The Effect of Suspected Alcohol Intoxication on Fatality and Injuries of Road Users in Metro Manila — 2005-2020

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ABSTRACT

Introduction. The ever-increasing global road traffic accidents is caused by several risk factors: human factors, vehicle factors, and road environmental factors. In the Philippines, 12,000 road users die annually due to road crashes and almost one-third are alcohol-related crashes.

Objectives. This study aims to investigate the effects of suspected alcohol intoxication on the severity of injuries among drivers and passengers in a major urban region in the Philippines using the Metro Manila Accident Recording and Analysis System (MMARAS) of the Metropolitan Manila Development Authority from 2005 to 2020.

Methods. The Metro Manila Accident Recording and Analysis System (MMARAS) was used to determine the data on trends and association for alcohol-related road crashes, while descriptive and inferential statistics such as logistic and multinomial regression were used to determine trends and associations.

Results. Suspected alcohol intoxication road crash cases in Metro Manila have decreased from 45 cases in 2005 to 31 cases in 2020. The year 2011 recorded the highest cases of alcohol-suspected road crashes. The years 2010, 2011, and 2012 recorded the highest number of driver's death while 2005, 2006, 2014, and 2019 recorded higher deaths for passengers. Cars and motorcycles are the most commonly involved vehicles in alcohol-suspected road crashes, while Quezon City (n=307) and Marikina City (n=267) are the common places of incidence for drunk-driving accidents. On the other hand, alcohol intoxication increases the risk of driver's death (OR=9.16; 95% CI [5.388-15.574]) and injury (OR=5.22; 95% CI [4.487-6.074]). While intoxicated, hitting an object (OR = 12.557; 95% CI [1.478-106.694]) and truck collisions (OR=7.176; 96% CI [1.261-40.817]) can increase the risk for driver's death. Meanwhile, side swipe (OR=2.330; 95% CI [1.029-5.277]) and angle impact (OR= 7.972; 95% CI [1.804-35.227]), increase the odds for driver injuries.

Conclusion. Suspected alcohol intoxication road crashes can be prevented; however, a collaborative effort is needed. The government is responsible for road safety education as well as effectively enforcing road safety-related laws, while the road users shall use the roadways responsibly.

Keywords: accidents, traffic, alcoholic intoxication, risk factors to crash

INTRODUCTION

According to the most recent report of the World Health Organization in 2022, road traffic injuries is the cause for approximately 1.3 million deaths every year, and the leading cause of death for children and young adults.[1] This burden of injury, disability, and death falls disproportionately on low- and middle-income countries and the most vulnerable road users, such as motorcyclists, bicyclists, and pedestrians. Although these countries are home to less than half of the

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world's vehicles, these countries account for 90% of the global toll of traffic deaths.[2]

Risk factors associated with increased road crash include human factors, vehicle factors, and road environmental factors.[3] Alcohol intoxication is under human behavior when a road user consumes alcohol prior to driving or while on the road. Alcohol decreases alertness of cognitive function of the brain leading to poor decision making, slower reaction rate and depressed thinking.[4]

In the Philippine context, the debilitating effects of alcohol related to crash are felt. Of the estimated 12,000 fatalities due to road crashes, about 25% are caused by drunk driving.[5] With that, the government enacted a law, the Republic Act No. 10586 (RA 10586) which is titled Anti-Drunk and Drugged Driving Act of 2013, that penalizes people driving under the influence of alcohol.[6] The act describes how a drunk driver is tested and how blood alcohol concentration (BAC) is used to measure the amount of alcohol in a person's blood set at 0.08 g/dL.

This study looked into the effects of alcohol intoxication on the following - death and injury among drivers, death and injury among passengers, and death and injury among pedestrians using the Metro Manila Accident Recording and Analysis System (MMARAS) from 2005 to 2020.

METHODS

This data analysis is taken from the Metro Manila registry coordinated by various government agencies in Metro Manila, Philippines from 2005-2020. This road crash database is referred to as the Metro Manila Accident Recording and Analysis System (MMARAS) primarily managed by the Metro Manila Development Authority (MMDA). It is created and operated by the Road Safety Unit (RSU) of the MMDA-Traffic Discipline Office-Traffic Engineering Center (MMDA-TDO-TEC), with the cooperation and assistance of the Traffic Enforcement Unit (TEU) of the Philippine National Police (PNP).

