

Road traffic injury risk from alcohol and cannabis use among emergency department patients in Argentina

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ABSTRACT

Objective. To report the risk from alcohol, cannabis, and their combined use for non-fatal road traffic injuries for drivers, passengers, and pedestrians.

Methods. Risk was estimated using the case-crossover method. Participants (N= 306) were injured patients from an emergency department in Mar del Plata, Argentina.

Results. Alcohol use (OR= 6.78, CI 95% 3.75-12.25) as well as combined alcohol and cannabis use (OR= 7.05, CI 95% 1.16-42.73) significantly increased the risk of a road traffic injuries. Alcohol use increased the risk in both, women (OR= 8.87, CI 95% 2.69-29.21) and men (OR= 6.16, CI 95% 3.10-12.23); in those >30 years old (OR= 6.01, CI 95% 2.09-17.24) and those <30 years old (OR= 7.15, CI 95% 3.49-14.65). This last group also had an increased risk after combined alcohol and cannabis use (OR= 7.05, CI 95% 1.16-42.75). Both drivers (OR= 6.40, CI 95% 3.23-12.69) and passengers (OR= 13.83, CI 95% 2.87-66.42) had an increased risk after alcohol consumption.

Conclusions. To our knowledge, these are the first estimates of the risk of having a road traffic injury after alcohol and cannabis consumption in one of the countries of the Southern Cone (Argentina, Chile, and Uruguay). These results highlight the urgent need to implement and enforce comprehensive alcohol control measures. Furthermore, given the global trend towards legalizing cannabis for recreational use, our results could also inform policymakers to enact or amend impaired driving laws.

Keywords

Alcohol drinking; cannabis; accidents, traffic; risk; Argentina.

A large percentage of deaths worldwide are due to road traffic injuries (RTI), ranking eighth among the causes of death globally (1). In the Americas, the mortality rate is 15.6%, and it is even higher in the Southern Cone (2). The Southern Cone is a geographical and cultural region in the southern part of South America and includes the countries nearest to the Antarctic area: Argentina, Chile, and Uruguay. In Argentina, road traffic crashes are the leading cause of death among those 15 to 34

years; however, only 5% of these injuries result in a fatality, and most of those injured have non-fatal injuries (3).

Among factors accounting for a higher rate of death and injuries in the country are human behaviors such as alcohol and other substance use (3). While the worldwide annual per capita consumption is 6.4 liters of pure alcohol, in the Americas it rises to 8 liters, and it is even higher in the Southern Cone, where the three countries show a typical wet drinking culture. This means

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that alcohol drinking is widely accepted, per capita consumption is high, and abstention rates are low (1).

The causal role of alcohol in RTI has been well established in the literature (4). However, the magnitude of the risk has been shown to vary. This heterogeneity could be attributed to individual and societal drinking characteristics, such as drinking patterns, drinking context (e.g., drinking in public venues), and other environmental factors such as alcohol control measures (5-7). Little data have been collected among countries from the Southern Cone. To the authors' knowledge, there have been only two studies of alcohol and RTI (as well as all causes of injury) in the Southern Cone, both carried out in 2001 in Mar del Plata, Argentina. One was part of the Emergency Room Collaborative Alcohol Analysis Project (ERCAAP), and the other of the WHO Collaborative Study on Alcohol and Injuries, and both, in turn, part of the International Collaborative Alcohol and Injury Study (ICAIS) (8,9). These studies showed a threefold increase in the risk for an RTI among those who self-reported alcohol use in the six hours prior to the event (10). However, epidemiological surveillance has shown an increase in driving under the influence of alcohol in the last years (11), and governmental data (12) indicates more than 10% of drivers have blood alcohol levels over the legal limit (0.5g/l). Additionally, in recent years there has been a rapid growth in the circulation of motor vehicles (especially motorcycles) (3). These factors highlight the need for new risk estimations of RTIs from alcohol.

Among illicit substances, cannabis is the most often used globally, and its consumption in the Americas has been increasing in recent years (13). Although experimental data show cannabis use may impair driving, epidemiological studies are not yet common. Results from high-income and northern hemisphere countries (such as Canada and Switzerland) have shown no increase in risk for all types of injury from cannabis use (14,15). A recent article presenting results from the same multicentric study as the one we present here also showed no increased risk for cannabis use but an augmented risk for the simultaneous use of alcohol and cannabis (16).

