Use of Cannabis and Alcohol by patients diagnosed with trauma in a Health Emergency Unit

Uso de Cannabis e Álcool por pacientes com diagnóstico de trauma em uma Unidade de Emergência de Saúde

Consumo de Cannabis y Alcohol por parte de pacientes diagnosticados de trauma en una Unidad de Emergencia

Kleber Ota de Oliveira
ORCID: https://orcid.org/0000-0001-9982-5798
State University of Maringa, Brazil
E-mail: kleberota@hotmail.com
Jessica Yuri Sakurada
ORCID: https://orcid.org/0000-0002-0875-9439
State University of Maringa, Brazil
E-mail: sakuradajessica@gmail.com
Deborah Thais Palma Scanferla
ORCID: https://orcid.org/0000-0001-7715-724X
State University of Maringa, Brazil
E-mail: deborahscanferla@gmail.com
Mariana Aparecida Oliveira Madia
ORCID: https://orcid.org/0000-0002-5493-2351
State University of Maringa, Brazil
E-mail: mari.madia@hotmail.com
Renata Sano Lini
ORCID: https://orcid.org/0000-0002-6161-2225
State University of Maringa, Brasil
E-mail: renatalini23@gmail.com
Marcia Regina Jupi Guedes
ORCID: https://orcid.org/0000-0002-2480-0438
State University of Maringa, Brazil
E-mail: mrjupi@yahoo.com.br
Érika Bando
ORCID: https://orcid.org/0000-0002-5828-8073
State University of Maringa, Brazil
E-mail: ebando@gmail.com
Magda Lúcia Félix de Oliveira
ORCID: https://orcid.org/0000-0003-4095-9382
State University of Maringa, Brazil
E-mail: mlfoliveira@uem.br
Jorge Juarez Vieira Teixeira
ORCID: https://orcid.org/0000-0001-7719-5350
State University of Maringa, Brazil
E-mail: jjvteixeira@uem.br
Simone Aparecida Galerani Mossini
ORCID: https://orcid.org/0000-0001-9535-0983
State University of Maringa, Brasil
E-mail: sagmossini@uem.br

Abstract
There are few data on the association of physical trauma and consumption of psychoactive substances. *Objective:* To investigate the use of marijuana and alcohol by trauma victims becomes important to subsidize prevention actions. *Methods:* 299 willingly given samples from individuals hospitalized in the years 2015-2017 due to trauma associated to the use of drugs of abuse were analyzed; the individuals were considered user of drugs of abuse either due to medical diagnosis or to self-reporting. Biological samples from the patients were first trialed for *Cannabis*; confirmation of cannabis use was performed via gas chromatography-mass spectrometry. Alcoholaemia was also investigated. *Results:* Males made up the majority of the assessed subjects (91.4%), their average age being 40 years. The major causes for trauma included traffic accidents (46.82%) followed by violence/aggression (26.77%).

Toxicological trialing for cannabis resulted in 14.72% positive samples and alcoholaemia varied between 9.38 to 17.85%. *Conclusion:* The abusive use of *Cannabis* is a risk factor for accidents and violence leading to traumatic injuries. The age range between the second and fourth decade of life and the automotive steering were relevant predictors for the use of *Cannabis*. Epidemiological studies provide important information to support preventive measures, considering the scarcity of studies on this theme.
Keywords*: Cannabis*; Injuries; Accidents; Violence.

Resumo

Existem poucos dados sobre a associação de trauma físico e consumo de substâncias psicoativas. *Objetivo:* Investigar o uso de maconha e álcool por vítimas de trauma torna-se importante para subsidiar ações de prevenção. *Metodologia:* foram analisadas 299 amostras voluntariamente de indivíduos hospitalizados nos anos de 2015 a 2017, devido a trauma associado ao uso de drogas de abuso; os indivíduos foram considerados usuários de drogas de abuso, seja por diagnóstico médico ou por autorrelato. Amostras biológicas dos pacientes foram primeiramente testadas para *Cannabis; a* confirmação do uso de *Cannabis* foi realizada através de cromatografia gasosa-espectrometria de massa. A alcoolemia também foi investigada. *Resultados:* Os homens compuseram a maioria dos sujeitos avaliados (91,4%), com idade média de 40 anos. As principais causas de trauma incluem acidentes de trânsito (46,82%) seguidos de violência / agressão (26,77%). O teste toxicológico para *Cannabis* resultou em 14,72% de amostras positivas e a alcoolemia variou entre 9,38 e 17,85%. *Conclusão:* O uso abusivo de *Cannabis* é um fator de risco para acidentes e violências, levando a lesões traumáticas. A faixa etária entre a segunda e a quarta década de vida e a direção automotiva foram preditores relevantes para o uso de *Cannabis* Estudos epidemiológicos fornecem informações importantes para subsidiar medidas preventivas, considerando a escassez de estudos sobre esse tema.
Palavras-chave: *Cannabis*; Lesões; Acidentes; Violência.

