

A 10-year Retrospective Analysis of Alcohol-related Road Crashes in the Philippines

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ABSTRACT

Background. Alcohol intoxication is one of the major risk factors contributing to fatal and injurious road crashes in the Philippines. Although road safety programs have been implemented to attempt to reduce alcohol-related road crashes, the rate of alcohol-related road crashes is still a major public health burden in the country.

Objective. To analyze the trend of alcohol-related road crashes in the Philippines, and to determine its effect on patient injuries and fatalities.

Methods. The 10-year database (2010 to 2020) on transport/vehicular crashes with alcohol intoxication (N = 35252) from the Online National Electronic Injury Surveillance System of the Department of Health was analyzed using descriptive statistics and logistic regression.

Results. A total of 35,252 cases of alcohol-related road crashes was recorded between 2010 to 2020 in the Online National Electronic Injury Surveillance System (ONEISS) of the Department of Health. An increasing trend of alcohol-related road crashes was observed until 2019 and declined by 2020. Alcohol-related road crashes significantly increased the odds of patient death (OR = 2.02, $p < 0.0001$). Meanwhile, Alcohol-related road crash was significantly associated with increased odds of sustaining amputation (OR = 19.04, $p < 0.0001$), open wound (OR = 2.16, $p < 0.0001$), open fracture (OR = 1.45, $p < 0.0001$), multiple injury (OR = 2.23, $p < 0.0001$), among others.

Conclusion. The findings confirm that alcohol-impaired driving remains a critical contributor to road crash fatalities and severe injuries in the Philippines. Strengthened enforcement, surveillance, and evidence-based prevention strategies are necessary to reduce alcohol-related road crash morbidity and mortality.

Keywords: road crash, alcohol intoxication, road safety, national traumatic injury database, Philippines

INTRODUCTION

Considered a toxic and psychoactive substance, alcohol alone is responsible for an estimated 3 million fatalities every year worldwide.¹ Globally, approximately 1.35 million fatalities and 30-50 million injuries are attributed to road crashes every year, with an estimated 3700 daily fatalities.² It is also the leading cause of death among children and young adults aged 5-29 years, the 8th leading cause of death for all age groups, and costs countries an estimated 3% of their gross domestic product.²

The World Health Organization recommends a 0.05% BAC as the standard for alcohol level while driving because exceeding this level can significantly and exponentially increase the risk of drivers in road crashes. In fact, this standard has been reduced to 0.02% BAC for young and novice drivers, who may suffer greater driving impairment once influenced by alcohol.² In the Philippines, the legal blood alcohol



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concentration (BAC) remains at 0.05% in general, and 0% for public-utility vehicle drivers and motorcyclists.³

The United Nations Decade of Action for Road Safety 2021-2030 announced its plan to reduce fatalities and morbidities due to road crashes by at least 50% through safer public transport and roads for walking and cycling, safer roads, vehicles, and behaviors, and improved emergency care.⁴ Unless drastic measures are made, the progress will not be enough to mitigate road crashes with the increasing urbanization and the number of registered vehicles.²

The Philippines is classified as one of the middle-income countries and belongs to the region with the highest proportion of population (76%), road crash fatalities (80%), and registered motor vehicles (59%).² Based on the consumer spending in the previous years, it has been predicted that the Philippines will have an increasing trend of alcohol and tobacco consumption up to 2025, with projected cost of approximately 10,410.08 million U.S. dollars.⁵ Aside from increasing alcohol consumption, the Philippines is considered as the 11th among the countries in the Asia Pacific Region with the greatest number of passenger vehicles sold with almost majority (43%) of Filipinos owning their own motorcycle or tricycle.⁶ This is why this research on alcohol risk to road crashes is an important basis for further policy formulations on drunk driving.

In 2009, the Philippines had no law prohibiting drink driving. In 2013, RA 10586, otherwise known as “An Act Penalizing Persons Driving Under the Influence of Alcohol, Dangerous Drugs, and Similar Substances, and for Other Purpose” was just passed as a law. It was not until April 28, 2014, that the implementing rules and regulations were issued by the DOTC, DILG, PNP, and DOH. Enforcement has been low from 2015 to the present, with random breath testing requiring probable cause. In case of a fatal crash, only some drivers are being tested for alcohol intoxication due to patient or individual consent. In the Philippines, mandatory alcohol breath analysis or alcohol blood analysis cannot be mandated as the law requires informed consent from the individual. Hence, the ‘alcohol suspected’ is the terminology used by the Department of Health (DOH) to refer to those with alcohol intoxication when admitted to the hospital, as indicated by the attending medical doctor in the patient history taking.

The framework of the study focuses on socio-demographic and hospitalization variables associated with alcohol-related crashes, as well as the impact of alcohol-related crashes on patient outcomes of death or recovery.

METHODS

The study analyzed the data from the Department of Health's Online National Electronic Injury Surveillance System. Data from 2010 to 2020 on transport/vehicular crashes with alcohol intoxication was extracted.

The Online National Electronic Injury Surveillance System, or ONEISS database of the DOH, is a repository of road crash data since 2010, when the electronic system was launched by the DOH. However, the dry run started in 2009, and formal uploading of data from various participating hospitals nationwide started in 2010.

ONEISS is a web-based system developed by DOH with the facility to electronically capture injury-related data from health facilities, store data in a centralized and secure location, process, consolidate, and transform data into meaningful information. It establishes a common or standard set of injury-related data elements collected for surveillance and standards to facilitate collection, management, transmission, analysis, access, dissemination, and sharing of data. ONEISS was initially implemented in 6 pilot hospitals in 2009, but today it has expanded to include more than 80% of all government and private hospitals and infirmaries in the Philippines with an initial number. On average, there are 37 DOH hospitals, 98 government hospitals, and 167 private hospitals reporting in the ONEISS in 2015. The average number of hospitals reporting in the ONEISS is 304 since 2015, but it was as low as 72 before 2015. The year 2016 had the greatest number of hospitals (375) reporting to the surveillance system. Then it dipped in 2019 to 288, which may be due to the pandemic. On average (since 2015), there are 37 Department of Health hospitals, 98 government hospitals, and 167 private hospitals reporting in the ONEISS. The majority of the data in the ONEISS, however, comes from DOH hospitals (50.5%), followed by government hospitals at 26.2% and then private hospitals at 23.3%. Health facilities with training on ONEISS are required to report injuries they managed to the system.