Individual characteristics, such as age and gender, could increase the risk of being involved in a road traffic crash under the effect of alcohol or cannabis. In general, young people are most likely to have an RTI (1). Also, they tend to report higher use of both alcohol and cannabis (1,13). Similarly, men are more likely to be involved in an RTI than women (1) and to report a higher consumption of alcohol (1). It is interesting to note, however, that in the Southern Cone, young women, as well as men, have a much higher DALYs (Disability-Adjusted Life Years) rate due to alcohol use than the global rate (17).

Although it is known that pedestrians are more vulnerable to RTI involving alcohol, most investigations have reported data from drivers who drink alcohol (1). Both alcohol and cannabis consumption could increase the risk of an RTI for non-drivers such as passengers and pedestrians since these substances can lead to impaired decisions regarding safety behaviors (e.g., not wearing a seat belt or helmet for passengers or crossing the street with a red light or without looking for oncoming cars for pedestrians). A significant proportion of injuries occur among pedestrians who walk under the effect

of alcohol (18) and intoxicated passengers (16) who distract the driver (1).

We hypothesize that risk will be increased for alcohol and combined use of alcohol and cannabis for all demographic subgroups, but risk will not be elevated for cannabis use alone. Accurate and timely data (for, as an example, establishing the alcohol-attributable burden) are necessary to inform public policies and assign resources for Southern Latin America.

The purpose of this study is to estimate the risk from alcohol and cannabis use for non-fatal RTI in an Argentinean city by gender and age and separately for drivers, passengers, and pedestrians.

METHODS

This case-crossover study was part of the Multi-Site Collaborative Study on Alcohol, Drug Use, and Road Traffic Injuries in Emergency Departments (16), conducted in a large public general hospital in Mar del Plata, Argentina, and followed protocols previously used in emergency departments (ED) studies in the International Collaborative Alcohol and Injury Study (ICAIS) (9).

Setting

Data were collected on all RTI patients who attended the emergency department (ED) of the Hospital Interzonal General de Agudos Oscar Alende (Mar del Plata, Argentina), around-the-clock (24 hours a day, 7 days a week) between December 2019 and March 2020. After obtaining informed consent, trained interviewers (psychologists, physicians, and advanced psychology or health sciences students) administered a structured 35-minute computerized questionnaire that included items related to the role of the patient in the RTI (driver, passenger pedestrian), drinking, and cannabis use within 6 hours prior to the event, and drinking and cannabis use during the same 6-hour period for each of the 7 days preceding the event. The interviews were anonymous, and the data were kept confidential. The study was approved by the Ethical Review Committee of the Oscar Alende General Hospital, Mar del Plata, Argentina.

Participants

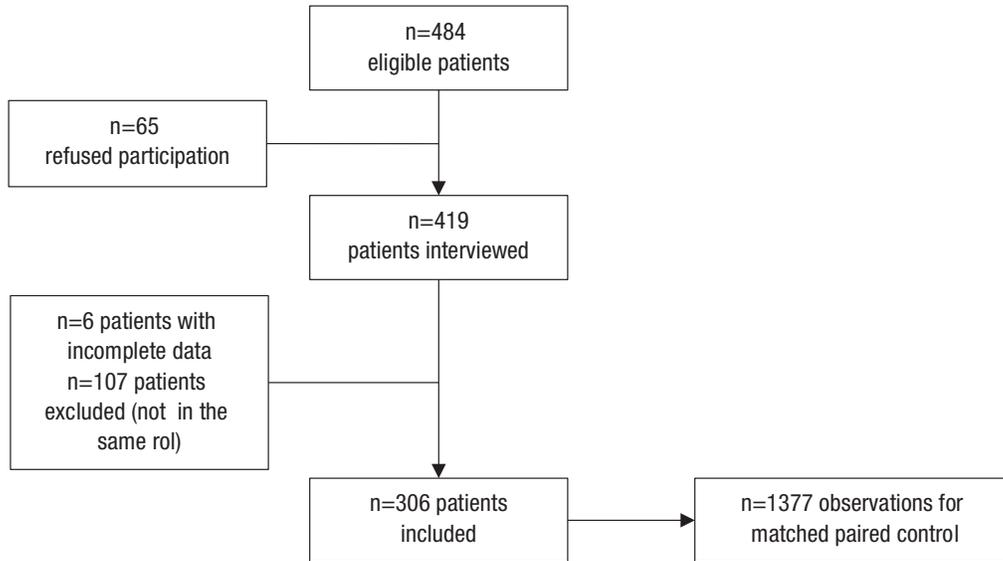
The inclusion criteria were: 1) being over 18 years old, 2) being in an RT crash/collision as a driver, passenger, or pedestrian, 3) arriving at the ED within the 6 hours after the crash or collision, and 4) providing informed consent to participate in the study.

