	Male	9.6			9.4		1.0 (0.3-2.7)	11.0		3.3(0.8-13.0)
Age	< 30 years	5.8	0.467	1	6.4	0.013	1	7.3	0.012	1
	≥ 30 years	11.9		Sex[1]	10.3		**1.9 (1.1-3.2)**	11.5		**1.7 (1.1-2.6)**
Schooling	Superior incomplete/ complete	5.8		1	7.8		1	8.7		1
	High School/technician complete/incomplete	9.7	0.072	6.6 (0.8-52.2)	8.1	0.786	1.1 (0.6-1.8)	8.5	0.385	1.2(0.8-1.9)
	Never studied up to 8th grade	12.6	0.011	**15.6 (1.9-127.8)**	12.1	0.108	1.6 (0.9-2.9)	16.2	< 0.001	**2.3 (1.5-3.6)**
Family income**	< 1,300	10.3			12.2			12.0		-
	1,300-2,200	12.5	0.624	-	9.7	0.239	-	10.8	0.631	
	2,200-4,200	7.5			6.3			11.5		
	≥ 4,200	7.6			7.5			9.0		
Type of Vehicle	Bus/truck	3.6		1	4.0		1	6.2		1
	Car	10.6	0.392	1.7 (0.5-5.7)	10.4	0.002	**3.4 (1.6-7.3)**	11.3	0.011	**2.4 (1.2-4.7)**
	Motorcycle	12.0	0.667	1.4 (0.3-5.7)	11.3	< 0.001	**4.0 (1.9-8.7)**	10.5	0.023	**2.4 (1.1-5.1)**
Time of collection	Before 8 p.m.	8.5	0.296	-	6.5	0,001	1	9.6	0,236	-
	After 8 p.m.	12.3			14.2		**2.0 (1.3-2.9)**	12.1		
Place of origin	Home, work, school, church, store,	9.0	0.336	-	8.2	0.006	**1**	9.9	0.225	-
	Restaurant, home, bar, club, gas station, hotel	13.8			15.5		**2.0 (1.2-3.4)**	14.2		
Reason for traveling	Work	6,6	0,005	1	5.5	0.005	1	7,4	0,002	1
	Leisure or other	13,3		**3.2 (1.4-7.0)**	12.9		**2.0 (1.2-3.2)**	12.8		**1.9 (1.3-2.8)**
Favorite drink[2]	Beer	9.8	0.876	-	11.1	0.001	**3.5 (1.7-7,3)**	**11,7**	0,006	-
	Others	8,6			3,4		1	5,7		
Binge	Not once an year	5.5	0.055	-	8.0	0.433	-	7.7	0.003	1
	At least once an year	11.8			9.9			12.7		**1.7 (1.2-2.4)**
Alcohol consumption pattern[3]	Light	9.5	0.994	-	8.6	0.649	-	9.5	0.025	-
	Moderate	9.8			11.7			16.7		
	Heavy	10.0			10.2			9.5		
Previous DUI accident	No	9.7	0.999	-	9.3	0.999	-	10.1	0.322	-
	Yes	6.2			7.1			15.4		
Stopped to be breathalyzed	Yes	16.9	0.063	2.5 (1.0-6.4)	17.8	0.001	**2.5 (1.5-4.1)**	18.4	< 0.001	**2.4 (1.6-3.6)**
	No	8.3		1	8.3		1	9.3		1
Drinking and driving -12m	Yes	12.8	0.010	**2.7 (1.3-5.8)**	5.7	0.128	0.7 (0.4-1.1)	12.9	0.202	-
	No	8.8		1	10.1		1	9.8		

*The regions were grouped by their similarities according to the following variables: gender, age, schooling, income, type of vehicle; tested throughout MANOVA.

**Value in Brazilian currency (Real). Equivalent to: < U$765.00 / U$765.00 -1,294.00 / U$1,294.00 – 2,470.00 / >U$2,470.00

[1] The variable gender was not inserted as a control on the North-Northeast region due to a small number of women (n=1).

[2] Favorite drink was not inserted on the final model on the Southeast region due to its collinearity with binge.

[3] Alcohol consumption pattern was not inserted on the final model on the Southeast region due to its collinearity with binge, favorite drink, and DUI 12 months.

