Polysubstance Use and Motor Vehicle Crashes in Illinois: An Exploration of Linked Crash and Hospital Data

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Research statement

Throughout this manuscript references are made to impairment and intoxicating substances, though the available data are not definitive on whether those diagnosed as such were truly intoxicated – that is, unable to adequately and safely navigate the roadway. Rather, the data indicate whether or not a substance was detected. Additionally, the presence of an intoxicating substance does not necessarily imply fault or guilt in the events leading to the crash. This manuscript utilizes linked crash and hospital files to conduct analyses, and since it is not possible to link every corresponding incident, the scale of crashes presented are likely an undercount of the true scale. For that reason, an emphasis is placed on the size and direction of proportions rather than count. As demonstrated below, the linked data are shown to be an unbiased representation of the population data.

This manuscript is intended as a high-level report on the state of substance use among those involved in motor vehicle crashes on Illinois roads. Any effect of the legalization of recreational cannabis in Illinois on roadway crashes and injuries is not yet fully understood. Substance use data among road users was aggregated for the years 2016 through 2020 and analyzed as a single combined data set. So the results as presented include pre-and-post cannabis legalization that was effective as of January 1, 2020. Any attempt to extrapolate information regarding cannabis legalization on roadway injuries would be misguided.

Unless otherwise specified, as is done in **Table 3**, presented statistics and figures are in reference to all road users: drivers, passengers, pedestrians, and cyclists – as identified in the crash file. The term *polysubstance* is in reference to the presence of more than one substance in a single patient. The hospital discharge file contains two fields for alcohol, one indicates its presence while the other indicates a blood-alcohol concentration (BAC) level above the legal driving limit of 0.08%. This research uses the presence of any alcohol level in analyses because an operator in Illinois may be legally convicted of driving under the influence even if their BAC is under the legal limit (Office of the Illinois Secretary of State). The hospital file does not indicate bodily concentrations for any other substance.

Methods and sources

Data linkage

Crash data from the Illinois Department of Transportation (IDOT) and hospital data from the Illinois Department of Public Health (IDPH) were obtained for the years 2016 through 2020 by the University of Illinois at Springfield (UIS) by way of an interagency data use agreement. Upon receipt of the data files, UIS established a probabilistic linkage methodology appropriate for the type of variables common among the disparate files. Data file linkage was accomplished using the software LinkSolv – which applies methods developed in the early 2000's by the National Highway Traffic Safety Administration's Crash Outcome Data Evaluation System program (McGlincy 2021). The LinkSolv software is especially useful for the type of data produced by states with a primate city – as Chicago is to Illinois. For example, Cook County, home to Chicago, is also home to some 40% of Illinois residents – rendering county a relatively indiscriminate field for data linking purposes.

Five data fields common to both files were determined to be those with the greatest linkage success rate: date of birth, county, crash date, age, and sex. Spatiotemporal tolerances were permitted and specified within the software between the crash and hospital files to allow for some lag between the incident (crash file) and subsequent treatment (hospital file). For example, crash date tolerances one day into the future were specified to allow for the passage of time before the crash victim could reach the hospital. Hospitals in counties bordering the county where the crash occurred were also tolerated for linking purposes, as those may have been the nearest appropriate facility.

The hospital files include rich (yet not personally identifying) individual patient data who were treated under urgent, emergency, and trauma admission types. Individual patient race, ethnicity, sex, and age are included as fields in the hospital files, among many others. A diagnosis of the presence of intoxicating substances conducted at the hospital is also included as a data field and investigated.

Data independence

Prior to data analysis, a check for independence between the linked and unlinked data files was performed. As commonly applied to large data sets, several Chi-squared (χ^2) tests were performed on variables within, and common across, the crash and hospital files that may affect the integrity of the linked data. The tested variables included two of the fields used in the data linkage process, age and sex, and were each found to have significant alpha values. A series of Cramer's V (φ_c) tests were also performed to estimate the strength of association between the crash and hospital files using the same variables (**Table 1**). Results indicate the linked data set is free of significant biases that would corrupt the outcome of analyses performed.

Table 1: Chi-squared and Cramer's V tests of unlinked struck cyclists

Characteristic	χ^2	Φ_c	*p*
Age	498	.477	<.01
Race	88.4	.201	<.001
Sex	14.5	.081	.013