Variables

Alcohol use was measured through self-report of drinking during the 6 hours prior to the RTI: "During the 6 hours before the RTI, did you consume alcohol?" *Cannabis use* was also measured through self-report of use during the 6 hours prior to the RTI: "During the 6 hours before your road traffic injury, did you consume any type of cannabis?"

Patients were then asked whether they had been in the same role (driver, passenger, pedestrian) on each of the 7 days before the RTI: "You said you were a [driver/passenger/pedestrian]

FIGURE 1. Participant flow diagram, injured patients, Mar del Plata, Argentina, 2020



and that your RTI occurred at [reported time]. Think of yesterday at the same time, were you also a [driver/passenger/pedestrian] at that time?" If patients answered "yes", they were asked, "Did you drink alcohol in the 6 hours before being a [driver/passenger/pedestrian]?" They were then asked the same question about *cannabis use* during that time. The same procedure was followed for each of the six other days preceding the RTI.

Statistical methods

We performed descriptive analysis for both the RTI patient and their paired controls. The measures were: alcohol use (yes=2, no=1), cannabis use (yes=2, no=1), and combined use of alcohol and cannabis (yes=2, no=1). Therefore, to estimate the risk of being injured (outcome= no=1, yes=2), Cox's regressions were made with each consumption measure considered as separated predictors and the identification of each patient as paired. Separate analyses were run for the total sample, and then by gender (women or men), age (less than 30 or more than 30 years old), and role (driver, passenger, or pedestrian), using the clogit function of the 'survival' package from the R 3.6.1. Software (19). Missing data were deleted listwise (n=6).

RESULTS

Participants

Among those admitted to the ED during the study period, 484 patients met the inclusion criteria. Of these, 65 refused to participate (response rate 83.4%). Patients who were not in the same role any of the seven days prior to the RTI were excluded (n=107) since the paired control matched for activity could not be obtained. Patients with mostly incomplete data were excluded (n=6). The final sample consisted of 306 patients in the injured group and n=1377 observations for the matched paired

control group, that is, the same patients in the same role as the one which that they were engaged at the time of the RTI during the same hour range, on any of the seven days before the event (Figure 1).

Descriptive data

Most participants were male, and more than half were less than 30 years old. A large majority of the patients (73%) were at the ED after being injured as drivers, while only a quarter of the sample consisted of passengers and pedestrians (Table 1).

Table 2 describes alcohol, cannabis, and the combined use of alcohol and cannabis in the 6 hours before the RTI and the control periods. As shown, 14% of patients reported drinking in the six hours before the event that caused the injury, 5% reported cannabis use in the six hours before the event, and an additional 2% reported simultaneous use of alcohol and cannabis.

TABLE 1. Description of injured patients (N=306), Mar del Plata, Argentina, 2020

	N (%)
Gender	
Women	98 (32)
Men	208 (68)
Age	
Less than 30 years	156 (51)
More than 30 years	150 (49)
Role	
Driver	224 (73)
Passenger	44 (14)
Pedestrian	38 (12)

Source: prepared by the authors from the results.

TABLE 2. Alcohol, cannabis use and combined use in injured patients before the event and in the control periods, Mar del Plata, Argentina, 2020

	Injured patients before the event (N=306)		Control periods (N=1377)	
	n (%)	CI 95%	n (%)	CI 95%
Alcohol use				
Yes	44 (14)	10-18	56 (4)	3-5
No	262 (86)	82-89	1321 (96)	95-97
Cannabis use				
Yes	16 (5)	3-8	52 (4)	3-5
No	290 (95)	92-97	1325 (96)	95-97
Combined alcohol and cannabis use				
Yes	7 (2)	1-4	14 (1)	1-2
No	299 (98)	95-99	1363 (99)	98-99

Source: prepared by the authors from the results. CI, confidence intervals.