[2,3] The variables with the smaller AIC are the ones that entered the final model.

purchase his/her own car. We believe this is reflected in the age findings. The correlation between binge drinking and beer as a favorite drink is important for public health, with particulary because of the emphasis in Brazilian culture on beer. As has been studied in depth by Pinsky and colleagues, beer has a specific "gold niche" in the culture of drinking in Brazil, due to adaptations in Brazil because of adaptations of Brazilian law that allow for beer to be advertised in a more flexible manner than beverages of higher alcohol content.[28,29] Both binge drinking and beer as a favorite drink were associated with positive blood alcohol concentration, which is in agreement with the international literature.[3,22,30,31] This correlation could be useful

to promote the prevention of binge drinking. Because individuals who drink in a binge pattern usually drink beer, measures to restrict its availability, including increased taxes, curfews and restriction of availability, – would help. These measures have been effective in preventing alcohol abuse, including drinking and driving, in other parts of the world.[32,33]

Only in the South and Midwest regions was the time of collection (after 8 p.m.) and coming from bars/restaurants associated with positive BAC. The literature indicates that the frequency of DUI is higher at night,[34,31] as is the consumption of alcoholic beverages in bars,[35] as was found in these regions. These differences could be explained in various ways: surveillance and law enforcement could occur in a more systematic way in the North/ Northeastern/ Southeast regions, decreasing frequencies at night and in areas with high concentration of alcohol consumption points (it is worth considering that data collection was completed shortly after the implementation of a law that lowered the legal BAC in June 2008, which could result in increased surveillance in certain regions of the country); and urban areas could differ in their roads in these regions, which we did not evaluate in this study. Our collection period (between 8 p.m. and 12 p.m.) could be too short to detect differences related to time of alcohol consumption in the other regions. To investigate any of these hypotheses, it would be necessary to conduct a new study that would explicitly model these variables.

Drivers who reported having been previously given a breathalyzer test were more likely to have consumed alcohol on the day of data collection, and this finding was evenly distributed throughout the different regions of Brazil. This finding is different from that of the international literature,[36] aand it may reflect some peculiar aspects of Brazilian law. Prior to the law of 2008, the use of breath alcohol tests was rare on the country's highways, which was reflected in the low prevalence found for this variable in our sample. Drivers who had already submitted to the test might have shown risk behaviors on previous occasions or were professional drivers who are more often tested. It is possible that we will see changes in this type of behavior in the future because of increased enforcement and breath alcohol test use in the country in the coming years.

Regarding the prevalence of positive BACs, we found no significant differences between regions. However, in the Southeast region, the percentage was 4.4%, whereas in the Midwest it was 8.1%, suggesting that significant regional differences could have been missed because of the small sample size. Independently of the differences between regions, the prevalence was high, especially if we consider that periods of higher risk (e.g., after midnight or on major holidays) were not included and the relatively low risk period from 12 p.m. to midnight. This prevalence is similar to others found in studies conducted in the U.S. from 10 p.m. to 12 p.m. on weekends.[36] Belgium,[39] Norway,[38] and North American and European states in general estimate the prevalence of DUI as highest for car drivers.[36-38] Our findings also show high prevalence in motorcycle professional drivers, highlighting the need to be better informed of the characteristics of these drivers with regard to drinking and driving. In a roadside survey in Thailand, the prevalence of positive BAC in motorcycle drivers was similar to that found for car drivers, 2.7%, and 1.9% among professional drivers.[39] However, data were not collected solely in peak risk hours. Prevalence may still be underestimated if the individuals who refused study participation had a positive BAC. However, because refusals were similar and low in the three studied regions, selection bias might not have significantly influenced the main study comparisons.

This study had some limitations that may influence the generalizability of the data obtained: 1) the sample is non-probabilistic, although random in nature; therefore, we cannot generalize the findings to all drivers who drive on federal highways; 2) data were obtained on federal highways only, which did not always intersect urban or suburban areas directly; therefore, our data may differ from those in pure urban environments (for example, downtown areas) where previous studies have demonstrated much higher rates of positive BACs;[16] 3) data collection was predominantly performed during the day, which may have underestimated the overall positive prevalence, as previously mentioned; and 4) some differences in the North-Northeast region were not significant, most likely because of the small sample size. Nevertheless, considering that predictors of DUI were similar among the three regions, data obtained in this study indicate that DUI prevention, especially by law enforcement or by the punishment of offenders, which are well-known measures for decreasing DUI in the international literature,[33] remain necessary throughout the country.

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Disclosures

Raquel De Boni
Employment*: Center for Drug and Alcohol Research of the Hospital das Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Brazil.*
Lisia von Diemen
Employment*: Center for Drug and Alcohol Research of the Hospital das Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Brazil.*
Paulina do Carmo Arruda Vieira Duarte
Employment: *Secretaria Nacional de Políticas sobre Drogas (Brazilian Secretariat for Drug Policies), Brazil.*
Daniela Benzano Bumaguin
Employment*: Center for Drug and Alcohol Research of the Hospital das Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Brazil.*
Juliana Balbinot Hilgert
Other*: Postgraduate Program of Epidemiology, Universidade Federal do Rio Grande do Sul, Brazil.*
Mary Clarisse Bozzetti
Other*: Postgraduate Program of Epidemiology, Universidade Federal do Rio Grande do Sul, Brazil.*
Anne Sordi
Employment*: Center for Drug and Alcohol Research of the Hospital das Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Brazil.*
Flavio Pechansky
Employment*: Center for Drug and Alcohol Research of the Hospital das Clínicas de Porto Alegre, Universidade Federal do Rio Grande do Sul, Brazil.*
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