The database in this study covers 2010-2020. In 2010, the electronic system had already been established. The system can only show core variables relevant to road crash cases for the Department of Health, such as socio-demographics, alcohol suspected in the medical history taking, type of vehicle involvement, type of road user, whether pedestrian, driver, or passenger, patient outcome, whether died, recovered, or unchanged, type of injury, and the region of road crash location.

The sampling frame is the entire database of DOH-ONEISS. These are voluntary hospitals, whether government, DOH, or private, that are voluntarily uploading injury data to the electronic online system.

Descriptive and Inferential Statistics using SPSS 31 were computed to explore and analyze the ONEISS dataset. Descriptive statistics were presented as graphs, charts, and tables, while Inferential statistics were done using logistic regression analysis.

The researchers secured a request to acquire the ONEISS database from 2010 to 2019, subject to guidelines approved by the Department of Health- Single Joint Research Ethics Board (DOH-SJREB).

RESULTS

The majority of the alcohol-related road crash victims are brought to the ER (94.44%) and are mostly male (85.85%). Drivers (61.34%) are the most common victim type, followed by passengers (16.29%) and pedestrians (3.67%). On the other hand, leisure (49.47%) was the most common activity, followed by unknown (24.42%) (Table 1).

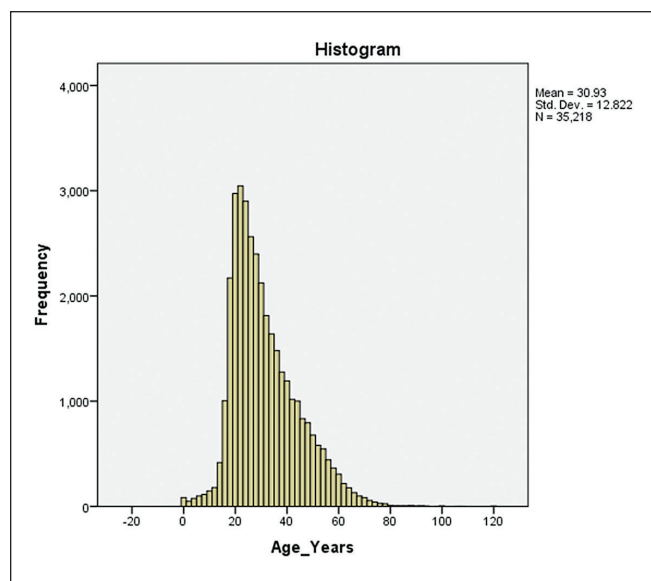


Figure 1. Age distribution of alcohol-related road crash patients from 2010 to 2020 (N = 35,218).

The average age of alcohol-related road crash patients is 30.93 (± 12.822). Figure 1 shows that the majority of the patients are of the economically productive age group.

The total number of alcohol intoxication cases reported in ONEISS is 35252 from 2010 to 2020. It is on a continuous increasing trend, peaking in 2019. The decrease in 2020 could be due to the COVID-19 pandemic (Figure 2).

Table 1. Socio-demographics of Alcohol-related Road Crash Patients from 2010 to 2019

	Frequency	Percent	Valid Percent
Patient Sex			
Female	3,446	9.775	10.222
Male	30,264	85.850	89.778
Missing	1,542	4.374	
Activity			
Leisure	17,438	49.467	61.732
Sports	71	0.201	0.251
Work related	709	2.011	2.510
Missing	7,004	19.868	
Consult Type			
ER	33,293	94.443	94.443
Inpatient	182	0.516	0.516
Outpatient	1,777	5.041	5.041
Total	35,252	100.000	100.000
Victim Type			
Driver	21,622	61.336	72.841
Passenger	5,744	16.294	19.350
Pedestrian	1,294	3.671	4.359
Missing	5,568	15.795	
Total	35,252	100.000	

Missing – no data encoded by the uploading hospital

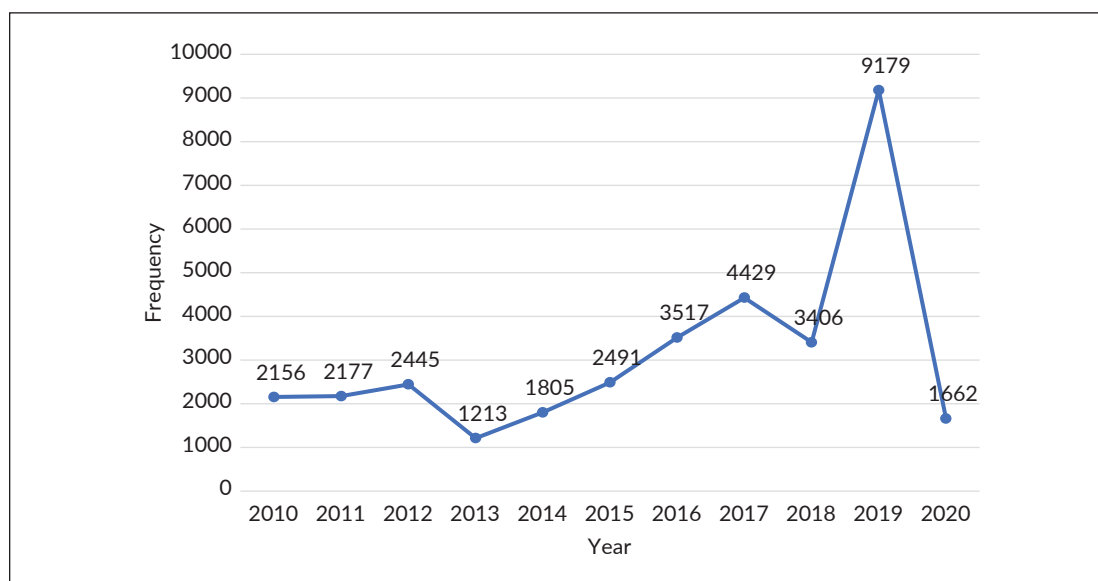


Figure 2. Frequency distribution of alcohol-related road crashes from 2010 to 2020 (n = 34,480).