Main results

Table 3 shows risk estimates for an RTI after alcohol and cannabis use (alone and combined) in the 6 hours before the event. Results show that either alcohol alone or alcohol and cannabis combined use increased at least six times the odds of suffering an RTI. Alcohol use significantly increased the risk of having an RTI for women (p < 0.01, OR 8.87, CI 95% 2.69-29.21) as well as for men (p < 0.01, OR 6.16, CI 95% 3.10-12.23), while risk for combined use was only significantly elevated for men. When risk was analyzed by age, alcohol use increased the risk of having an RTI among both, those over 30 years (p < 0.01, OR 6.01, CI 95% 2.09-17.24) and those under 30 years (p < 0.01, OR 7.15, CI 95% 3.49-14.65). Moreover, this latter group showed an increased risk of injury for the simultaneous use of alcohol and cannabis (p < 0.05, OR 7.05, CI 5% 1.16-42.73). When risk was analyzed by role, alcohol use significantly increased the risk of having an RTI among drivers (p < 0.01, OR= 6.40, CI 95% 3.23-12.69) and passengers (p < 0.01, OR= 13.83, CI 95% 2.87-66.42), but not for pedestrians.

DISCUSSION

This study estimated the risk of having a non-fatal injury after being involved in a road traffic incident while under the effects of alcohol and/or cannabis. Findings suggest our hypotheses

were only partially borne out. Alcohol use increased the risk of having an RTI for men and women. While alcohol use elevated the risk for both those under 30 and those older, the combined use of alcohol and cannabis resulted in elevated risk only for those under 30. Drivers and passengers showed an elevated risk for alcohol alone but not for combined use, while pedestrians showed no elevated risk for alcohol or cannabis use, single or combined.

The proportion of patients who self-reported alcohol or cannabis use in the six hours before the RTI is similar to data found in a previous study from Peru and the Dominican Republic (16). Compared to that study, we also found a similar risk of RTI after the combined use of alcohol and cannabis and no significant increased risk after only cannabis use. However, the almost 7-fold increase (OR=6.78) in risk of injury after alcohol consumption we found here is notably higher than the one in the Peru/Dominican Republic study (OR=2.41). This is also higher than the estimate found in a secondary analysis of RTI across several countries in the region (OR=5.0) (8), in a European study (OR=3) (14), and an African study (OR=5.3) (20).

Overall, alcohol or alcohol and cannabis combined use increased about six times the odds of an RTI. This finding aligns with a previous study performed 20 years ago in the same site (10) but shows a markedly higher risk. This increased risk could be due to the increased number of vehicles in circulation, especially motorcycles (3), the increase in the number of people reporting drinking and driving (11), and the increase in heavy episodic drinking among youth (11) that follows the increase in marketing strategies from the alcohol industry (21,22).

Although overlapping confidence intervals preclude us from concluding which gender, age, and traffic role group is at a higher risk, some inferences can be made. Regarding gender, we found that both women and men were at an increased risk of having an RTI after alcohol consumption, unsurprisingly given the rise of heavy episodic drinking among women in Argentina (11). Likewise, participants older and younger than 30 years old had a similar risk of having an RTI after alcohol consumption. However, they appear to differ in the risk of an RTI after the combined use of alcohol and cannabis. Specifically, we found a seven fold increase in risk for those under 30 years old and no risk for those over that age. This difference could be attributed to diverse cannabis consumption patterns. Given the global trend towards legalizing the recreational use of cannabis, our results could inform policymakers, not only for the enactment or amendment of impaired driving laws, but for

TABLE 3. Conditional regressions to predict the risk of having a Road Traffic Injury after alcohol and cannabis use in the 6 hours prior to the event, Mar del Plata, Argentina, 2020