Resumen

Hay pocos datos sobre la asociación de trauma físico y consumo de sustancias psicoactivas. *Objetivo:* Investigar el uso de marihuana y alcohol por víctimas de trauma se vuelve importante para subsidiar acciones de prevención. *Metodología*: se analizaron 299 muestras entregadas voluntariamente de personas hospitalizadas en los años 2015-2017 por trauma asociado al uso de drogas de abuso; los individuos fueron considerados usuarios de drogas de abuso ya sea por diagnóstico médico o por autoinforme. Primero se probaron muestras biológicas de los pacientes para detectar *Cannabis*; la confirmación del consumo de *Cannabis* se realizó mediante cromatografía de gases-espectrometría de masas. También se investigó la alcoholemia. *Resultados:* Los varones constituyeron la mayoría de los sujetos evaluados (91,4%), siendo su edad promedio de 40 años. Las principales causas de trauma incluyeron los accidentes de tráfico (46,82%) seguidos de la violencia/agresión (26,77%). Las pruebas toxicológicas para el cannabis dieron como resultado un 14,72 % de muestras positivas y la alcoholemia varió entre el 9,38 y el 17,85 %. *Conclusión:* El uso abusivo de *Cannabis* es un factor de riesgo de accidentes y violencia que conduce a lesiones traumáticas. El rango de edad entre la segunda y cuarta década de la vida y el manejo del automóvil fueron predictores relevantes para el consumo de cannabis. Los estudios epidemiológicos proporcionan información importante para apoyar las medidas preventivas, considerando la escasez de estudios sobre este tema.
Palabras clave: *Cannabis*; Lesiones; Accidentes; Violencia.

1. Introduction

The abuse of drugs is both a health and social issue in Brazil, which negatively impacts society and families and leads to acts of violence by the users and to their hospitalization due to traumas and intoxications, overbearing the Unified Health System (Sistema Único de Saúde in Portuguese, Brazilian major public health government organization, abbreviated as SUS). Such problems demand attention (Chitas et al., 2014).

In Brazil, traffic accidents and violence are the major external causes for trauma, morbidity and mortality (Mascarenhas & Barros, 2015). Data from The National Road Safety Observatory state that 400 thousand people become victims of traffic accidents every year in Brazil – 47 thousand of them leading to deaths – and a great deal of financial resources designated for public health end up used for rehabilitation of individuals injured due to such traffic accidents. Also, the majority of these victims are often at work age, which leads to even more negative impact to society as a whole (Falconi, 2017).

Cannabis is the most consumed drug in the world. In Brazil, even though illegal, such scenario is not different. Data from reports published by the Research Unit on Alcohol and Drugs (UNIAD) state that cannabis is the illegal substance most

consumed in Brazil; 5.8% of the adult population report having used cannabis at least once in life and 2.5% report having used cannabis at least once in 2012 (Laranjeira et al., 2012). Consumption of Cannabis is associated with physical and psychological alterations that become risk factors for the occurrence of traumas (Abreu et al., 2016).

Toxicological analyses involve trialing and confirmation techniques, one of the major ones being gas chromatography coupled to mass spectrometry (GC/MS) (Moreau & Siqueira, 2016). They are fundamental for detection of psychoactive substances when individuals are being tended at urgency and emergency levels, and also provide epidemiological data which can be used for better monitoring of the consumption of drugs in Brazil, considering the scarcity of studies on this theme.

The aim of this study was to investigate the consumption of Cannabis and alcohol by patients hospitalized in an emergency health unit who have been hospitalized due to trauma using trialing and confirmation techniques.

2. Methodology

The present research is a retrospective epidemiological study involving toxicological analyses. This study is part of a larger project named "Epidemiologic monitoring of intoxications caused by drugs of abuse: investigation of sentinel events via epidemiological, clinical and laboratorial criteria" – Research Program for the Unified Health System: Shared Management in Health, which was approved by the Ethics Committee for Research on Humans of the State University of Maringá (COPEP/UEM), n° 458.185.