Patient death due to alcohol intoxication as a risk factor is also on an increasing trend from 2011 and peaked during 2018. There is a total of 495 deaths where alcohol intoxication is a risk factor (Figure 3).

For road crash patients with alcohol intoxication as a risk factor, unimproved cases increased through the years along with the total number of cases, peaking in 2019. Total improved is 24554 while total unimproved is 3295 (Figure 4).

Motorcycles were the most involved vehicle from 2010 to 2020. More than 80% is composed of motorcycles. Tri-

cycles are the next most involved vehicle, followed by Pedestrians (Figure 5).

The regions with the highest reports of Transport/Vehicular crash cases where alcohol intoxication is a risk factor are Region III (4628), Region I (4428), and Region VI (4091).

On the other hand, ARMM is the lowest with 117, followed by CARAGA region with 312, and Region IX with 417 (Figure 6).

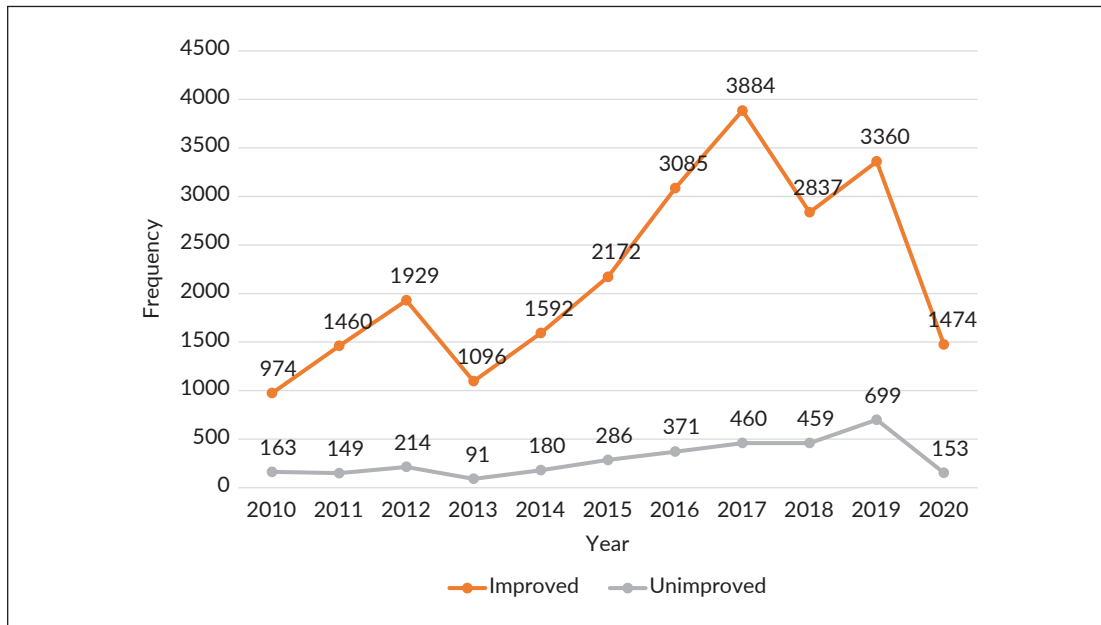


Figure 3. Frequency distribution of alcohol-related road crash deaths from 2010 to 2020 (n = 484).

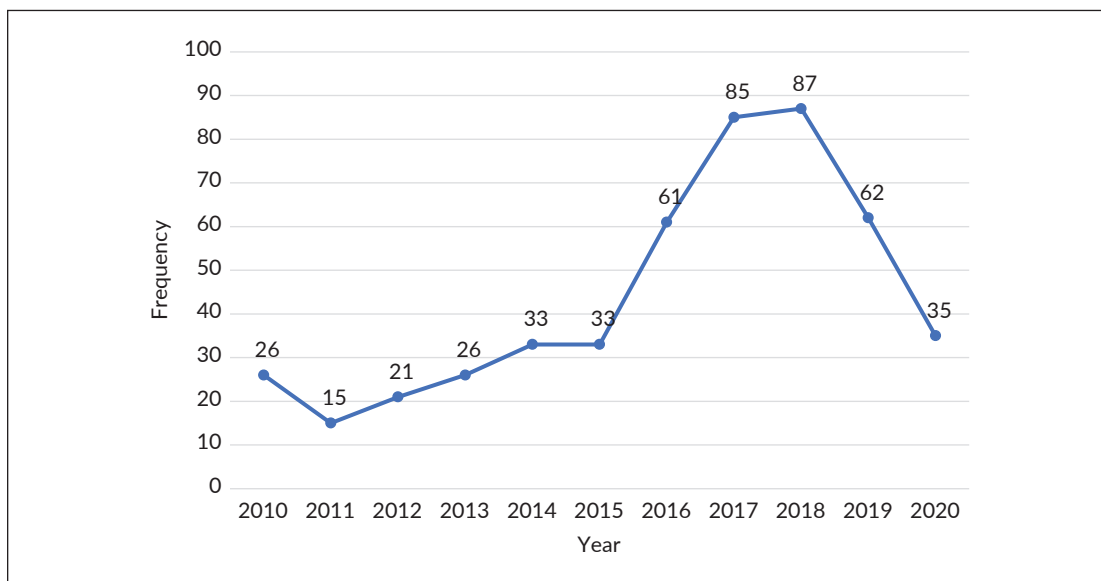


Figure 4. Frequency distribution of alcohol-related road crash injuries from 2010 to 2020 (n = 27,088).