	Total		Gender				Age				Role					
			Women		Men		<30		>30		Driver		Passenger		Pedestrian	
	OR	CI 95%	OR	CI 95%	OR	CI 95%										
Alcohol	6.78**	3.75-12.25	8.87**	2.69-29.21	6.16**	3.10-12.23	7.15**	3.49-14.65	6.01**	2.09-17.24	6.40**	3.23-12.69	13.83**	2.87-66.42	1.75	0.14-22
Cannabis	1.75	0.64-4.74	0.24	0.02-2.07	2.85	0.94-8.6	1.70	0.58-5.02	2.03	0.16-25.74	1.94	0.61-6.16	2.30	0.25-20.98	NA	NA
Combined alcohol and cannabis	7.05*	1.16-42.73	NA	NA	4.3	0.65-28.54	7.05**	1.16-42.75	NA	NA	1.45	0.65-28.54	NA	NA	NA	NA

Source: prepared by the authors from the results. OR, odds ratio; CI, confidence interval; NA, not applicable. **p<0.01 *p<0.05

comprehensive policies regarding cannabis use and the mitigation of its possible harms.

Like Cherpitel and colleagues (16) in Peru and the Dominican Republic, we found that drivers and passengers had an increased risk of injury after alcohol consumption, while pedestrians did not. However, in our results, the magnitude of the risk was substantially greater than that for those two countries. Although unsurprising, since Argentina has a higher prevalence of drinkers and a higher per capita consumption, this finding should underscore the importance of enforcement of drinking and driving laws and other policies to reduce drinking.

Despite the constraint posed by the wide confidence interval, the increased risk for passengers is substantial and noteworthy, as there are no public measures aimed at preventing the harm of alcohol among passengers. The role of alcohol in an RTI as a passenger might be due to passengers consuming more alcohol or not caring about being drunk at the moment of getting into a vehicle, since they are not responsible for driving, while at the same time distracting the driver (23), or not using safety measures (e.g., helmet or seat belt) increasing the risk of being injured if involved in a RTI. Further endeavours should elucidate the mechanisms behind this finding.

Some limitations of this study need to be addressed. First, few participants used cannabis (n=16) or combined alcohol and cannabis (n=7) six hours before the RTI, resulting in wide confidence intervals and no data in some cells. A larger sample size would have allowed more precise estimates. Second, the quantity of both alcohol, and cannabis consumption, was not taken into account and would be expected to affect the risk of injury in a dose-response manner (24), that is the more of a substance used the greater the risk of an RTI. Also, prior research found that those who drink and use cannabis before the injury are more likely to drink more during the six hours before the event than those who did not combine cannabis and alcohol (25). Results here are considered representative of those of the city in which the data were collected, as the sample was taken from the only ED in the city receiving, by law, all traffic injuries, but may not be representative of other cities or countries. In the same sense, non fatal injuries requiring medical care may not be representative of less severe injuries, or more several injuries (fatal). Last, although the use of a case-crossover design controls for stable confounders (such as impulsivity, driving experience and other personal traits), residual confoundings, such as social desirability bias affecting self report, or other transitory factors, such as weather at the time of the crash and road conditions might have affected our findings.

Conclusions

We found alcohol use as well as combined alcohol and cannabis use significantly increased the risk of a road traffic injury. Alcohol use increased the risk in both women and men; in those >30 years old and those <30 years old. This last group also had an increased risk after combined alcohol and cannabis use. Both drivers and passengers had an increased risk after alcohol consumption.

These are, as far as we know, the first estimates of the risk of having an RTI after alcohol and cannabis consumption in one of the Southern Cone countries. Given the global trend towards legalizing cannabis for recreational use, our results could inform policymakers not only to enact or amend impaired driving laws, but also to consider how the evolving policy landscape regarding cannabis might affect the use of or harms from alcohol. Furthermore, our finding of a substantial rise in the risk of an RTI after alcohol consumption from the year 2001 to the present, and the magnitude of the risk for both drivers and passengers, highlights the urgency to implement and enforce comprehensive alcohol control measures in Argentina.

Author contributions. MM and CC conceived the original idea and designed the study. RIP, MC, GS, PVG and TS collected the data. KC analyzed the data. All authors interpreted the results. KC, MC, PVG and TS wrote the paper's draft. All authors reviewed the paper, contributed with ideas and approved the final version.

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Conflicts of interests. None declared.