This is a retrospective transversal cohort study, with a qualitative and quantitative approach. This study followed the methodological recommendations described by Severino et al (2018). Results were obtained from secondary data and toxicological analyzes.

2.1 Studied population

The studied population was selected based on convenience sampling, as subjects were chosen according to sentinel events reports obtained via epidemiological monitoring programs (Rutstein et al., 1976). Sentinel events considered valid for the study amounted to "individuals diagnosed with trauma in association (or possibly associated) with intoxication due to abuse of drugs", hospitalized' in an urgency and emergency health unit at the University Hospital of Maringá (HUM).

The studied population comprised individuals of both genders aged older than 18 that have been diagnosed with trauma in association with use of drugs that have been hospitalized in the University Hospital of Maringá from 2015 to 2017. The cases were notified to the local Centre for Control of Intoxications (CCI/HUM), either spontaneously or via active monitoring which is carried out daily at the urgency/emergency units of the hospital.

2.2 Source of data

Information on the hospitalized patients was used as the major source of data, which included the Report on Toxicological Event involving ethanol and/or other drugs of abuse (OT/IA) from the CCI/HUM alongside patient information sheets.

The variables preditoras associated with individual characteristics, circumstances of the accidents and conditions of post-accident hospitalization were compiled in electronic datasheets using *Microsoft Office Excel 10.0.*

2.3 Statistical Analysis

Data were analyzed using Stata version 9.0® (Stata Corporation, College Station, TX, USA). The chi-square test was used assuming statistical significance when $p<0.05$ for univariate analysis. Odds/ratio (OR) and Confidence Interval (CI) were

used for univariate analysis and for logistic regression. Only variables of p values < 0.20 were considered for logistic regression analysis. The predictor variables were adjusted for the final analyses.

2.4 Laboratorial investigation

Biological samples obtained from the assessed subjects were used for toxicological trialing of cannabis and alcoholaemia. Collection of samples was carried out by trained technicians of the Laboratory of Clinical Analyses of the University Hospital of Maringá. Urine for analysis of cannabis was obtained via spontaneous urination, which was then placed in sterile collection flasks. Blood samples for analysis of alcoholaemia were obtained via venous puncture and assessed for ethanol using a Vitros Analyzer 250 (Johnson & Johnson Company®).

Toxicological analyses for assessment of alcoholaemia, trialing and confirmation of cannabis were performed at the Laboratory of Toxicology of the State University of Maringá. Trialing for cannabis was carried out via immunochromatography in urine for qualitative assessment of drugs (RapidTox, AmericaBiomedica®), according to manufacturer specifications. Urine samples of positive result during trialing for cannabis were further analyzed for confirmation using a GC/MS apparatus DSQ II, with a gas chromatography column HP-5MS and injector Triplus AS (Thermo Scientific®).

3. Results

In the period ranging from 2015 to 2017, the emergency unit of the University Hospital of Maringá tended to 299 cases of trauma. There were 96, 91 and 112 cases in the years of 2015, 2016 and 2017, respectively. For all 299 trauma victims quick tests were performed for cannabis trialing, and 44 samples were positive for cannabis. Further confirmation analyses were performed via GC-MS; two samples (one collected in 2015, and the other in 2016) were not confirmed positive when analyzed via GS/MS. Patient data are show in Table 1.

Table 1 - Data of patients hospitalized due to trauma at the University Hospital of Maringá in years 2015 – 2017, Maringá-PR.

Variable		Frequency n(%)
Gender	Male	275 (91.97)
	Female	24 (8.03)
Age	13-25	59 (19.73)
	26-45	115 (38.46)
	>46	125 (41.80)
Years of education	≤ 8 years	153 (51.17)
	> 8 years	76 (25.42)
	Unknown	70 (23.41)
Origin	Maringá	204 (68.23)
	Outskirts	95 (31.77)
Time hospitalized	≤ 24h	36 (12.04)
	> 24h	263 (87.96)
Event	Accident	202 (67.56)
	Violence/aggression	84 (28.09)
	Unkown	13 (4.35)
Cannabis*	Positive	42 (14.05)
	Negative	257 (85.95)
Alcoholaemia	Positive	37 (12.37)
	Negative	253 (84.62)
	Unkown	9 (3.01)

Source: Authors *Biological sample: urine.