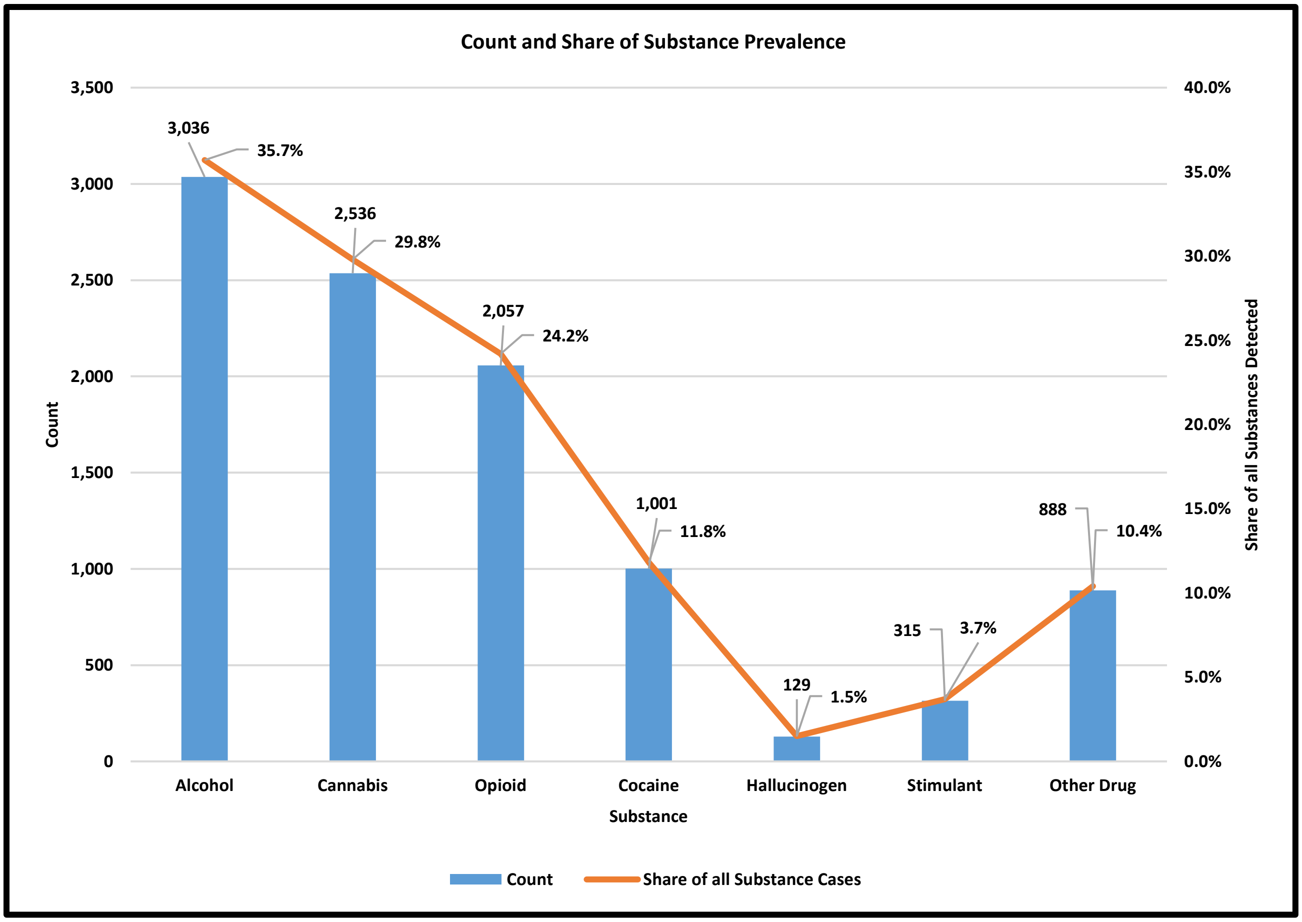
Results

The following sections utilize 337,418 linked crash and hospital discharge observations, or patients, from 2016 through 2020 to establish an understanding of the current state of substance use on Illinois roadways among those involved in a motor vehicle crash. Text analyzing and contextualizing the presented figures and tables accompanies each section. Though the reader is encouraged to study the details of presented figures and tables as the full extent of insights provided is not covered in the text alone.

Substance use and crashes

Figure 1 establishes the prevalence of individual substances for which a crashed road user was diagnosed. The alert reader will notice the sum of substance shares totals more than 100%, this is because the denominator used in the calculation is the number of crashes involving a substance. Since substances are used in combination with others, there are more substance uses than crashes involving substances. Alcohol is the most commonly used substance with nearly 2/3 of crashes, followed by cannabis with almost 30%, then by opioids at close to a quarter of crashes.

*Figure 1: Prevalence of substances among all road users involved in a motor vehicle crash**



**Because of polysubstance use, shares do not add to 100%*

Polysubstance use and crashes

Using linked Illinois crash and hospital discharge data from 2016 through 2020, 0.354% (1,193) of crashes involved drivers, passengers, pedestrians, and cyclists who were identified as having two or more intoxicating substances in their system. Though each road user type is represented in the data as testing positive for at least two substances, drivers accounted for more than ¾ of polysubstance crashes. **Table 2** shows that other vehicle occupants (passengers) represented the second greatest share, followed by pedestrians and cyclists, respectively, of road users testing positive for multiple substances. Additionally, some 2.52% (8,501) of linked crashes were identified in which a road user was diagnosed as positive for at least one intoxicating substance.

Polysubstance use by road user type

Table 2: Distribution of polysubstance use in crashes by road user type

Road User	Polysubstance Crash Count	Share of Polysubstance Crashes	At Least One Substance Count	Share of at Least One Substance
Driver	915	76.7%	6,568	77.3%
Passenger	180	15.1%	1,354	15.9%
Pedestrian	71	5.94%	435	5.11%
Cyclists	27	2.26%	144	1.69%

Where **Table 2** communicates the distribution of road user type across polysubstance crashes, **Table 3** digs a bit deeper by analyzing the types of substances commonly associated with road user types. For example, among drivers involved in crashes alcohol was the most common substance found at 38% of drivers with at least one intoxicating substance. Also among drivers, cannabis was second common at 28% followed closely by opioids at 25%. Among passengers, cannabis was the most frequently occurring substance at 41%, followed by alcohol at 28%. About a third of struck pedestrians who were identified as having an intoxicating substance in their system had used alcohol. Also among those pedestrians, some 28% had opioids, and a quarter had cannabis, followed closely by cocaine at 22%. Struck cyclists later diagnosed at the hospital as positive for an intoxicating substance most commonly had used cannabis, at 39% of such cases. Cocaine (27%), opioid (26%), and alcohol (26%) use split most of the remaining cases involving struck cyclists. Finally, among struck pedestrians, the share positive for cocaine was double that of drivers, and among struck cyclists, the share was nearly two and a half times the rate.