The MMARAS dataset as a whole has a total number of 1,353,799 road crash cases from January 2005 to December 2020**.** In this analysis however, a subset of 714 suspected alcohol intoxication related cases from January 2005 to December 2020 was considered to analyze alcohol intoxication among road crash incidents in Metro Manila.

Road users are defined in this study as - Driver is a person driving a mechanically propelled vehicle, or a pedal cycle; Passenger is anyone carried-in or on a mechanically propelled vehicle or pedal cycle; Pedestrian is anyone travelling on foot. MMARAS counts the number of fatalities and injured persons for every road user for each road crash incident. MMARAS also records vehicle types involved in road crash incidents.

The researchers mined the databases for useful information using statistical and other computational techniques to look for patterns. Inclusion criteria includes only road crash incidents and transport/vehicular crash patients who are alcohol-suspected.

The MMARAS database has a variable for the crash causation. It is divided into three broad categories: Human Error, Mechanical Defect, and Road Defect. The specifics of "Human Error" are where "Suspected Alcohol Intoxication" is indicated, and isolated for the purpose of this study. These crash causations are taken from blotter reports of the road crash incidents, thus suspected alcohol intoxication is usually inferred through subjective smelling of the persons involved in the crash or some field sobriety tests such as the straight-line test since the use of breath analyzers are not widely used in the Philippines yet.

Descriptive and Inferential Statistics were computed to explore and analyze the MMARAS dataset. Descriptive statistics were presented as graphs, charts, and tables, while Inferential statistics are done using Logistic and Multinomial Regression models.

After securing an approval from the Department of Health-Single Joint Research Ethics Board (DOH-SJREB), the researchers were cleared for implementation. The researchers requested and were given a copy of the MMARAS database.

RESULTS

The total number of "Alcohol Suspected" cases is 714 recorded from January 2005 to December 2020. This peaked in 2011 with 146 cases (Figure 1). The working terminology is "Alcohol suspected' since these data came from blotter reports and only has subjective tests used such as alcoholic breath or some field sobriety tests such as the straight-line test as basis for suspecting alcohol intoxication since breathalyzers are still not widely used in the Philippines yet, and needs informed consent by driver. This study is a secondary analysis of the MMARAS database.

Drivers are the most common road user killed due to alcohol intoxication cases for years 2010, 2011, and 2012. Passengers are the most common fatality for years 2005, 2006, 2014, and 2019. Pedestrians are the most common fatality for the years 2007 and 2018 (Figure 2).

For injury, drivers are also the most injured road user for most years, followed by passengers. In 2005, passengers are the most injured road user. Pedestrians are generally the least injured victims through the years, although they incurred the greatest number of injuries in 2007 and 2017 (Figure 3).

Drivers are the most killed and most injured road user among road crash cases. 2% of cases have at least one driver killed, and 37.8% has at least one driver injured. Private cars are the most involved vehicle type with 64.4% of the crashes involving at least one car. This is followed by motorcycles with 50% of cases involving at least one motorcycle. The most common collision type is side-swipe collision comprising 20.7% of alcohol suspected crashes, followed by rear-end collision comprising 13.6%. Among junction types, 16.9%

of alcohol suspected crashes occurred not in junctions, while 2.5% happened in crossroads and 2.1% happened in T-junctions (Table 1).

Metro Manila has 17 cities. Majority of suspected alcohol cases from 2005 to 2020 are from Quezon City (n=307) and Marikina City (n=267) (Figure 4).

Using logistic regression for alcohol intoxication as predictor, the results showed that alcohol intoxication increases the odds ratio of Driver Fatality by 9.16 times and Driver Injury by a factor of 5.22. Alcohol intoxication increases the odds ratio of Passenger Fatality by a factor of 19.74, and Passenger Injury by 4.75 times. For pedestrian fatality, alcohol intoxication increases the odds ratio by a factor of 2.77, and Pedestrian Injury by 1.06 (Table 2).