Males made up the majority of individuals hospitalized (91.97%). Most of the subjects were aged under 46 (58.19%). The majority of the patients reported having had formal education for less than 8 years (51.17%). A significant percentage of the patients (23.41%) did not report the educational level, then it was not possible to include this variable in the statistical analyzes. As for patient origin, most reported being from the city of Maringá (68.23%), and most remained hospitalized for more than 24h in the University Hospital of Maringá (87.96%). The main reason for hospitalization was trauma due to accidents (67.56%), including falls and traffic accidents, followed by violence/aggression (28.56%). Of the 299 patients assessed, 42 (14.05%) of them were positive for cannabis and blood samples from 37 (12.37%) of them were positive for alcohol.

Table 2 shows the univariate analysis. There was no significant difference in cannabis use between males and females ($p = 0.820$) and patient origin ($p = 0.631$). However, the use of cannabis presented statistical significance for age, hospitalization time and event. As for alcohol, no variable in any analysis led to any kind of significant result.

Table 2 - Univariate analysis of data from patients hospitalized due to trauma in the HUM from 2015 to 2017, Maringá-PR.

	Predictor variable	*Cannabis* Positive n(%)	Negative n(%)	Univariate analysis OR (95% IC)	p-value	Alcoholaemia > 10mg/dL Positive n(%)	Negative n(%)	Univariate analysis OR (95% IC)	p-value
Gender	Masculino	39(92.86)	236(91.83)	1.16 (0.33-4.06)	0.820	35(94.59)	231(91.30)	1.67(0.37-7.43)	0.498
	Feminino	3(7.14)	21(8.17)	Reference		2(5.41)	22(8.70)	Reference	
Age	13-25	14(33.33)	45(17.51)	**4.01(1.58-10.20)**	**0.002**	10(27.03)	47(18.58)	1.09(0.13-9.24)	0.937
	26-45	19(45.24)	96(37.35)	**2.55(1.09-5.96)**	**0.025**	9(24.32)	103(40.71)	1.72(0.75-3.94)	0.197
	>46	9(21.43)	116(45.14)	Reference		18(48.65)	103(40.71)	Reference	
Origin	Maringá	30(14.71)	174(85.29)	1.19 (0.58-2.45)	0.631	25(67.57)	174(68.77)	1.06(0.50-2.21)	0.883
	Outskirts	12(12.63)	83(87.37)	Reference		12(32.43)	79(31.23)	Reference	
Time	24h	9(21.43)	27(10.51)	**2.32(1.00-5.41)**	**0.044**	6(16.22)	28(11.07)	1.56(0.59-4.07)	0.364
hospitalized	More than 24h	33(78.57)	230(89.49)	Reference		31(83.78)	225(88.93)	Reference	
Event	Accident	21(51.22)	181(73.88)	**2.69 (1.35-5.35)**	**0.003**	23(74.19)	172(69.92)	1.24(0.53-2.90)	0.624
	Violence/Aggression	20(48.78)	64(26.12)	Reference		8(25.81)	74(30.08)	Reference	

Note: Significant OR in bold letters. OR = Odds Ratio; CI = Confidence Interval. Source: Authors.

The variables with statistical significance in the chi-square test were accompanied by confirmation of the adjusted model for logistic regression (Table 3).

Table 3 - Logistic regression analysis of cannabis use by patients hospitalized due to trauma in the HUM from 2015 to 2017, Maringá-PR.

		Cannabis		Multivariate analysis*	
		Positive n(%)	**Negative** n(%)	**OR (95% IC)**	**p-value**
Event	Accidents	21(51.22)	181(73.88)	2.16(1.07-4.35)	0.031
	Violence/Aggression	20(48.78)	64(26.12)	Reference	
Age	13-25	14(33.33)	45(17.51)	1.39(0.61-3.18)	0.435
	26-45	19(45.24)	96(37.35)	2.98(1.16-7.71)	0.024
	>46	9(21.43)	116(45.14)	Reference	
Time hospitalized	24h	9(21.43)	27(10.51)	2.21(1.08-5.52)	0.088
	>24h	33(78.57)	230(89.49)	Reference	

*Adjusted by event, age and time of hospitalization. OR = Odds Ratio; CI = Confidence Interval. Source: Authors**.**

The analysis confirmed that individuals in adulthood (26-45 years) are 1.9 times more likely to use cannabis (OD 2.98, 95%, CI: 1.16-7.71) when compared to other age groups. Regarding the type of trauma, patients who used cannabis were 1.1 times more likely to be hospitalized due to trauma caused by accidents (OR 2.16, 95% CI 1.07-4.35) and were more likely to remain hospitalized for less than 24 hours (OR 2.21 95% CI: 1.08-5.52).