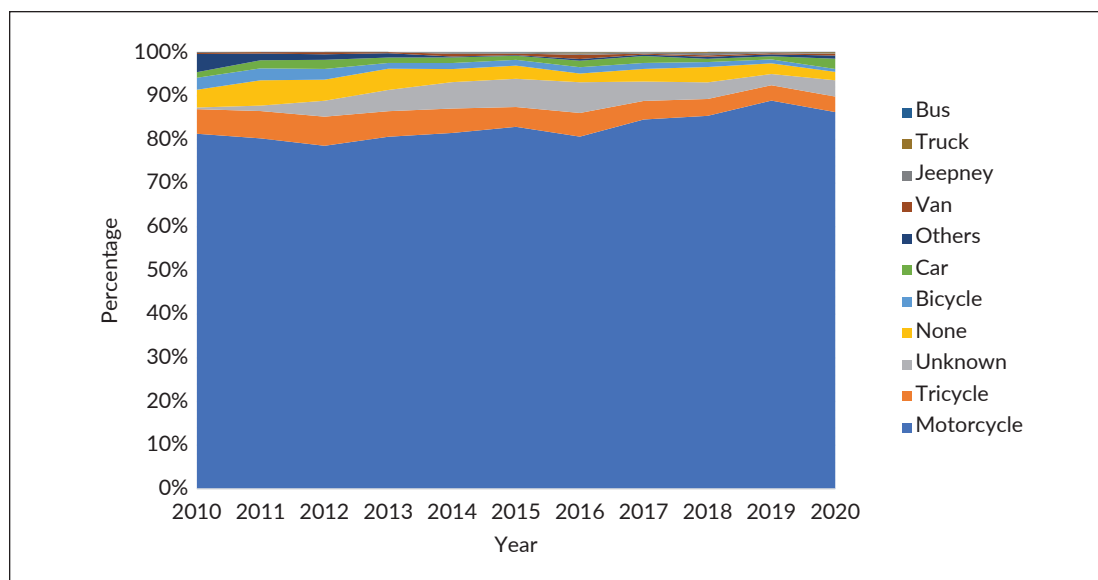


Figure 5. Frequency distribution of vehicles involved in alcohol-related road crashes from 2010 to 2020.

Logistic Regression was done to analyze the effect of alcohol intoxication on the odds of road user injury/fatality. The variable “Alcohol Suspected” was used as a lone independent variable to predict the occurrence of patient death and injuries among patients in the ONEISS database. 356532 cases are considered in each of the regression models.

The odds ratio of suffering amputation (OR = 19.04), open wound (OR = 2.16), Open Fracture (OR = 1.45), Closed Fracture (OR = 1.42), Burn (OR = 2.23), Avulsion (OR = 3.04), Abrasion (OR = 1.40), Multiple Injury (OR = 2.23) and Patient Death (OR = 2.02) are significantly increased by alcohol intoxication (Table 2).

For patient deaths within alcohol intoxication cases, variables considered are risky road user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 0.3% of the dependent variable is explained by the model. Pedestrian involvement (OR = 2.08), Sleep (OR = 2.40), and a one-year increase in Age (OR = 1.009) significantly increase the odds ratio of patient death (Table 3).

Variables considered for road behaviors are risky user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 0.9% of the dependent variable is explained by the model. Involvement of Motorcycles (OR = 1.16), Smoking (OR = 1.38), and Sleep (OR = 1.51) significantly increase the odds ratio of suffering multiple injuries. On the other hand, leisure (OR = 0.936), involvement of tricycle (OR = 0.805), involvement of car (OR = 0.72), helmet use (OR = 0.737), airbag use (OR = 0.176), no safe equipment (OR = 0.77), and a one-year increase in age (OR = 0.993) significantly decreases the odds ratio of suffering multiple injuries (Table 4).

For abrasion, variables considered are risky road user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 3.2% of the dependent variable

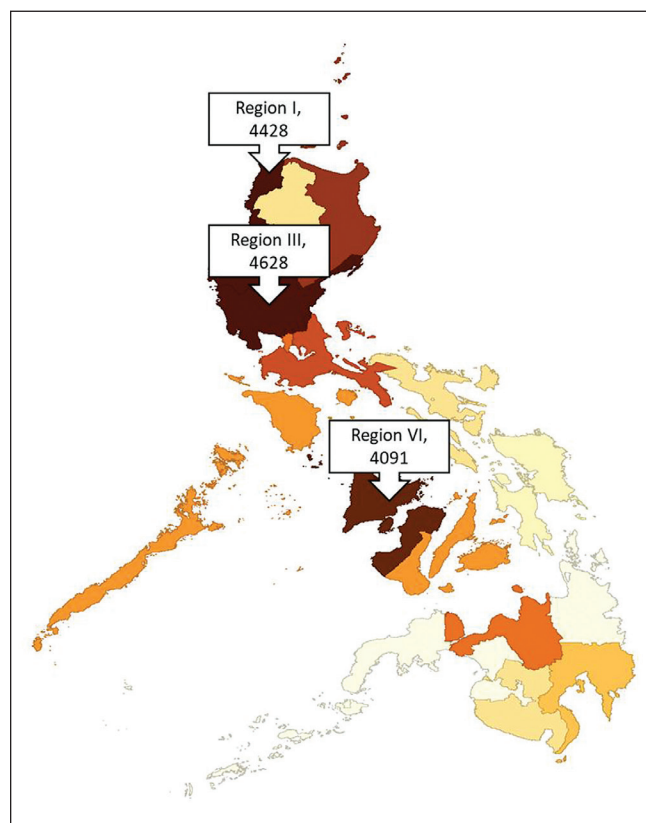


Figure 6. Location of alcohol-related road crashes from 2010 to 2020.

is explained by the model. Results show that leisure activity (OR = 1.19), work-related activity (OR = 1.49), involvement of pedestrians (OR = 1.21), involvement of motorcycles (OR = 1.51), involvement of bicycles (OR = 1.36), and sleep (OR = 1.56) significantly increase the odds ratio of suffering abrasion. On the other hand, a one-year increase in age significantly decreases the odds ratio of suffering abrasion by a factor of 0.098.