Among the 714 total alcohol cases in the MMARAS database, only 157 cases were considered for logistic

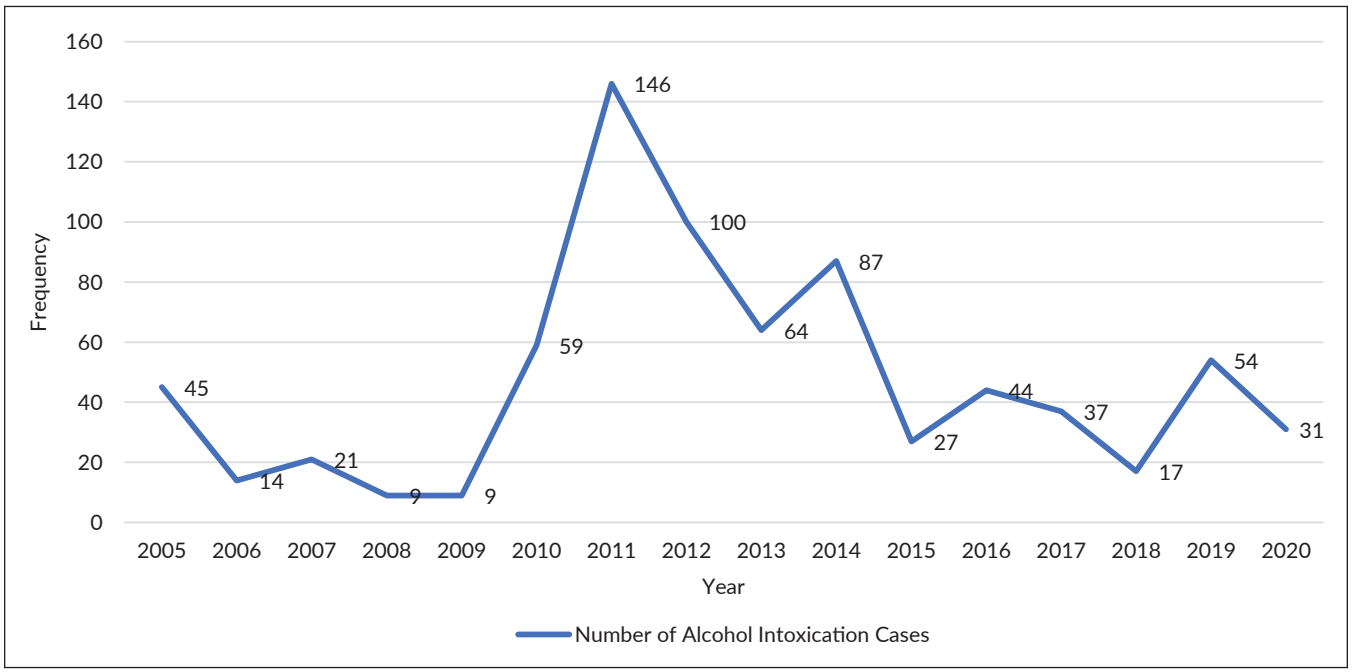

Figure 1. Suspected Alcohol Intoxication Cases in Metro Manila from 2005 to 2020.