4. Discussion

Physical trauma and use of psychoactive substances are two common health issues in Brazil which affect individuals at work age, harming them at both social and professional levels (Ibiapino et al., 2017; Mascarenhas & Barros, 2015). Males are usually more prone to the abuse of illicit drugs than females and are thus also more likely to be hospitalized in emergency units due to overdose or trauma (Tice, 2017), as also seen in the present study. Males are also more likely to become addicted to illicit drugs or ethanol than females, and such is linked to the fact males are more easily and more often exposed to drugs than females (UNODC, 2018).

A sociodemographic study carried out in Brazil has demonstrated there is a correlation between education level and use of psychoactive substances, the prevalence of use of drugs being higher among individuals with less than 8 years of formal education (Abreu et al., 2016), similarly to what is reported in the present study, suggesting more time of formal education is a protective factor which prevents the use of drugs. We believe the more information one individual has access to, including formal education in schools and universities, the better the comprehension of the harmful effects caused by use of such substances leading to a lifestyle aimed at preserving health and quality of life, avoiding the use of drugs.

In Brazil, most hospitalizations due to external causes involve young adults at productive age (Mascarenhas & Barros, 2015; Ribeiro et al., 2014), reducing the power of the national workforce and burdening health care systems.

A study on causes of hospitalizations in emergency units in Brazil reported a prevalence of 69.6% of hospitalizations caused by falls and/or traffic accidents (Ibiapino et al., 2017), results very similar to the data described in our study, as these events are common causes for hospitalizations.

Other studies carried out outside Brazil involving trauma and use of drugs report the incidence of cannabis use varies from 5,8% to 27% (Bakke et al., 2016; Liakoni et al., 2018), results similar to the ones described in our study. Another study, in Brazil, reported that from samples obtained from 365 fatally injured victims, 14% were positive for cannabis (Andreuccetti et al., 2018).

Traffic accidents remain a great public health issue worldwide. The World Health Organization (WHO) estimates that more than 1.2 million of people die every year due to traffic accident, more than 91% of such deaths taking place in underdeveloped countries (WHO, 2016).

It has been reported that the potency of the cannabis commercialized in the past 2 decades has increased (Pharm et al., 2016), which is another reason for worry, as the effects caused by its use can be potentialized as well even though the same amount of cannabis is consumed.

For alcoholaemia, concentrations higher than 10 mg/dL can lead to subtle subclinical effects. Concentrations between 30 and 90 mg/dL can lead to euphoria, reduced attention and reduced ability to critically assess situations. Concentrations between 90 and 180 mg/dL cause excitement accompanied by total loss of the ability to critically assess situations, also decreasing the ability to respond to outer stimuli. Concentrations ranging from 180 to 300 mg/dL lead to mental confusion, disorientation, debility, loss of balance and impaired perception (Marinho & F Passagli, 2013). According to Brazilian law (Federal Law 12.760/2012, article 276), driving under the effects of ethanol at blood concentrations higher than 10 mg/dL leads to legal penalties, and driving under the effects of concentrations higher than 6 dg/mL is considered criminal. It is very well established that driving under the effects of alcohol significantly increases the risks for traffic accidents (Zhao et al., 2015), but little is known regarding the influence of other substances on traffic accidents.

Little is known on the simultaneous effects of ethanol and cannabis, but a recent study has demonstrated that the simultaneous use of both substances can increase THC blood concentrations (Hartman et al., 2015), increasing the effects of the cannabis consumed.

Studies on the effects of driving under the influence of cannabis have demonstrated that subjects driving under such conditions have impaired attention and reflexes, increased reaction times and impaired motor and cognitive abilities (Fornari et al., 2016; Hartman, 2014). Other studies have also evidenced there is a greater risk for traffic accidents due to use of cannabis even when there is no ethanol involved, demonstrating cannabis by itself can compromise the ability of individuals to drive safely, causing traffic accidents (Bondallaz et al., 2017).

In our study, the prevalence of cannabis use was even higher than the prevalence for ethanol use among the assessed patients, evidencing cannabis has become as important and frequent as alcohol as a drug of abuse associated with traumas.