*Table 3: Distribution of substance use by road user type**

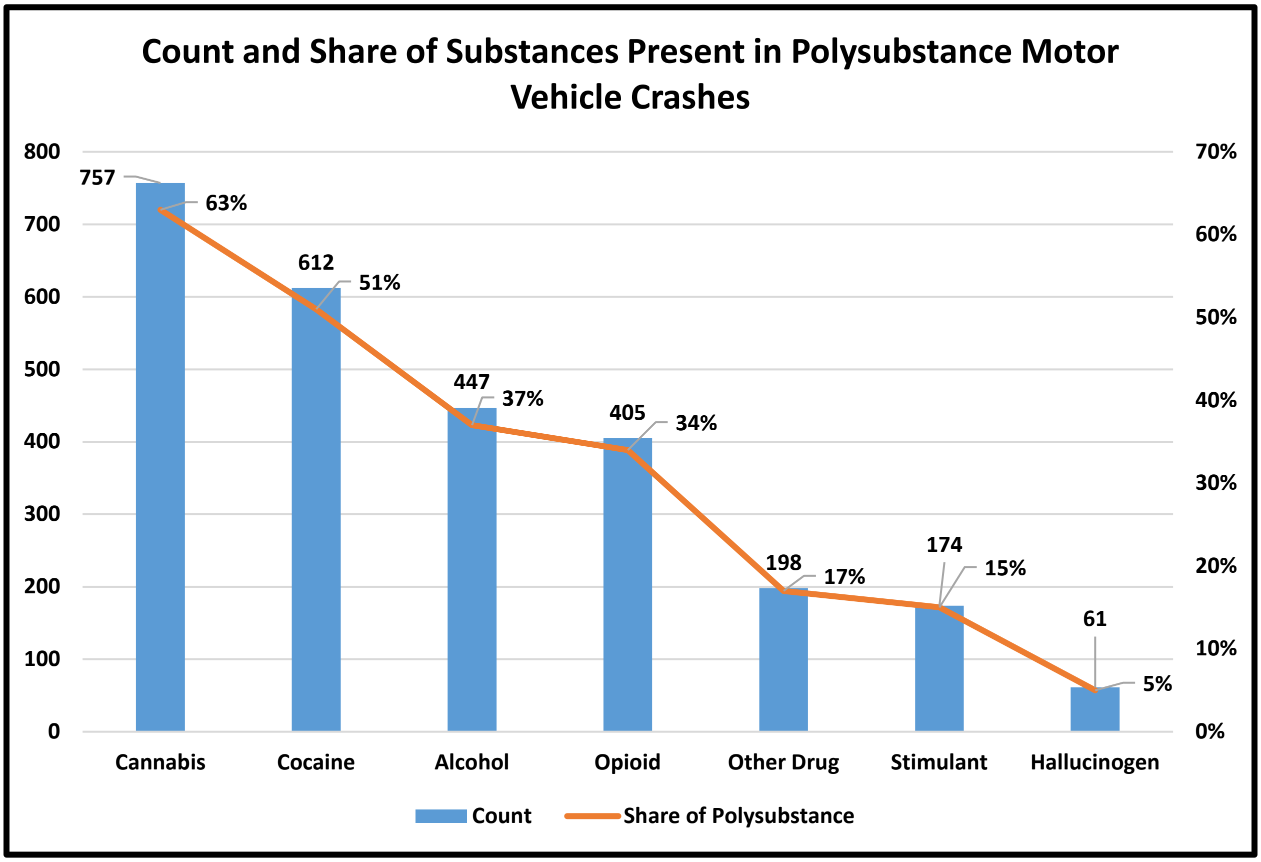
Substance	Driver	Share of Drivers	Passenger	Share of Passengers	Pedestrian	Share of Pedestrians	Cyclist	Share of Cyclists
Alcohol	2470	38%	385	28%	144	33%	37	26%
Cannabis	1814	28%	556	41%	110	25%	56	39%
Opioid	1613	25%	286	21%	121	28%	37	26%
Cocaine	743	11%	133	10%	95	22%	39	27%
Hallucinogen	103	2%	18	1%	-	-	-	-
Stimulant	240	4%	58	4%	12	3%	-	-
Other Drug	727	11%	120	9%	29	7%	12	8%

**Because of polysubstance use columns do not add to 100%; "-" denotes cell count less than 10*

Substance combinations

Figure 2 shows the frequency and share of all polysubstance crashes for the six substances for which patients are tested and data available in the hospital discharge file. The most frequently combined substance was cannabis, with nearly two-thirds, or 757 incidents, of polysubstance crashes involving the drug. Cocaine was the second-most frequently occurring at 51%, 612 incidents, of crashes. Alcohol and opioids had a similar frequency and share among polysubstance crashes at 447 cases or 37%, and 405 cases or 34%, respectively.

Figure 2: Count and share of substances present in polysubstance motor vehicle crashes among all road users



Frequency of combined substances

Figure 3 (and supplemental **Table 3.1**) shows the distribution and frequency for which substances were used in combination among all road users involved in a motor vehicle crash. Some 960 crashes involved a combination of two substances, 199 involved three, and 33 involved four substances present in a single road user.

The combination of cannabis and cocaine was the most frequently occurring dual substance among those treated for injuries sustained in a motor vehicle crash at 33% of cases (318) with two substances present. Cannabis and alcohol was the second most frequently detected at just over a quarter (246) of dual substance cases. Opioids and cocaine, cannabis and opioids, and alcohol and cocaine are the third, fourth, and fifth most frequently occurring combinations, respectively. Of the top five most frequently occurring combinations cannabis and cocaine are both involved in three, followed by alcohol and opioids which are both involved in two. Further, cannabis is involved in half of the top ten substance combinations. Opioids and cocaine are involved in four of the top ten combinations and alcohol is involved in three. These findings as presented in **Figure 3** and **Table 3.1** suggest that cannabis is the most frequently dually combined substance among those involved in a crash.