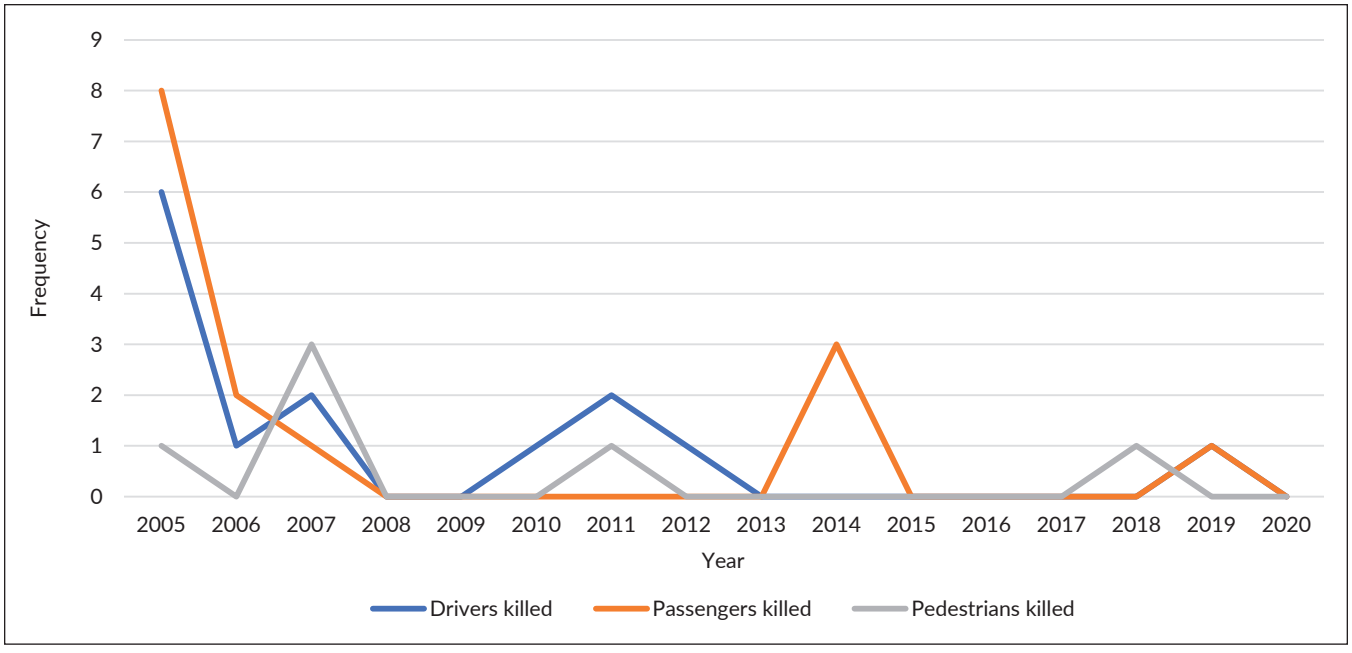

Figure 2. Suspected Alcohol Intoxication Fatalities through the Years.

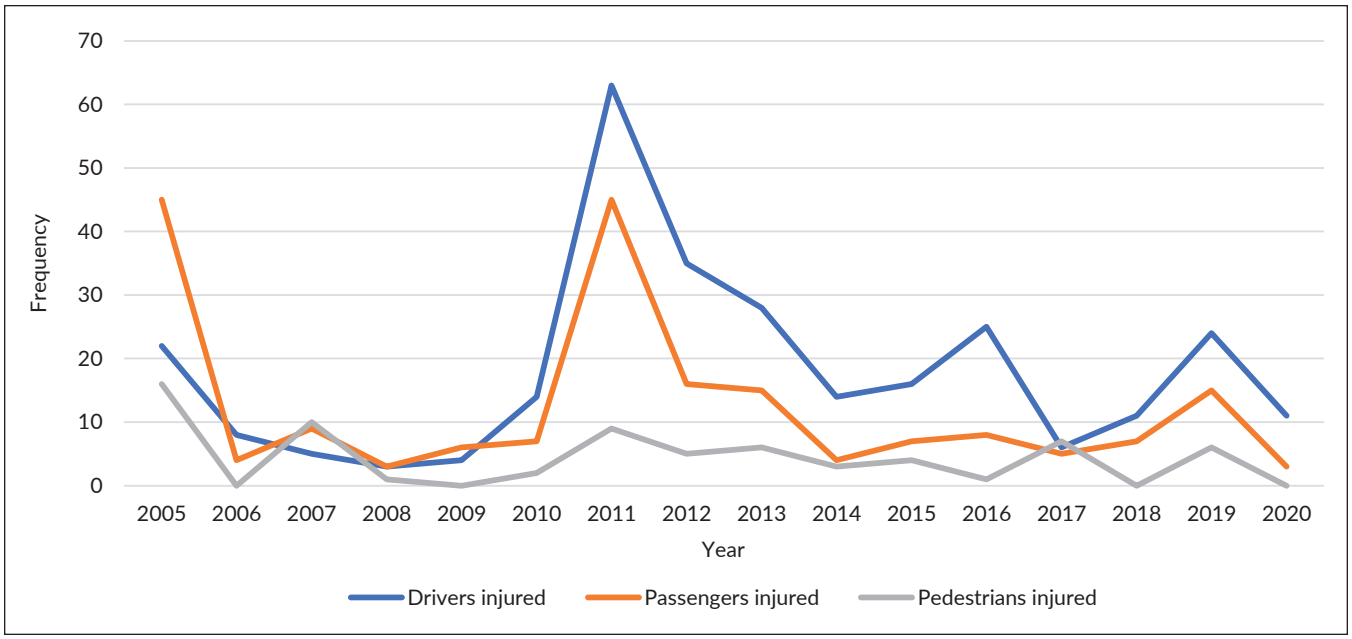

Figure 3. Suspected Alcohol Injuries Cases through the Years.