For avulsion, variables considered are risky road user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 0.8% of the dependent variable is

explained by the model. Results show that leisure activity (OR = 1.27), involvement with motorcycles (OR = 1.19), smoking (OR = 2.13), and a one-year increase in age (OR = 1.005) significantly increase the odds ratio of suffering avulsion. On the other hand, helmet use significantly decreases the odds ratio of suffering avulsion by a factor of 0.727.

For concussion, variables considered are risky road user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 1.2% of the dependent variable is explained by the model. Results show that using no safety equipment increases the odds ratio of suffering a

Table 2. Effect of Alcohol Intoxication on the Odds of Road User Injury and Fatality

Variables	Parameter Estimate	Standard Error	p-value	Odds Ratio	95% CI for OR	
					Lower	Upper
<i>Amputation</i>	2.947	0.043	<0.0001	19.042	17.517	20.700
<i>Open Wound</i>	0.768	0.012	<0.0001	2.156	2.104	2.210
<i>Open Fracture</i>	0.373	0.036	<0.0001	1.451	1.353	1.557
<i>Closed Fracture</i>	0.352	0.017	<0.0001	1.423	1.376	1.471
<i>Contusion</i>	-0.292	0.017	<0.0001	0.747	0.722	0.773
<i>Concussion</i>	-0.023	0.027	0.404	0.978	0.927	1.031
<i>Burn</i>	0.800	0.071	<0.0001	2.225	1.935	2.558
<i>Avulsion</i>	1.112	0.019	<0.0001	3.042	2.933	3.155
<i>Abrasion</i>	0.339	0.011	<0.0001	1.403	1.372	1.435
<i>Multiple Injury</i>	0.806	0.013	<0.0001	2.239	2.183	2.296
<i>Died</i>	0.705	0.049	<0.0001	2.023	1.837	2.228

Table 3. Logistic Regression Associated with Patient Death within Alcohol Intoxication Cases

Variables	Parameter Estimate	Standard Error	p-value	Odds Ratio	95% CI for OR	
					Lower	Upper
<i>Age (years)</i>	0.009	0.004	0.015	1.009	1.002	1.017
<i>Sleep</i>	0.876	0.288	0.002	2.401	1.364	4.225
<i>None (Pedestrian)</i>	0.730	0.231	0.002	2.075	1.319	3.264
<i>Constant</i>	-4.361	0.139	<0.0001	0.013		

Table 4. Logistic Regression of Risk Factors Associated with Multiple Injuries within Alcohol Intoxication Cases

Variables	Parameter Estimate	Standard Error	p-value	Odds Ratio	95% CI for OR	
					Lower	Upper
<i>Age (years)</i>	-0.007	0.001	<0.0001	0.992	0.991	0.995
<i>Sleep</i>	0.412	0.133	0.002	1.510	1.163	1.959
<i>Smoking</i>	0.323	0.113	0.004	1.381	1.106	1.724
<i>No Safe Equipment</i>	-0.258	0.072	<0.0001	0.773	0.671	0.891
<i>Airbag Use</i>	-1.735	0.831	0.037	0.176	0.035	0.900
<i>Helmet Use</i>	-0.305	0.103	0.003	0.737	0.602	0.902
<i>Car</i>	-0.328	0.137	0.016	0.720	0.551	0.941
<i>Motorcycle</i>	0.149	0.050	0.003	1.161	1.052	1.280
<i>Tricycle</i>	-0.216	0.083	0.009	0.805	0.685	0.947
<i>Leisure</i>	-0.066	0.031	0.033	0.936	0.881	0.995
<i>Constant</i>	1.179	0.094	<0.0001	3.250		

concussion by a factor of 1.52, and a one-year increase in age increases the odds ratio of suffering a concussion by a factor of 1.01. On the other hand, work-related activity (OR = 0.541), involvement of tricycle (OR = 0.36), involvement of pedestrian (OR = 0.669), involvement of motorcycle (OR = 0.68), and smoking (OR = 0.535) significantly decrease the odds ratio of suffering concussion.

For contusion, variables considered are risky road user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 1% of the dependent variable is explained by the model.

Results show that a one-year increase in age significantly increases the odds ratio of suffering a contusion by a factor of 1.008. On the other hand, leisure (OR = 0.781), involvement in motorcycles (OR = 0.747), involvement in bicycles (OR = 0.661), and smoking (OR = 0.547) significantly decrease the odds ratio of suffering contusion (Table 5).

For closed fracture, variables considered are risky road user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 0.6% of the dependent variable is explained by the model. Results show that involvement of pedestrians (None) (OR = 1.412), sleep (OR = 2.42), and a

Table 5. Logistic Regression of Risk Factors to Abrasion, Avulsion, Concussion, and Contusion within Alcohol Intoxication Cases