Figure 3: Distribution and frequency of combined substances among all road users

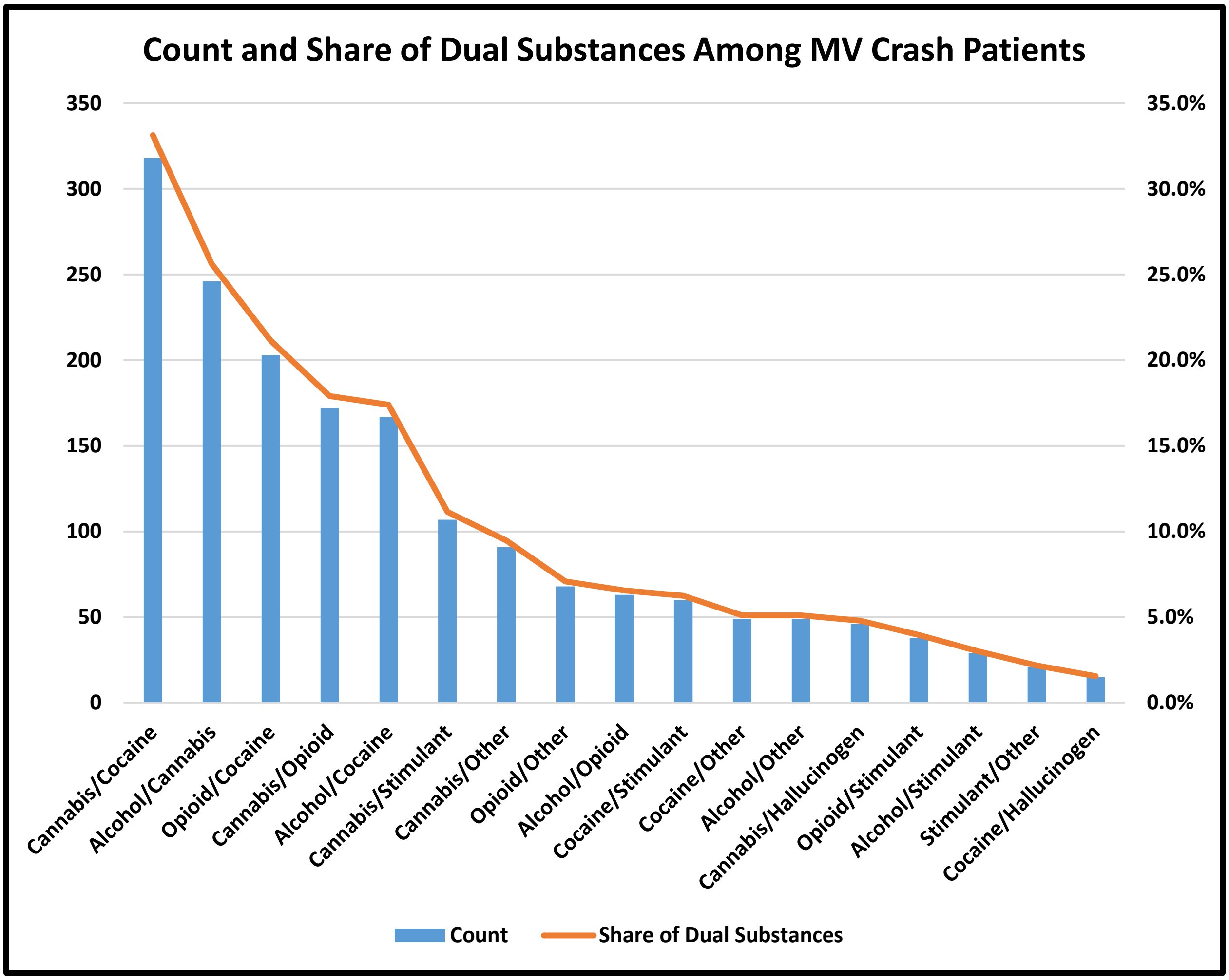


*Table 3.1: Count and share of dual substances among MV crash patients**

	Cannabis/ Cocaine	Alcohol/ Cannabis	Opioid/ Cocaine	Cannabis/ Opioid	Alcohol/ Cocaine	Cannabis/ Stimulant	Cannabis/ Other	Opioid/ Other	Alcohol/ Opioid	Cocaine/ Stimulant	Cocaine/ Other	Alcohol/ Other	Cannabis/ Hallucinogen	Opioid/ Stimulant	Alcohol/ Stimulan t	Stimulant/ Other	Cocaine/ Hallucinogen
Count	318	246	203	172	167	107	91	68	63	60	49	49	46	38	29	21	15
Share	33%	26%	21%	18%	17%	11%	9.5%	7.1%	6.6%	6.3%	5.1%	5.1%	4.8%	4.0%	3.0%	2.2%	1.6%

**Four combinations involving hallucinogens were omitted to comply with the interagency DUA*

When the analysis is taken one step further to explore combinations of three substances among those involved in a crash, cannabis stands out yet again. Of the 199 cases involving three substances, cannabis was one of the combined drugs in 164 of them. The prevalence of cocaine was close behind at 145 cases, opioids at 94, and alcohol at 85 of the tri-substance incidents. Among all road users involved in a motor vehicle crash who were positive for four substances, cannabis was present in 28 of the 33 patients. Cocaine was present in 26, opioids 24, stimulants 18, and alcohol 13 of the crash patients. Finally, the "other drug" category showed up in 17 of the patients who had four substances detected.

Polysubstance combinations by road user type

Table 4 displays the distribution of the count and share of dual-substance combinations by road user type. Among crashed drivers who had at least two substances present in their system, the combination of cannabis and cocaine was the most prevalent at almost 35% of such drivers. The combination of cannabis and alcohol was the second most frequently occurring combination at almost 28% of cases, followed by cannabis and opioids at 19%, and finally alcohol and cocaine at 18.3%. Among passengers involved in a crash with a combination of at least two substances, a statistical tie emerges between cannabis and alcohol at 23.9% (38 cases) and cannabis and cocaine at 23.3% (37 cases). Also among passengers, cannabis and stimulants (15.7%, 25 cases) and cannabis and opioids (15.1%, 24 cases) come up third and fourth, respectively. All but three substance combinations for pedestrians are redacted for DUA compliance reasons, yet opioids and cocaine (38%, 23 cases), cannabis and cocaine (34%, 21 cases), and alcohol and cocaine (23%, 14 cases) represent the most frequently occurring substances. Another statistical tie emerges among cyclists struck by a motor vehicle with at least two substances present between cannabis and cocaine (55%, 11 cases) and opioids and cocaine (50%, 10 cases).