regression due to missing data. Using logistic regression on driver fatality among suspected alcohol cases, the results show that hit object increases the odds ratio of driver fatality by a factor of 12.5 while truck involvement increases the odds ratio of driver fatality by a factor of 7.18. The results also show that side swipe increases the odds ratio of driver injury by a factor of 2.33, "other Collision types" increase the odds ratio of driver injury by a factor of 8.9, and angle impact collision increases the odds ratio of driver injury by a factor of 7.97. In case of vehicle involvement, motorcycle involvement increases the odds ratio of driver injury by a factor of 4.16 (Table 3). For Passenger Fatality among suspected alcohol cases, "only rear end collision" is statistically significant at 95% confidence level and it increases the odds ratio of passenger fatality by a factor of 21.25. For Passenger Injury, "Not at Junction" junction type is significant for passenger injury and crashes that are not at junctions decreases the odds ratio of passenger injury by a factor of 0.38 (Table 3). For pedestrian fatality and injury, there were no variables that passed the threshold for forward selection may be due to its small sample size.

Multinomial Regression on Classification of Crash among Suspected Alcohol Cases

Multinomial Regression was done to analyze which other variables are significantly associated with Classification of Crash within alcohol suspected cases. Classification of crash is a variable with 3 levels: Fatal, Injurious, and Damage to Property. Damage to Property was used as the reference category in this analysis. Forward selection was done to select the variables included in the regression model. Variables considered are collision types, vehicle types, and junction types. There were only 157 cases considered in this model due to missing data. Nagelkerke R-square suggests that up to 16.7% of the dependent variable is explained by the model. Motorcycle involvement and truck involvement are the only variables selected to be included in the model. Truck significantly increases the odds ratio of fatal crashes by a factor of 11.36. Motorcycle involvement significantly increases the odds ratio of fatal crashes by a factor of 4.54 times. Motorcycle involvement also significantly increases the odds ratio of injurious crash by a factor of 4.45 times (Table 4).

DISCUSSION

Alcohol consumption is a well-known risk factor for sustaining road traffic injuries worldwide.[7] Drink driving is widely recognized as an important factor of the 1.3 million people dying in road crashes worldwide every year. Drink driving increases the risk of road traffic crashes, as well as the risk of fatal injuries.[8] In this study in Metro Manila, alcohol intoxication is one of the major risk factors to road traffic crashes. In a study, it was cited that 40.7% of the road traffic crashes related fatalities were associated with alcohol consumption among which 20.3% were car drivers.[9]

In this study in the Philippines, the most involved vehicles with drivers suspected of alcohol intoxication are private vehicles and motorcycles. Drunk driving in tandem with motorcycle vehicles is a deadly combination. In this study, 401 motorcycle crashes were associated with alcohol intoxication. Motorcycle drivers and passengers can sustain broken bones, burns, facial fractures, limb amputations, paralysis, quadriplegia, road rash, spinal cord injuries, and traumatic brain injury.[10]

The common mode of transport within the city are private car vehicles and motorcycles, hence, it is not uncommon for these types of vehicles to be involved in road crash. In a 2020 study by the National Highway Traffic Safety Administration (NHTSA) in the United States, there is an evident disproportionate fatalities among various vehicle types used while being alcohol intoxicated. Alcohol intoxicated motorcyclists are found to be the most involved road users in fatal accidents than any other vehicle types.[11] Motorcycles are the most favorable mode of transportation in low middle income countries (LMICs) as it is relatively low cost and offers faster mobility in traffic congested areas.[12]

In terms of location of suspected alcohol intoxication cases, majority of cases came from Quezon City (n=307) and Marikina City (n=267). Quezon City comprises nearly one-fourth (23.19%) of Metro Manila's population and ranks first among highly urbanized cities in the Philippines. In 2018, Quezon City has the highest employment rate among the cities in Metro Manila.[13] Meanwhile, Marikina City experienced proliferation of industrial plants which in turn increased the working population and number of vehicles. Useche et al.[14] found that professional drivers who regularly consume alcoholic drinks have higher rates of accidents and traffic fines. Meanwhile, Gicquel et al.[15] showed in their study that those who belong in the productive age group are those who were found to have been involved in fatal accidents.