Intoxication Cases						
Variables	Parameter Estimate	Standard Error	p-value	Odds Ratio	95% CI for OR	
					Lower	Upper
Abrasion						
Age (years)	-0.020	0.001	<0.0001	0.980	0.978	0.982
Sleep	0.446	0.132	0.001	1.562	1.206	2.023
Bike	0.310	0.139	0.025	1.364	1.039	1.790
Motorcycle	0.414	0.045	<0.0001	1.513	1.385	1.652
None (Pedestrian)	0.192	0.097	0.047	1.211	1.002	1.463
Work Related	0.396	0.112	<0.0001	1.486	1.193	1.850
Leisure	0.172	0.031	<0.0001	1.188	1.119	1.262
Constant	0.859	0.060	<0.0001	2.361		
Avulsion						
Age (years)	0.005	0.002	0.015	1.005	1.001	1.008
Smoking	0.756	0.130	<0.0001	2.130	1.652	2.747
Helmet Use	-0.318	0.143	0.026	0.727	0.549	0.964
Motorcycle	0.171	0.071	0.016	1.187	1.032	1.365
Leisure	0.242	0.052	<0.0001	1.274	1.151	1.410
Constant	-2.781	0.099	<0.0001	0.062		
Concussion						
Age (years)	0.010	0.002	<0.0001	1.010	1.006	1.015
Smoking	-0.625	0.274	0.022	0.535	0.313	0.915
No Safe Equipment	0.418	0.120	0.001	1.519	1.199	1.923
Motorcycle	-0.381	0.091	<0.0001	0.683	0.571	0.817
None (Pedestrian)	-0.402	0.195	0.039	0.669	0.457	0.980
Tricycle	-1.023	0.204	<0.0001	0.360	0.241	0.537
Work Related	-0.615	0.274	0.025	0.541	0.316	0.926
Constant	-3.078	0.162	<0.0001	0.046		
Contusion						
Age (years)	0.008	0.002	<0.0001	1.008	1.005	1.011
Smoking	-0.603	0.183	0.001	0.547	0.382	0.783
Bike	-0.414	0.198	0.037	0.661	0.448	0.975
Motorcycle	-0.292	0.054	<0.0001	0.747	0.672	0.830
Leisure	-0.248	0.041	<0.0001	0.781	0.721	0.846
Constant	-1.682	0.076	<0.0001	0.186		

one-year increase in age (OR = 1.004) significantly increase the odds ratio of suffering a closed fracture. On the other hand, leisure activity significantly decreases the odds ratio of suffering a closed fracture by a factor of 0.808.

For open fracture, variables considered are risky road user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 0.7% of the dependent variable is explained by the model.

Results show that pedestrian involvement (OR = 1.75) and a one-year increase in age (OR = 1.008) significantly increase the odds ratio of suffering an open fracture. On the other hand, leisure activity significantly decreases the odds ratio of suffering an open fracture by a factor of 0.789. The involvement of bicycles is not significant.

For open wounds, variables considered are risky road user behaviors, use of safety equipment, vehicle types, and age. 20683 cases are considered in this model. Nagelkerke R-square suggests that up to 0.9% of the dependent variable is explained by the model.

Results show that involvement of a tricycle (OR = 1.51), involvement of a motorcycle (OR = 1.26), involvement of a bicycle (OR = 1.85), and a one-year increase in age (OR = 1.01) significantly increase the odds ratio of suffering an open wound. On the other hand, leisure activity (OR = 0.944) and use of helmet (OR = 0.735) significantly decrease the odds ratio of suffering open wounds (Table 6).

DISCUSSION

Alcohol-related road crash risk

A total of 35,252 cases of alcohol-related road crashes were recorded between 2010 and 2020 in the Online National Electronic Injury Surveillance System (ONEISS) of the Department of Health. An increasing trend of alcohol-related road crashes was observed until 2019 and declined by 2020. Fatalities ($N = 495$) were reported to have an increasing trend from 2011 and peaked in 2018. Road crash injuries were categorized into two types: improved and unimproved cases. The trend of improved cases ($N = 24554$) was on an increasing trend until 2017 and has declined since then. Unimproved cases ($N = 3295$) were observed to also have an increasing trend and peaked in 2019.

The risk of fatal and serious injurious road crashes increases when driving under the influence of alcohol and any psychoactive substances or drugs, especially with a BAC level equal to or greater than 0.04 g/dl.⁴ Garrison et al. found that 35% of fatal road crashes involve alcohol use.⁷ Reduction in visual perception and impaired vigilance are observed with a BAC level of at least 0.03%. Cognitive processes responsible for attention can also be impaired by alcohol between 0.05% and 0.08% BAC. Compared to a sober driver, drivers under the influence of alcohol are found to be significantly associated with increased risk for road crash involvement even as low as 0.04% BAC.

Table 6. Logistic Regression of Risk Factors to Closed Fracture, Open Fracture, and Open Wound within Alcohol Intoxication Cases

Variables	Parameter Estimate	Standard Error	p-value	Odds Ratio	95% CI for OR	
					Lower	Upper
Closed Fracture						
Age (years)	0.004	0.002	0.020	1.004	1.001	1.008
Sleep	0.886	0.150	<0.0001	2.425	1.808	3.252
None (Pedestrian)	0.345	0.134	0.010	1.412	1.086	1.837
Leisure	-0.213	0.050	<0.0001	0.808	0.732	0.892
Constant	-2.431	0.073	<0.0001	0.088		
Open Fracture						
Age (years)	0.008	0.003	0.015	1.008	1.002	1.014
Bike	-1.954	1.003	0.051	0.142	0.020	1.012
None (Pedestrian)	0.560	0.204	0.006	1.750	1.174	2.609
Leisure	-0.237	0.087	0.006	0.789	0.665	0.936
Constant	-3.736	0.125	<0.0001	0.024		
Open Wound						
Age (years)	0.010	0.001	<0.0001	1.010	1.008	1.013
Helmet Use	-0.308	0.076	<0.0001	0.735	0.633	0.852
Bike	0.616	0.135	<0.0001	1.851	1.422	2.410
Motorcycle	0.227	0.049	<0.0001	1.255	1.140	1.381
Tricycle	0.413	0.081	<0.0001	1.511	1.290	1.771
Leisure	-0.058	0.029	0.047	0.944	0.891	0.999
Constant	-0.896	0.062	<0.0001	0.408		

The overall decline in road crashes may be primarily due to the COVID-19 pandemic, which disrupted the transportation system worldwide. In Alabama, the prevalence of road crashes was reduced a week after the enforcement of the stay-at-home orders to reduce the spread of the COVID-19 virus. Although the prevalence of road crashes decreased, the trend of road crash fatalities remained approximately the same, which may primarily be due to the reduced road traffic volume and decreased enforcement of road traffic laws. Drunk driving and other risky road user behaviors such as speeding, drowsy driving, and nonuse of seatbelts were still significantly associated with severe injuries due to road crashes. Also, severe road crash injuries increased during weekends, in rural areas, and between 6PM and 6AM.⁸