*Table 4: Dual-substance combinations by road user type**

		AlcCan	AlcOpi	AlcCoc	AlcHal	AlcSti	AlcOth	CanOpi	CanCoc	CanHal	CanSti	CanOth	OpiCoc	OpiHal	OpiSti	OpiOth	CocHal	CocSti	CocOth	HalSti	HalOth	StiOth
Driver	*Count*	198	48	132	-	24	42	137	249	34	76	72	149	-	36	62	12	52	40	-	-	20
	Share of Drivers	27.5%	6.7%	18.3%	-	3.3%	5.8%	19.0%	34.6%	4.7%	10.6%	10.0%	20.7%	-	5.0%	8.6%	1.7%	7.2%	5.6%	-	-	2.8%
Passenger	*Count*	38	-	19	-	-	-	24	37	-	25	13	21	-	-	-	-	-	-	-	-	-
	Share of Passengers	23.9%	-	11.9%	-	-	-	15.1%	23.3%	-	15.7%	8.2%	13.2%	-	-	-	-	-	-	-	-	-
Pedestrian	*Count*	-	-	14	-	-	-	-	21	-	-	-	23	-	-	-	-	-	-	-	-	-
	Share of Pedestrians	-	-	23%	-	-	-	-	34%	-	-	-	38%	-	-	-	-	-	-	-	-	-
Cyclist	*Count*	-	-	-	-	-	-	-	11	-	-	-	10	-	-	-	-	-	-	-	-	-
	Share of Cyclists	-	-	-	-	-	-	-	55%	-	-	-	50%	-	-	-	-	-	-	-	-	-

** ”-“ Denotes cell count of less than 10; shares do not add to 100%*

Hospital charges and substances

Figure 4 portrays the distribution of hospital charges of linked data for the treatment of all road users involved in a motor vehicle crash between 2016 and 2020 stratified by the presence of intoxicating substances. A clear association is made evident between the presence of one or more intoxicating substances and increased hospital charges. The average hospital charge to treat a patient with three substances present was nearly $75,000, or more than seven times the cost to treat someone involved in a crash with no substances present. When looking at median charges the contrast between zero and three substances becomes even starker. The median charge to treat a patient with three substances present was over $36,000, or 9.5 times the median cost to treat a patient with no substances present. The quite large standard deviations, and long right tails in the distribution curves, reflect the unpredictable nature of motor vehicle crashes. That is, some suffered severe injury requiring extensive medical treatment while others escaped with relatively minor injuries. Those with four substances present represented a relatively small sample of 33, which may have contributed to that cohort having a relatively lower average and median treatment cost but similar standard deviation.

Figure 4: Distribution of hospital charges by number of substances present in crash patient