Table 1. Frequency Distribution of Variables Investigated among Suspected Alcohol Intoxication Cases (N=714)

	Frequency	Percent
Road User Fatality		
A driver is killed	14	2
A passenger is killed	8	1.1
A pedestrian is killed	4	0.6
Road User Injury		
A driver is injured	270	37.8
A passenger is injured	121	16.9
A pedestrian is injured	46	6.4
Vehicle Involvement		
A cycle/pedicab is involved in crash	25	3.5
A motorcycle is involved in crash	357	50
A tricycle is involved in crash	76	10.6
A car is involved in crash	460	64.4
A Jeepney is involved in crash	65	9.1
A taxi/FX is involved in crash	55	7.7
A bus is involved in crash	12	1.7
A van is involved in crash	30	4.2
A truck is involved in crash	31	4.3
A train is involved in crash	1	0.1
Collision Type		
Angle Impact	83	11.6
Head-on	32	4.5
Hit and Run	22	3.1
Hit Object	31	4.3
Hit Parked Vehicle	26	3.6
Hit Pedestrian	44	6.2
Multiple Collision	13	1.8
No Collision Stated	90	12.6
Other	20	2.8
Rear-end	97	13.6
Self-Accident	24	3.4
Side Swipe	148	20.7
Missing	84	
Junction Type		
Bridge/Flyover	4	0.6
Crossroads	18	2.5
Not at junction	121	16.9
Other	6	0.8
Parking Area	2	0.3
Rotunda	6	0.8
T junction	15	2.1
Tunnel/Underpass	1	0.1
U turn slot	9	1.3
Y junction	1	0.1
Missing	531	

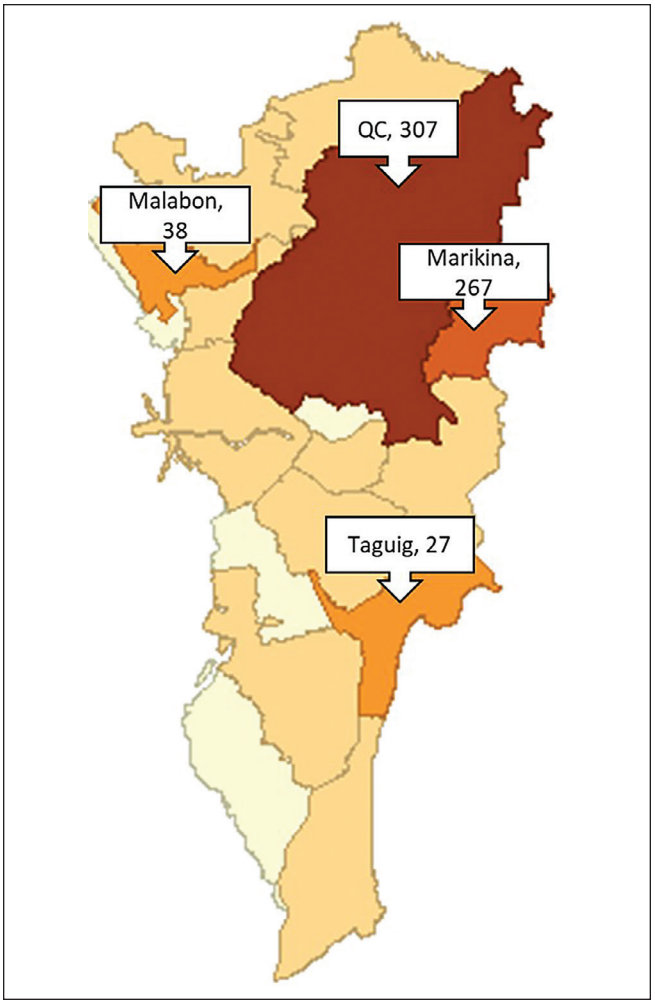

Figure 4. Location of Suspected Alcohol Intoxication Cases through the Years.