Cannabis is the most prevalent substance found in samples obtained from drivers (Banta-Green, 2016; Logan et al., 2018). Studies involving fatal victims or severely injured individuals have demonstrated cannabis as the illicit drug most often found in samples obtained from such individuals in developed countries; the prevalence varies from 1.3% to 25% (Favretto et al., 2018; Håvard et al., 2018; Valen et al., 2017). These data evidence cannabis has become a substance which poses as much risk as alcohol for drivers. A 7-year survey study carried out in Greece, evidenced that cannabis is prevalent in 46,6% of the victims that tested positive for psychoactive substances and were involved in fatal traffic accidents (Papalimperi et al., 2019).

Data from South American countries, such as Brazil, and from other underdeveloped countries are usually scarce or even non-existent. The use of cannabis while driving has become an important cause for traffic accidents. It is important that more studies on this topic be carried out, so more data can be gathered in order to allow government and health care agencies to better develop public policies aimed at increasing consciousness on use of cannabis and driving.

As for violence, a study on the links between violence/aggression and use of drugs has demonstrated that cannabis is the second most often found drug of abuse in samples from patients which had suffered some sort of violence (Liakoni et al., 2018). There are few studies on the use of cannabis and its links to violent events, but as cannabis impairs cognitive abilities, it is expected that its use can cause individuals to more easily engage in violent behaviors (Liakoni et al., 2018; Schoeler et al., 2016). The use of cannabis can cause panic and paranoia, and abstinence can lead to irritability, anger and violent, explosive behavior (Liakoni et al., 2018; Schoeler et al., 2016). Feelings of fear, "loss of control" and panic can also induce violent behavior (Gibson-Smith et al., 2015; Hammersvik, 2015). The use of cannabis also increases heart rates, making individuals more prone to become agitated and act violently (Daniel et al., 2015; Drug Enforcement Agency, 2014).

5. Conclusions

The toxicological analysis allowed to show that the period between the second and fourth decade of life and the automotive steering were configured as relevant predictors for *Cannabis* use. Attention should be focused on the relationship between the consumption of psychoactive substances and occurrence of trauma. The data showed that the probable relationship between the variables cannot be ignored, evidencing that the data of the study are relevant in the Brazilian scenario. Such data are important for public health agencies to better develop strategies aimed at preventing use of drugs and protecting the population from its harmful effects.

Health surveillance systems and toxicological testing allow for the establishment of better public health policies aimed at preventing the abuse of alcohol and *Cannabis*. As a perspective for future work, we intend to implement active methods of epidemiological surveillance, events and sentinel units, that can be used in the formulation of indicators for monitoring care and implementing local public policies.

Ackowledgements

References

Abreu, A. M. M., Parreira, P. M. S. D., Souza, M. H. do N., Barroso, T. M. M. D. de A., Abreu, A. M. M., Parreira, P. M. S. D., Souza, M. H. do N., & Barroso, T. M. M. D. de A. (2016). Profile of Consumption of Psychoactive Substances and Its Relationship To Sociodemographic Characteristics: a Contribution To a Brief Intervention in Primary Health Care, Rio De Janeiro, Brazil. *Texto & Contexto - Enfermagem*, 25(4), 1–9. https://doi.org/10.1590/0104-07072016001450015

Andreuccetti, G., Cherpitel, C. J., Carvalho, H. B., Leyton, V., Miziara, I. D., Munoz, D. R., Reingold, A. L., & Lemos, N. P. (2018). Alcohol in combination with illicit drugs among fatal injuries in Sao Paulo, Brazil: an epidemiological study on the association between acute substance use and injury. *Injury*. https://doi.org/10.1016/j.injury.2018.09.035

Bakke, E., Bogstrand, S. T., Normann, P. T., Ekeberg, Ø., & Bachs, L. (2016). Influence of alcohol and other substances of abuse at the time of injury among patients in a Norwegian emergency department. *BMC Emergency Medicine*, 16(1), 20. https://doi.org/10.1186/s12873-016-0085-2

Banta-Green, C. (2016). Cannabis Use among Drivers Suspected of Driving Under the Influence or Involved in Collisions: Analysis of Washington State Patrol Data. *Foundation for Traffic Safety*. https://aaafoundation.org/cannabis-use-among-drivers-suspected-driving-influence-involved-collisions-analysis-washington-state-patrol-data/