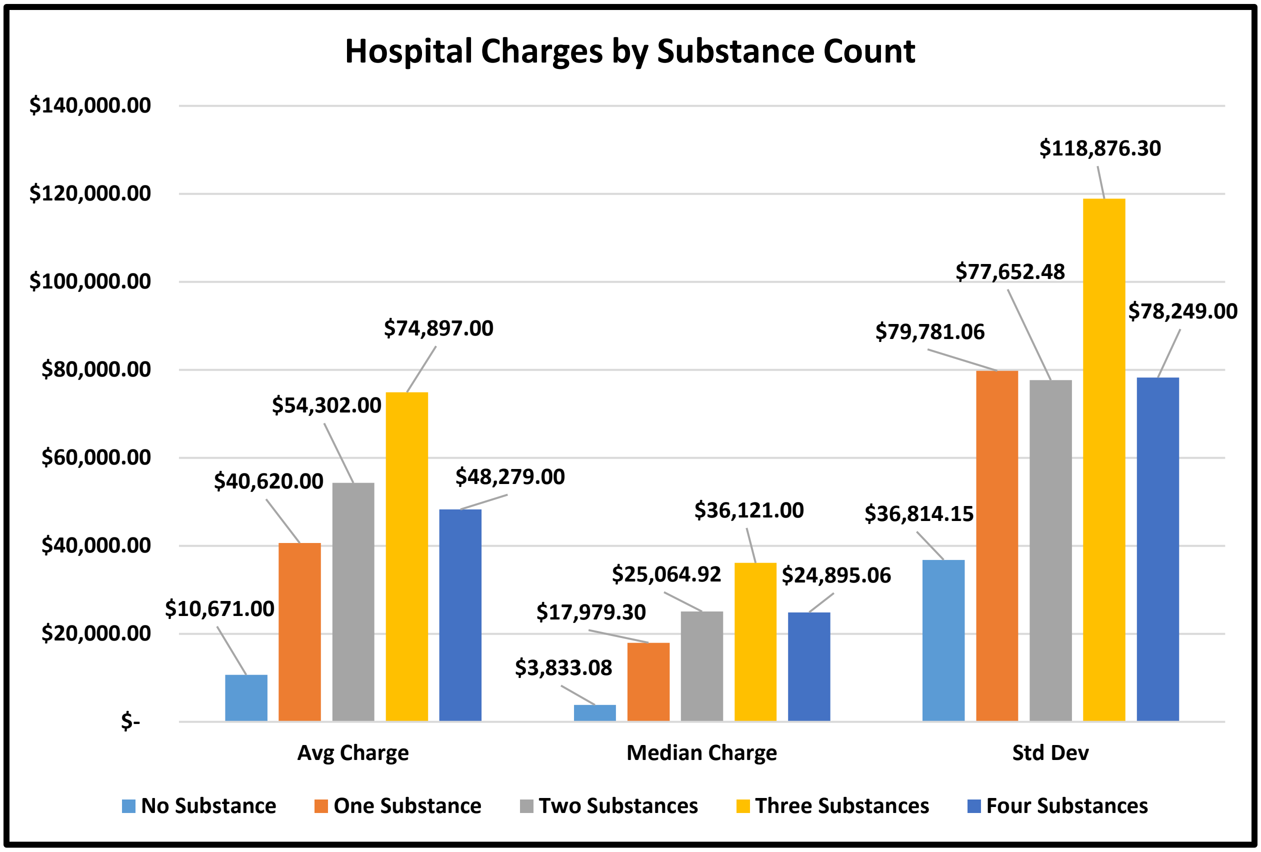
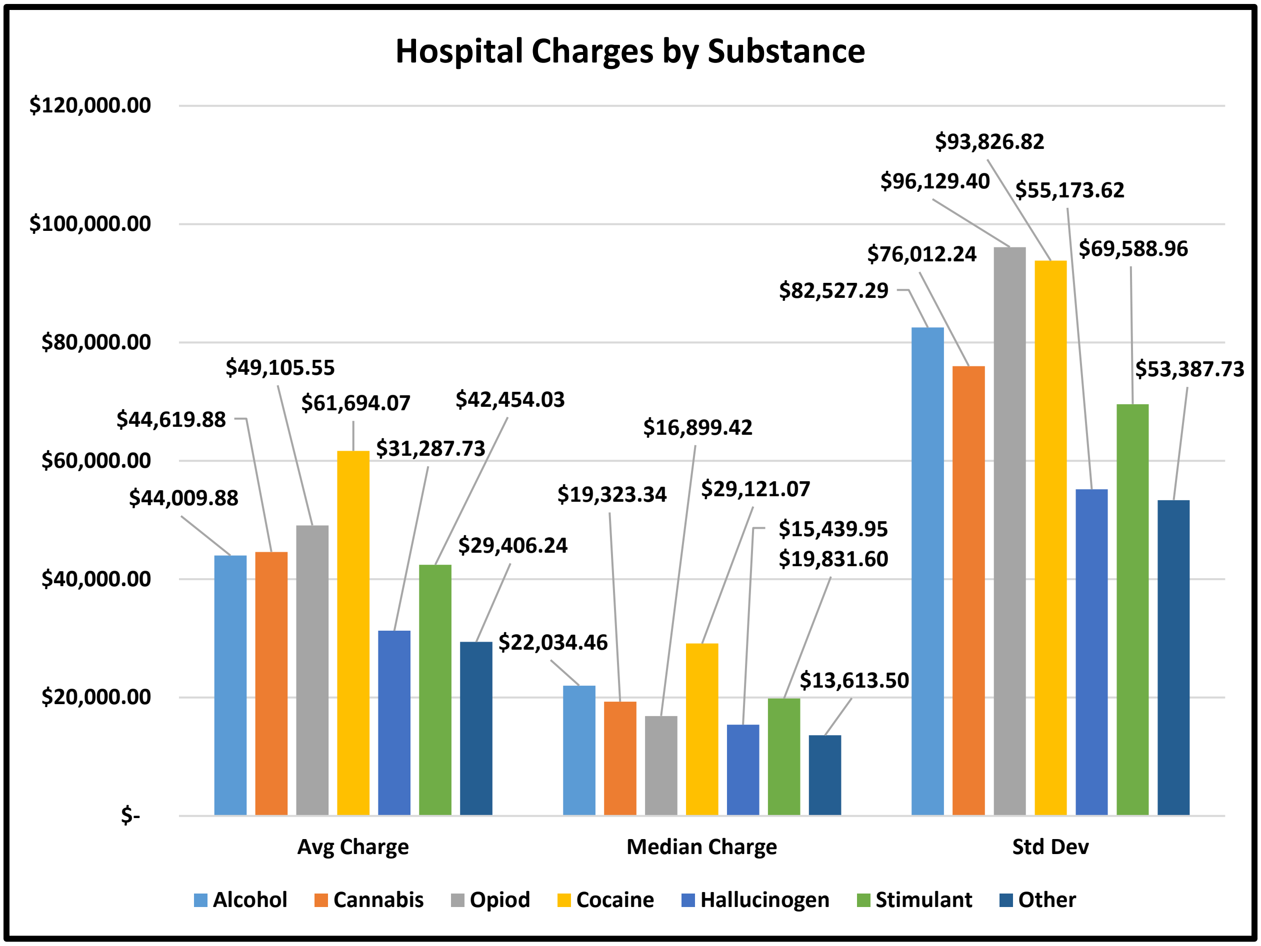


Figure 5 depicts the distribution of hospital charges by substance type present in the motor vehicle crash patient receiving treatment. Patients positive for cocaine (n=1,001) had the highest average and median hospital charges at nearly $62,000 and almost $30,000, respectively, across all substances. Patients positive for opioids (n=2,057) had the second highest average treatment charge at greater than $49,000, or $12,500 (20%) less than cases involving cocaine. Though cocaine cases remain among those with the highest charges both by average and by median, the other substances change rank positioning a bit between the measures. The standard deviation of charges by substance type plays a key role in interpreting the results in **Figure 5**. Once more, charge distributions have a long right-sided tail and large standard deviations. Those large standard deviations combined with big averages and smaller median charges imply wide variation in charge distribution, along with some very high outlier charges that work to inflate averages.