Table 2. Logistic Regression Using Alcohol Intoxication as Predictor

Road User Fatality or Injury	Parameter Estimate of Alcohol Intoxication	Standard Error	p-value	Odds Ratio of Alcohol Intoxication	95% CI for OR	
					Lower Bound	Upper Bound
Driver fatality	2.215	0.271	<.0001	9.160	5.388	15.574
Driver injury	1.653	0.077	<.0001	5.221	4.487	6.074
Passenger fatality	2.982	0.358	<.0001	19.735	9.783	39.811
Passenger injury	1.559	0.100	<.0001	4.752	3.907	5.779
Pedestrian fatality	1.020	0.502	0.042	2.772	1.037	7.413
Pedestrian injury	0.063	0.152	0.681	1.065	0.790	1.435

Table 3. Logistic Regression on Driver Fatality, Driver Injury, and Passenger Fatality among Suspected Alcohol Cases

Independent Variables	Parameter Estimate	Standard Error	p-value	Odds Ratio	95% CI for OR	
					Lower Bound	Upper Bound
Driver Fatality						
Truck Involvement	1.971	0.887	0.026	7.176	1.261	40.817
Hit Object	2.530	1.092	0.020	12.557	1.478	106.694
Constant	-2.534	0.532	<.0001	0.079		
Driver Injury						
Motorcycle involvement	1.426	0.373	<.0001	4.163	2.003	8.653
Angle impact collision	2.076	0.758	0.006	7.972	1.804	35.227
Other collision types	2.186	0.857	0.011	8.903	1.661	47.717
Side swipe	0.846	0.417	0.043	2.330	1.029	5.277
Constant	-1.362	0.301	<.0001	0.256		
Passenger Fatality						
Other Collision type	2.956	1.532	0.054	19.215	0.954	387.120
Rear-End Collision	3.057	1.252	0.015	21.255	1.827	247.294
Rotunda	2.950	1.614	0.067	19.113	0.809	451.739
Constant	-5.153	1.112	<.0001	0.006		

Table 4. Multinomial Regression on Classification of Crash among Suspected Alcohol Cases

Categories of Classification of Crash	Independent Variables	Parameter Estimate	Standard Error	p-value	Odds Ratio	95% CI for OR	
						Lower Bound	Upper Bound
Fatal	Intercept	-2.130	0.466	<.0001			
	Motorcycle Involvement	1.514	0.639	0.018	4.543	1.297	15.907
	Truck Involvement	2.430	0.958	0.011	11.355	1.737	74.233
Non-Fatal (Injurious)	Intercept	-0.085	0.229	0.710			
	Motorcycle Involvement	1.493	0.393	<.0001	4.452	2.062	9.612
	Truck Involvement	0.617	0.879	0.483	1.853	0.331	10.367

a. The reference category is: Damage to Property

Years 2011, 2012, 2013, 2018, 2019 and 2020 are identified in the MMARAS annual reports where suspected alcohol use is a top crash causation factor, regardless of the number of cases recorded. These are also among the years with the highest recorded number of driver deaths as well as passenger deaths. The cases of suspected alcohol cases vary since the level of enforcement specific for detecting intoxicated drivers also vary through the years depending on priorities set by authorities and political leaders. The number of reported cases has slightly dropped since 2013, however this may be due to the implications of the new drunk and drugged driving law which have harsher implications for offenders. Due to the legal repercussions of drunk driving, alcohol suspicion on the part of apprehending officials must be accompanied by hard evidence which is difficult to obtain considering that the number of breathalyzers is very limited especially during the early stages of implementation. But as the technology keeps up in the later years, so are the number of alcohol-related apprehensions.

Alcohol intoxication cases in road traffic is more likely to cause severe injuries and fatalities. In this study in Metro Manila, alcohol increased the risk of driver death by a factor of 9.16 (95% CI [5.388-15.574]) and driver injury by a factor of 5.22 (95% CI [4.487-6.074]). These results are similar to other studies exploring the severity of alcohol-related road crashes.[15,16] Driver deaths are more likely to occur than

injuries when a driver is found to have drunk and driven.[17] In a study in the Philippines by Marquez et al.[18], alcohol is one factor for sustaining severe injuries in road crashes since alcohol impairs normal function of the brain and central nervous system, thus, adversely affecting decision making and alertness.[19] Alcohol affects motor skills of the eye, hand, and foot coordination.[4] Globally, an average of between 11% and 17% of drivers in major regions report to have engaged in this behavior.[20]