The lack of enforcement, such as a reduction in testing for alcohol among drivers, may contribute to the occurrence of alcohol-related road crashes. In Bucharest, breath alcohol and blood alcohol levels among drivers ($N = 5284$) are analyzed before and during the COVID-19 pandemic. During COVID-19, there was a reduction in the number of tests conducted to determine alcohol levels among drivers, as well as an increase in drivers with minimally elevated breath alcohol concentration levels.⁹

However, there are reports of increased alcohol consumption during the pandemic. In Uruguay, there was an increase in the frequency (17.7%) and volume (~28%) of psychoactive substances, particularly alcohol and drugs, primarily because of psychological distress brought about by COVID-19. The increase in substance use, including alcohol, was significantly associated with psychological distress. Around 18.7% reported experiencing high levels of psychological stress during the early phase of the COVID-19 pandemic.¹⁰ The increase in the number of populations with alcohol intoxication may also impact the number of alcohol-related road crashes; hence, further exploration of alcohol consumption among drivers during times of pandemic should also be explored.

A study on the impact of COVID-19 on alcohol use by a group of individuals who were arrested and convicted of driving while under the influence of alcohol was conducted. The average drinks per week ranged from 9.46 to 9.83 drinks, but an increase in the number of drinking days increased. Although the drinking days increased, the volume of alcohol remained the same. The factors that are found to be associated with increased drinking days included the stress brought about by worries about finances and job status, while the limited finances contributed to the inability to increase alcohol consumption.¹¹

The Philippines is composed of three major islands, which are Luzon, Visayas, and Mindanao. Two regions of Luzon have the highest recorded cases of alcohol-related road crashes, which were Region III – Central Luzon ($N = 4628$) and Region I – Ilocos Region ($N = 4428$). Region VI – Western Visayas ($N = 4091$) had the third-highest record of alcohol-related road crashes. Central Luzon is an administrative

region composed of 7 provinces, 116 municipalities, and 14 cities, with 2 highly urbanized cities, and approximately 11.39% of the population of the Philippines based on the 2020 Census.¹² The Ilocos Region is divided into 4 provinces, 116 municipalities, and 9 cities, with approximately 4.86% of the entire population of the Philippines.¹³ Both Central Luzon and the Ilocos Region make up approximately 16.25% of the total population of the Philippines based on the 2020 census. The region with the third-highest alcohol-related road crash reports was Western Visayas. The Western Visayas, with 7.30% of the entire population of the Philippines, is composed of 6 provinces, 117 municipalities, and 16 cities.¹⁴

Three (3) regions from Mindanao reported the lowest number of alcohol-related road crashes, which were the Autonomous Region of Muslim Mindanao (ARMM) ($N = 117$), Region XIII – Caraga Region ($N = 312$), and Region IX – Zamboanga Peninsula ($N = 417$). Comprising 4.04% of the country's entire population, the Autonomous Region in Muslim Mindanao is grouped into 5 provinces, 116 municipalities, and 2 cities.¹⁵ The Caraga administrative region is divided into 5 provinces, 67 municipalities, and 6 cities, of which 1 is a highly urbanized city, with approximately 2.57% of the country's population.¹⁶ The Zamboanga Peninsula is composed of approximately 3.55% of the country's population and is divided into 3 provinces, 67 municipalities, and 5 cities, of which 1 is a highly urbanized city.¹⁷ The number of populations and the urbanization level of the regions may be a contributory factor in alcohol-related transport and vehicular accidents.

Demographic Risks

Comparing the provinces of Luzon and Visayas with the greatest number of reported alcohol-related road crashes, with Mindanao having the least, it may be due to the high degree of urbanization in Luzon. Li et al. showed that central urban areas with high land-use intensity and diversity, particularly the areas for residential and commercial areas with a high number of human activities, have a high number of road crash reports compared to other areas.¹⁸ The high population density and increased driving speed can be responsible for the increased road crashes in rural areas.¹⁸ Areas with high population density, specifically residential areas, banks, and hospitals, were found to be significantly associated with increased risk for road crashes, while schools were shown to have decreased risk for road crashes.¹⁹ The high population density worsened by temporary parking and uncertainty of waiting time may contribute to the increased incidence of road crashes in areas for public services, while the reduction in speed, presence of school zone and speed limit signages can deter road crashes.¹⁹

Furthermore, the majority of infrastructure projects, including transportation mobility sectors, costing about 3.6 trillion Philippine pesos, are in Luzon. The increase in transportation infrastructure in Luzon led to increased road traffic volume. Despite the proliferation of road infrastructure

projects, road space for pedestrians, cyclists, and motorcyclists is unattended, contributing to an increase in road crashes for these vulnerable road users.⁴

Behavioral Risk Factors

For the prevalence of risky behaviors, including drunk driving, an online survey among drivers in Canada ($N = 1500$) and the US ($N = 1501$) showed that US drivers were more likely to engage in risky driving behavior during the pandemic compared to Canadian drivers. The risky driving behaviors most often reported were drunk driving (7.6%) and speeding (7.6%) in the US, and speeding (5.5%) and distracted driving (4.2%) in Canada. Driving within 2 hours after alcohol consumption was more prevalent in the US compared to Canada.²⁰

In this study, age was significantly associated with increased odds of patient fatality. Similarly, Chen et al. found that drivers aged 50 to 60 years were significantly associated with more severe alcohol-related road crashes compared to younger age groups ranging from 20 to 30 years old.²¹ Old age was also determined to be significantly associated with injury severity by Chen and Mu in their analysis of road crash data among elderly motorcycle drivers in Taiwan.²² Recovery among older adults is more complicated compared to that of younger road crash victims. The assessment of road crash victims 1 to 2 years after the date of accident showed that older adults aged 65 and above who sustained mild to moderate injury had lower physical functioning and general health, and 71% self-reported pre-injury chronic diseases compared to younger road crash victims.²³