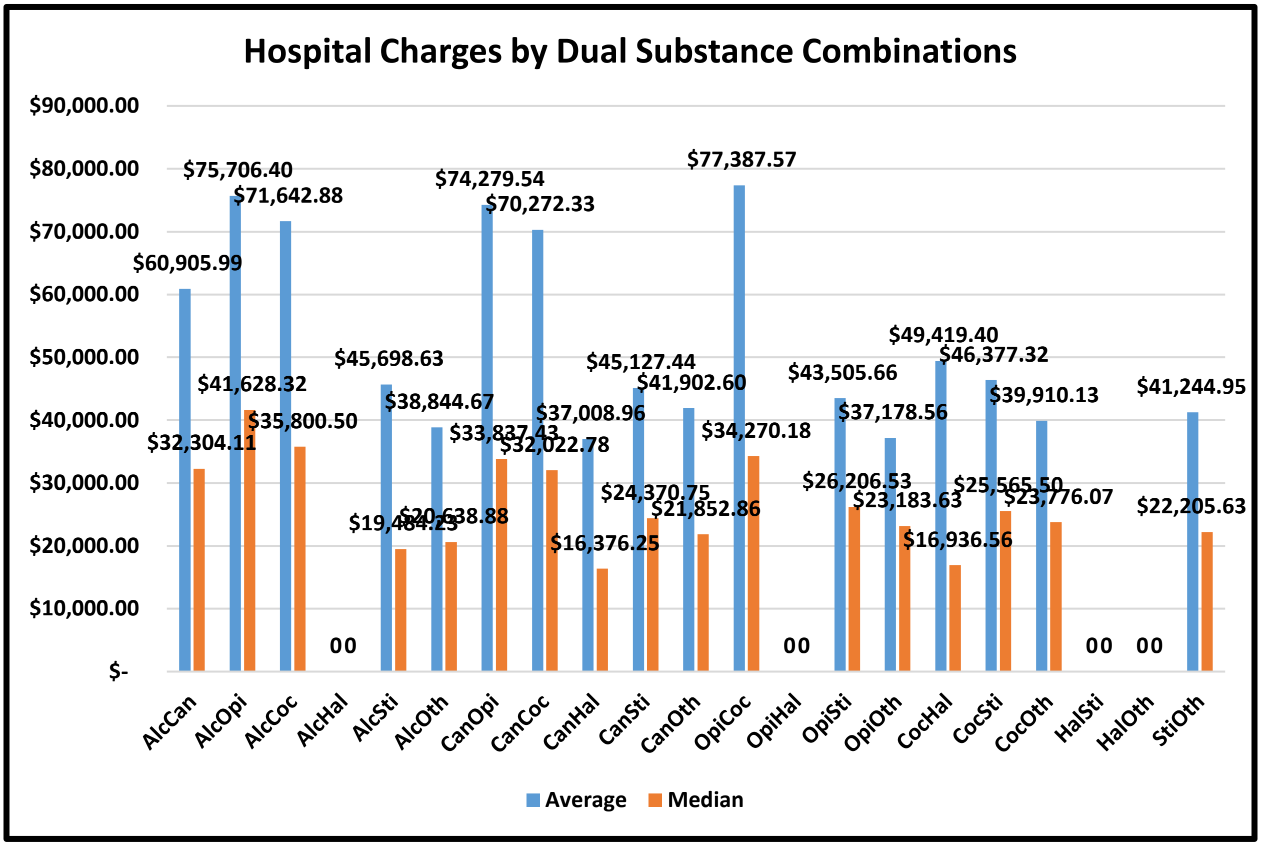
*Figure 5: Distribution of hospital charges by substance**



**Alcohol n = 3,036; Cannabis n = 2,536; Opioid n = 2,057; Cocaine n = 1,001; Hallucinogen n = 129; Stimulant n = 315; Other Drug n = 888*

Figure 6 (and supplemental **Table 6.1**) displays the distribution of hospital charges by dual substance combinations of all road users involved in a motor vehicle crash. Once more, averages are much higher than median charges, reflective of some very high individual cases – also resulting in quite large standard deviations. Sample sizes here a smaller than those presented in **Figure 5** above, which may permit some of those averages to be artificially inflated. Still, substance combinations with the highest charges are among those with the largest sample size – opioid and cocaine average the highest hospital charge and have the third largest sample size of 203.

*Figure 6: Hospital charges by dual substance combinations of motor vehicle crash patients**



**Alcohol and Hallucinogens, Opioids and Hallucinogens, Hallucinogens and Stimulants, and Hallucinogens and "other" were omitted for cell counts of less than 10*

Table 6.1: Supplemental table to Figure 6

	AlcCan	AlcOpi	AlcCoc	AlcHal	AlcSti	AlcOth	CanOpi	CanCoc	CanHal	CanSti	CanOth
Average	$60,905.99	$ 75,706.40	$ 71,642.88	-	$45,698.63	$ 38,844.67	$ 74,279.54	$ 70,272.33	$37,008.96	$45,127.44	$ 41,902.60
Median	$32,304.11	$ 41,628.32	$ 35,800.50	-	$19,484.23	$ 20,638.88	$ 33,837.43	$ 32,022.78	$16,376.25	$24,370.75	$ 21,852.86
Std Dev	$76,913.56	$ 86,924.21	$100,100.64	-	$69,434.46	$ 45,077.43	$123,800.54	$107,069.54	$70,926.89	$64,246.65	$ 55,967.95
n =	246	63	167	-	29	49	172	318	46	107	91

	OpiCoc	OpiHal	OpiSti	OpiOth	CocHal	CocSti	CocOth	HalSti	HalOth	StiOth
Average	$77,387.57	-	$ 43,505.66	$37,178.56	$49,419.40	$ 46,377.32	$ 39,910.13	-	-	$41,244.95
Median	$34,270.18	-	$ 26,206.53	$23,183.63	$16,936.56	$ 25,565.50	$ 23,776.07	-	-	$22,205.63
Std Dev	$123,891.5	-	$ 48,413.52	$48,640.29	$103,082.5	$ 73,307.48	$ 42,021.35	-	-	$56,555.96
n =	203	-	38	68	15	60	49	-	-	21

Injury severity by substance type

Figure 7 (and supplemental **Table 7.1**) shows the injury severity of all road users involved in a motor vehicle crash by the substance found in their system. For this analysis the linked KABCO injury severity score native to the crash file was used. The far-right column of **Table 7.1** displays the total number (n) of observations for each severity level – by which the injury severity share was calculated.