In this study in Metro Manila, 'hit object' is 12.557 (95% CI [1.478-106.694]) times more likely to cause driver fatality. According to Insurance Institute for Highway Safety (IIHS), about 20 percent of motor vehicle crash deaths result from a vehicle leaving the roadway and hitting a fixed object alongside the road. This fixed object may be trees, utility poles, and traffic barriers. Motorists also run off the road because of excessive speeds, falling asleep, inattention or poor visibility.[21]

Meanwhile, this study in the Philippines showed that truck involvement in road crash increases driver fatality by a factor of 7.176 (96% CI [1.261-40.817]). Road traffic crashes with involvement of truck vehicle and alcohol often results to most catastrophic ones.[22]

On the other hand, side swipe increases driver injury by a factor of 2.330 (95% CI [1.029-5.277]), angle impact collision by a factor of 7.972 (95% CI [1.804-35.227]), and other collision types by 8.903 (95% CI [1.661-47.717]). Side swipe collision in combination with drink-driving is also shown in other studies to increase injury and fatality.[23] Injuries from side swipe collision comes from the direct blows to the individual caused by primary point of impact given that side structure of most vehicles is weaker compared to either front or back end. These injuries include crush injuries, broken bones and fractures, traumatic brain injuries, spinal injuries, internal bleeding or damage to organs, and severe lacerations.[23] Angle impact collision in this study in Metro Manila increases the odds of driver injury by a factor of 7.972 (95% CI [1.804-35.227]). This is similar to a study wherein occupants of vehicles involved in angle crashes were nearly 11 times more likely to be seriously/fatally injured compared to opposite direction sideswipe crashes (OR: 10.85, 95 % CI: 9.24–12.73).[24] In Brazil, dos Santos et al. showed that alcohol consumption is associated with other risky road behaviors such as speeding, failure to use helmets, and not having a driver's license.[12] Drivers who are multiple offenders of drunk driving are more likely to have injuries related to risky behaviors. More so, drunk drivers not only put themselves at risk but also other road users such as their passengers and pedestrians.

In the Philippines, efforts have been implemented to prevent fatalities from substance-related road crashes. The Anti-Drunk and Drugged Driving Act was passed in 2013. The law requires suspected drunk drivers involved in road accidents to have their blood alcohol concentration (BAC) measured.[6] Since its passing, the NCR has observed lower cases of alcohol-suspected road crashes. However, there are still gaps in the policy such as: 1) the standard cut-off point used in the Philippines is much lower than the international standards recommended by the World Health Organization (0.05 g/dL vs. 0.02 g/dL); and 2) there are limited breathalyzers available for use which affects its implementation.[1,25] In addition, the sanctions imposed in the Philippines are also lax compared to other countries. For instance, RA 10586 violators in the Philippines can only be sanctioned with penalty payment, suspension of driver's license up to 12 months, or confiscation of vehicle plate number (RA 10586, 2013).[6] In Columbia, violators can face up to 10 years of driver's license suspension with 20 to 50 hours of community work, while in Taiwan, drunk drivers causing severe injuries or death among victims can have their driver's licenses confiscated for a lifetime.[26] This calls for stricter and stronger implementation in enforcing the Anti-Drunk and Driving law in the Philippines.

This study is limited by missing cases, hence, there should be efforts by government agencies to improve the surveillance, reporting and recording road crash cases and other related information. The main cause of missing data in the MMARAS database is the quality of reporting in the police blotter reports. In many cases, it becomes impossible for authorities to indicate everything in the blotter especially in cases where the road users involved are seriously injured and hospitalized. This can be addressed with better surveillance such as closed-circuit cameras.

CONCLUSION

'Drinking and driving' is a common risky behavior. This study in Metro Manila showed that driving under the influence of alcohol will more likely cause fatalities and injuries among various types of road users - the driver, passenger, and pedestrian. Together with other risk factors such as the type of vehicle used and type of collision, alcohol was shown to increase the odds of death or injury of a driver, passenger, or pedestrian.

It is important to manage drunk driving/ drink driving cases through information and education campaigns using evidence-based data such as this study in Metro Manila using a registry of road crash cases.

Statement of Authorship

JLL contributed in the conceptualization of work, drafting and revising, and final approval of the version to be published; TJH contributed in the conceptualization of work and acquisition of data; SFL contributed in the conceptualization of work, acquisition and and analysis of data, and drafting and revising, and final approval of the version to be published.

Author Disclosure

All authors declared no conflicts of interest.

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