Bondallaz, P., Chtioui, H., Favrat, B., Fornari, E., Giroud, C., & Maeder, P. (2017). On-Road Studies. In Handbook of Cannabis and Related Pathologies. *Elsevier Inc*. https://doi.org/10.1016/B978-0-12-800756-3/00045-4

Chitas, V., Negreiros, J., & Barreira, T. (2014). Uso de drogas, comportamentos sexuais de risco e comportamentos antissociais na adolescência: Padrões de associação. *Psychologica*, 57(2), 73–93. https://doi.org/10.14195/1647-8606_57

Daniel, M., Ekenbäck, C., Agewall, S., Brolin, E. B., Caidahl, K., Cederlund, K., Collste, O., Eurenius, L., Frick, M., Younis-Hassan, S., Henareh, L., Jernberg, T., Malmqvist, K., Spaak, J., Sörensson, P., Hofman-Bang, C., & Tornvall, P. (2015). Risk Factors and Markers for Acute Myocardial Infarction With Angiographically Normal Coronary Arteries. *American Journal of Cardiology*, 116(6), 838–844. https://doi.org/10.1016/j.amjcard.2015.06.011

Drug Enforcement Agency. (2017). Drugs of Abuse: A DEA Resource Guide. US Department of Justice. https://www.dea.gov/sites/default/files/drug_of_abuse.pdf Accessed set. 2022.

Falconi. (2017). Retrato da Segurança Viária 2017 (4th ed.). https://www.ambev.com.br/conteudo/uploads/2017/09/Retrato-da-Segurança-Viária_Ambev_2017.pdf

Favretto, D., Visentin, S., Stocchero, G., Vogliardi, S., Snenghi, R., & Montisci, M. (2018). Driving under the influence of drugs: Prevalence in road traffic accidents in Italy and considerations on per se limits legislation. *Traffic Injury Prevention*, 0(0), 000. https://doi.org/10.1080/15389588.2018.1500018

Fornari, E., Bondallaz P., Favrat B., & Chtioui H. (2016). Cannabis and its effects on driving skills. Forensic Science International. *Forensic Sci Int.* 268, 92-102. https://doi.org/10.1016/j.forsciint.2016.09.007

Gibson-Smith, D., Bot, M., Milaneschi, Y., Twisk, J. W., Visser, M., Brouwer, I. A., & Penninx, B. W. J. H. (2015). Marijuana Use is Associated With Worse Outcomes in Symptom Severity and Violent Behavior. *Journal of Clinical Psychiatry*, 4(September), 4–5. https://doi.org/dx.doi.org/10.4088/JCP.14m09658

Hammersvik, E. (2015). Four barriers and a set of values that prevent violence among cannabis growers. *International Journal of Drug Policy*, 26(3), 290–295. https://doi.org/10.1016/j.drugpo.2014.08.011

Hartman, H. (2014). Cannabis Effects on Driving Skills. *Clinical Chemistry*. 59(3), 1–25. https://doi.org/10.1373/clinchem.2012.194381.Cannabis

Hartman, R. L., Brown, T. L., Milavetz, G., Spurgin, A., Gorelick, D. A., Gaffney, G., & Huestis, M. A. (2015). Controlled cannabis vaporizer administration: Blood and plasma cannabinoids with and without alcohol. *Clinical Chemistry*, 61(6), 850–869. https://doi.org/10.1373/clinchem.2015.238287

Håvard, F., G, J. R. E., Galina, N., Vigdis, V., & Hallvard, G. (2018). Roadside survey of alcohol and drug use among Norwegian drivers in 2016-17: a follow up of the 2008-9 survey. *Traffic Injury Prevention*, 0(0), 000. https://doi.org/10.1080/15389588.2018.1478087

Ibiapino, M. K., Sampaio, B. P., Souza, R. A. R. de, Padoin, F. A., & Couto, V. B. M. (2017). Serviço de atendimento móvel de urgência : epidemiologia do trauma no atendimento pré-hospitalar. 6–9. https://doi.org/10.23925/1984-4840.2017v19i2a5

Laranjeira, R., Pinsky, I., Caetano, R., Mitsuhiro, S. S., & Madruga, C. (2012). II Brazilian National Alcohol and Drugs Survey. UNIAD: Unidade de Pesquisas em Álcool e Drogas. https://inpad.org.br/wp-content/uploads/2014/03/Lenad-II-Relat%C3%B3rio.pdf Accessed sep. 2022.