This study showed that alcohol-related road crashes were significantly associated with increased odds of patient death. Aside from fatalities, road crashes have long-term implications for their victims. About 85% of road crash victims in Sweden reported experiencing permanent medical impairment even after approximately 8 to 18 years after the crash.²⁴ A reduction of physical activity from 63% before the crash to 34% after the crash shows that permanent medical impairment can lead to a lower quality of life several years after the crash.²⁴

Alcohol-related road crashes were significantly associated with increased odds of sustaining amputation, open wound, open fracture, closed fracture, burn, avulsion, abrasion, and multiple injury. The vehicle types that were significant were motorcycles, tricycles, cars, bicycles, and pedestrians. Sleep and smoking were the two risky road user behaviors that were identified as significant. The activities prior to the crash that contributed to alcohol-related crashes were leisure activities and work. The safety equipment that was significant with alcohol related road crashes was helmet, airbag, among others.

Vehicle Risks

Involvement of vehicle type in road crashes is also an important variable in road crashes. In 2020, although a

decline of 39.5% in sales of motor vehicles was reported in the country, the Philippines still ranked as the 11th country with the greatest number of passenger cars sold in the Asia Pacific Region. Also, it is estimated that approximately 43% owned a motorcycle or tricycle, and 9.3% owned a car, jeep, or van in the country in 2020.²⁵ The results of the study showed that throughout the 10-year period, motorcycles were the most reported vehicle type involved in road crashes, followed by tricycles and pedestrians. Although pedestrians had lower road crash incidents compared to motorcycles and tricycles, only pedestrians were significantly associated with increased odds of patient fatality, which indicates the impact of alcohol-related road crashes among pedestrians.

Pedestrians are found to be vulnerable to alcohol-related road crashes, especially when intoxicated drivers fail to recognize pedestrians. In this study, the involvement of pedestrians was found to be significantly associated with increased odds of sustaining certain injuries such as abrasion, closed fracture, and open fracture. In other studies, significant factors that increased the risk of fatality and severe injuries among pedestrians are vehicle maneuver, road type, lighting condition, shoulder type, posted speed, and driver age.²⁶ Also, pedestrian fatalities and injuries increase at night by approximately 89% compared to daytime road crashes.²⁶

In this study, the involvement of motorcycles was significantly associated with increased multiple injuries, may be due to the use of helmets among motorcyclists. The primary cause of increased mortality among motorcyclists, together with pedestrians and cyclists, is the high impact or transfer of high energy from the vehicle to the pedestrian during a crash.²⁷ Motorcycle drivers (6.93%) with positive blood alcohol levels are found to have significantly higher injury severity scores and have an increased risk of sustaining severe injuries compared to drivers who have not consumed alcohol.²⁸ Among motorcyclists and car drivers, approximately 62% had heavy alcohol levels, and the majority of road crashes were significantly associated with younger age, higher injury severity score, and lower Glasgow Coma Scale score.²⁹

Other Risk Factors

The results of the study indicated that work-related activity was significantly associated with increased odds of sustaining abrasion but decreased odds of concussion. In Australia, work-related road crashes are responsible for 15% of the national road toll and 33% of occupational fatalities, and vehicle involvement is found to be the most common mechanism of injury and is responsible for a 4 times higher chance than the mechanism of injury for occupational fatalities.³⁰ Workers mostly drive to work in the morning (around 8 AM) and drive back home at around 4 to 7 PM; therefore, employees and employers should promote strategies that will ensure safety in driving to work and back home.

Prolonged working hours also contributed to the increased risk of road crashes (Nguyen et al., 2020, page

9). Drivers working more than 50 hours per week are also found to engage in major risky road user behaviors.³¹ In West Virginia, males (94.7%), whites (91.4%), those who tested positive for alcohol and drugs, license status, vehicle type and age, and weather were found to contribute to work-related fatal road crashes.³²

This study showed alcohol-related injuries sustained by workers. Gane et al. found that injury type and severity, hospital admission, socioeconomic status, low educational attainment, civil status, and employer support have an impact on return to work.³³ Further, musculoskeletal injuries due to road crashes delayed return to work, ranging from 1 month to 2 years, took sick leave ranging from 3 months to 2 years, and required costly modification of work duties.³³

This study is limited to the geographical locations based on the location of the hospital with the ONEISS system. The missing data also posed a challenge; hence, surveillance and reporting systems should be improved. Since ONEISS is a hospital-based system and only a few road crash victims consult in hospitals or are hospitalized, this study captures only road crash victims who sustained injuries that were brought to the hospitals, and not those who did not incur any injury, or those who died and were not brought to hospitals. The study constitutes data on road crashes that were brought to hospitals and health facilities in the Philippines.

Although this database has existed and evolved for years, there has been limited literature on the analysis of reports related to road crashes, particularly alcohol intoxication. This study is one of the first steps to examine alcohol intoxication among patients involved in road crashes in the Philippines and investigate the trends, factors, and patient outcomes of alcohol-related road crashes.

CONCLUSION

The study analyzed the alcohol-related road crashes ($N = 35252$) of the DOH-ONEISS between 2010 and 2020. There has been an increasing trend of alcohol-related road crashes, fatalities, and injuries with improved and unimproved outcomes peaking in 2019, 2018, 2017, and 2019, respectively, except for 2020 due to the pandemic.

The factors that were significantly associated with alcohol-related crashes are age, vehicle type, risky road user behavior, activity prior to the crash, and safety equipment.

The findings of the study showed the effects of alcohol on driving behavior and road safety. The assessment of the legal driving standards and legal driving limit with alcohol use should be further re-analyzed. Progress in legislation and monitoring against the major risk factors of road crashes, specifically speeding, drunk driving, and use of safety equipment, should be pursued.

Statement of Authorship

The author certified fulfillment of ICMJE authorship criteria.

Author Disclosure

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