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Riesgo de lesiones por accidentes de tránsito debido al consumo de alcohol y cannabis en pacientes de urgencias en Argentina

RESUMEN

Objetivo. Informar sobre el riesgo lesiones por accidentes de tránsito debido al consumo de alcohol, cannabis o su combinación en conductores, pasajeros y peatones.

Métodos. Se estimó el riesgo mediante el método de casos cruzados. Los participantes (N = 306) fueron pacientes que habían sufrido lesiones, provenientes de una sala de urgencias en Mar del Plata (Argentina).

Resultados. El consumo de alcohol (OR = 6,78, IC95% 3,75-12,25), así como el consumo combinado de alcohol y cannabis (OR = 7,05, IC95% 1,16-42,73) aumentaron significativamente el riesgo de traumatismos por accidentes de tránsito. El consumo de alcohol aumentó el riesgo tanto en mujeres (OR = 8,87, IC95% 2,69-29,21) como en hombres (OR = 6,16, IC95% 3,10-12,23); así como en mayores de 30 años (OR = 6,01, IC95% 2,09-17,24) y en menores de 30 años (OR = 7,15, IC95% 3,49-14,65). Este último grupo también tuvo mayor riesgo tras un consumo combinado de alcohol y cannabis (OR = 7,05, IC95% 1,16-42,75). Tanto los conductores (OR = 6,40, IC95% 3,23-12,69) como los pasajeros (OR = 13,83, IC95% 2,87-66,42) presentaron mayor riesgo después del consumo de alcohol.

Conclusiones. Hasta donde sabemos, estas son las primeras estimaciones del riesgo de sufrir lesiones por accidentes de tránsito tras el consumo de alcohol y cannabis en uno de los países del Cono Sur (Argentina, Chile y Uruguay). Estos resultados ponen de relieve la urgente necesidad de aplicar y hacer cumplir medidas integrales de control del alcohol. Además, dada la tendencia mundial hacia la legalización del cannabis para consumo recreativo, nuestros resultados también podrían orientar a los responsables de las políticas para que promulguen o enmienden las leyes sobre la conducción con capacidades alteradas debido al consumo de sustancias.

Palabras claves Consumo de bebidas alcohólicas; cannabis; accidentes de tránsito; riesgo; Argentina.

Risco de lesões no trânsito devido ao uso de álcool e cannabis entre pacientes atendidos em um pronto-socorro na Argentina

RESUMO

Objetivo. Relatar o risco de lesões não fatais no trânsito atribuível ao álcool, à cannabis e a seu uso combinado para motoristas, passageiros e pedestres.

Métodos. O risco foi estimado usando o método clínico cruzado (*case-crossover*). Os participantes (N=306) eram feridos atendidos em um pronto-socorro em Mar del Plata, Argentina.

Resultados. O uso de álcool (OR = 6,78, IC95% 3,75; 12,25) e o uso combinado de álcool e cannabis (OR= 7,05, IC95% 1,16; 42,73) aumentaram significativamente o risco de lesões no trânsito. O uso de álcool aumentou o risco tanto em mulheres (OR = 8,87, IC95% 2,69; 29,21) quanto em homens (OR = 6,16, IC95% 3,10; 12,23); naqueles >30 anos de idade (OR = 6,01, IC95% 2,09; 17,24) e <30 anos de idade (OR = 7,15, IC95% 3,49; 14,65). Esse último grupo também apresentou um risco maior após o uso combinado de álcool e cannabis (OR = 7,05, IC95% 1,16; 42,75). Tanto motoristas (OR = 6,40, IC95% 3,23; 12,69) quanto passageiros (OR = 13,83, IC95% 2,87; 66,42) apresentaram risco maior após o consumo de álcool.

Conclusões. Até onde sabemos, estas são as primeiras estimativas do risco de lesões de trânsito após o consumo de álcool e cannabis em um dos países do Cone Sul (Argentina, Chile e Uruguai). Os resultados destacam a necessidade urgente de implementar e aplicar medidas abrangentes de controle do álcool. Além disso, considerando a tendência global de legalização da cannabis para uso recreativo, nossos resultados também poderiam ajudar os formuladores de políticas a decretar ou alterar as leis sobre a condução sob efeito de substâncias psicoativas.

Palavras-chave Consumo de bebidas alcoólicas; cannabis; acidentes de trânsito; risco; Argentina.