Liakoni, E., Gartwyl, F., Ricklin, M., Exadaktylos, A. K., & Krähenbühl, S. (2018). Psychoactive substances and violent offences: A retrospective analysis of presentations to an urban emergency department in Switzerland. *PLoS ONE*, 13(3), 1–14. https://doi.org/10.1371/journal.pone.0195234

Logan, B. K., D'Orazio, A. L., Mohr, A. L. A., Limoges, J. F., Miles, A. K., Scarneo, C. E., Kerrigan, S., Liddicoat, L. J., Scott, K. S., & Huestis, M. A. (2018). Recommendations for toxicological investigation of drug-impaired driving and motor vehicle fatalities-2017 update. *Journal of Analytical Toxicology*, 42(2), 63–68. https://doi.org/10.1093/jat/bkx082

Marinho, P., & F Passagli, M. *(2013). Toxicologia Forense - Teoria e Prática. Revista Brasileira de Criminalística, 2(1), 52.* https://doi.org/10.15260/rbc.v2i1.35

Mascarenhas, M. D. M., & Barros, M. B. de A. (2015). Caracterização das internações hospitalares por causas externas no sistema público de saúde, Brasil, 2011. *Revista Brasileira de Epidemiologia*, 18(4), 771–784. https://doi.org/10.1590/1980-5497201500040008

Moreau, R. L. de M., & Siqueira, M. E. P. bastos. (2016). Toxicologia Analítica (2nd ed.). Guanabara Koogan.

Papalimperi, A. H., Athanaselis, S. A., Mina, A. D., Papoutsis, I. I., Spiliopoulou, C. A., & Papadodima, S. A. (2019). Incidence of fatalities of road traffic accidents associated with alcohol consumption and the use of psychoactive drugs : A 7-year survey (2011-2017). *Experimental and Therapeutic Medicine*. 2299–2306. https://doi.org/10.3892/etm.2019.7787

Pharm, S., A, S. F. B., Gon, C., Botany, M. S., D, S. C. P., & James, C. (2016). Changes in Cannabis Potency over the Last Two Decades (1995-2014) - Analysis of Current Data in the United States Short Title Cannabis Potency over the Last Two Decades in USA Department of Computer Science , University of West Georgia ,. *Biological Psychiatry*. https://doi.org/10.1016/j.biopsych.2016.01.004

Ribeiro, M., Perrenoud, L. O., Duailibi, S., Duailibi, L. B., Madruga, C., Marques, A. C. P. R., & Laranjeira, R. (2014). The Brazilian drug policy situation: The public health approach based on research undertaken in a developing country. *Public Health Reviews*, 35(2), 1–32. https://doi.org/10.1007/BF03391706

Rutstein, D. D., Berenberg, W., Chalmers, T. C., Child, C. G., Fishman, A. P., Perrin, E. B., Feldman, J. J., Leaverton, P. E., Lane, J. M., Sencer, D. J., & Evans, C. C. (1976). Measuring the quality of medical care. A Clinical Method. *New England Journal of Medicine*, 294(11), 582–588. https://doi.org/10.1056/NEJM197603112941104

Severino, A. J. (2018). Metodologia do trabalho científico. Ed. Cortez.

Schoeler, T., Theobald, D., Pingault, J., Farrington, D. P., Jennings, W. G., & Piquero, A. R. (2016). Continuity of cannabis use and violent offending over the life course. *Psychol Med.* 46(8):1663–1677. https://doi.org/10.1017/S0033291715003001

Tice, P. (2017). 2016 National Survey on Drug Use and Health: Detailed Tables. Center for Behavioral Statistics and Quality. https://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs-2016/NSDUH-DetTabs-2016.pdf Accessed sep. 2022.

UNODC. (2018). Women and Drugs: Drug use, drug supply and their consequences.

Valen, A., Bogstrand, S. T., Vindenes, V., & Gjerde, H. (2017). Increasing Use of Cannabis among Arrested Drivers in Norway. *Traffic Inj Prev*. 17;18(8):801-806. https://doi.org/10.1080/15389588.2017.1321114

World Health Organization. (2016). Global Status Report on Road Safety (1st ed.). Department of Violence and Injury Prevention and Disability.

Zhao, X., Zhang, X., & Rong, J. (2015). Study of the Effects of Alcohol on Drivers and Driving Performance on Straight Road. *Mathematical Problems in Engineering*. https://doi.org/10.1155/2014/607652