As made clear in **Figure 7**, the share of cases involving substances generally increases as injury severity becomes more severe. Though the linked data unfortunately become less useful when examining fatal incidents, of which this data set contains 1,842 cases according to the crash file. The lack of fidelity regarding fatal crashes could be due to any number of complicating treatment and/or administrative factors resulting in the decedent going untested for substances.

Figure 7: Share of KABCO injury severity scores by substance

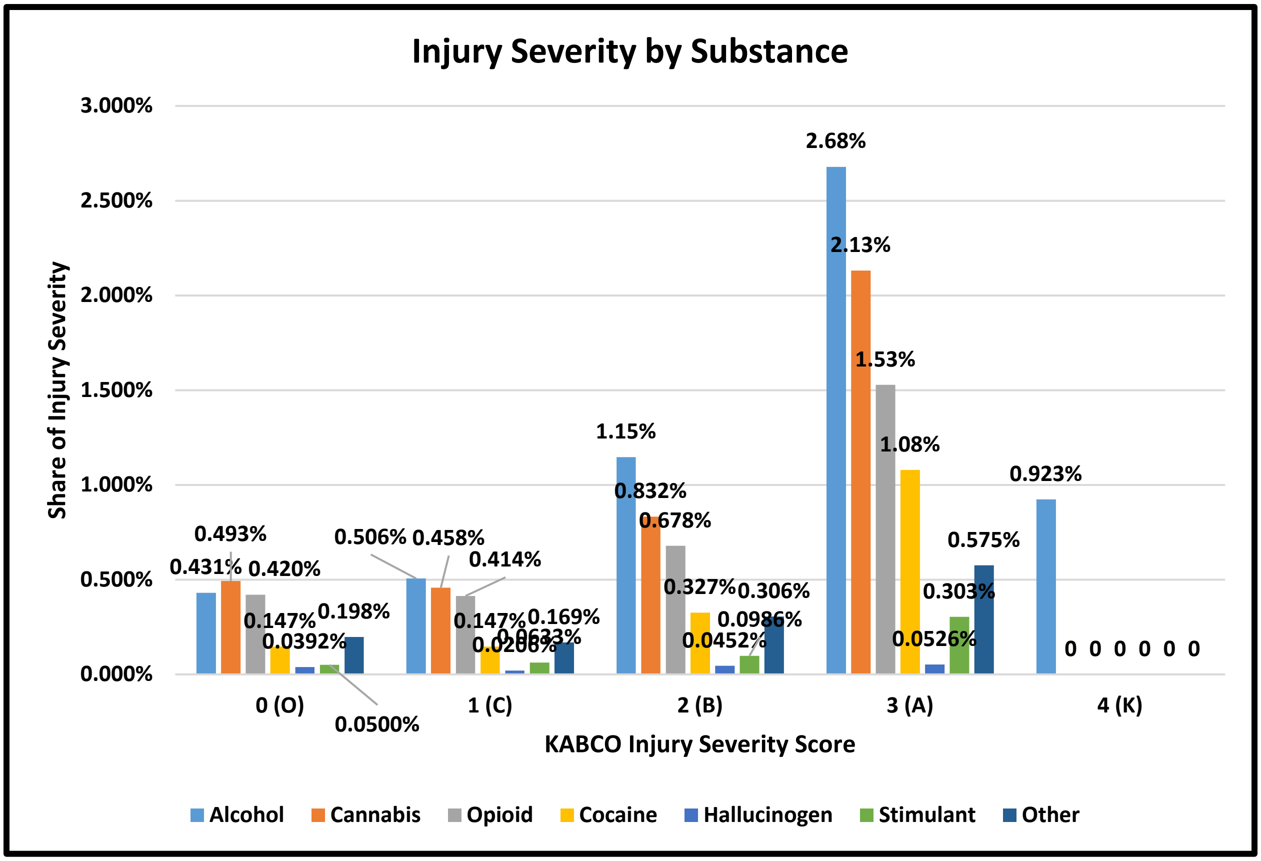


*Table 7.1: Supplemental table of injury severity by substance type**

Injury		Alcohol	Cannabis	Opioid	Cocaine	Hallucinogen	Stimulant	Other	n
0 (O)	Count	517	591	504	176	47	60	237	119,975
	Share	0.431%	0.493%	0.420%	0.147%	0.0392%	0.0500%	0.198%	
1 (C)	Count	368	333	301	107	15	46	123	72,715
	Share	0.506%	0.458%	0.414%	0.147%	0.0206%	0.0633%	0.169%	
2 (B)	Count	1,268	920	750	361	50	109	338	110,558
	Share	1.15%	0.832%	0.678%	0.327%	0.0452%	0.0986%	0.306%	
3 (A)	Count	866	689	494	349	17	98	186	32,328
	Share	2.68%	2.13%	1.53%	1.08%	0.0526%	0.3031%	0.5754%	
4 (K)	Count	17	-	-	-	-	-	-	1,842
	Share	0.923%	-	-	-	-	-	-	

**0 (O) = No apparent injury; 1 (C) = reported/not evident; 2 (B) = non-incapacitating injury; 3 (A) = incapacitating injury; 4 (K) = fatal; "-" indicates cell count of less than 10*

Injury severity by substance count

Figure 8 (and supplemental **Table 8.1**) shows the relationship between the number of distinct substances present in a single patient and that patient's injury severity level suffered during a motor vehicle crash. Beginning with road users who suffered no apparent injury as a result of their crash, the blue bar in **Figure 8**, we see the share who escape uninjured diminishes quickly as substance count increases. Nearly 36% of road users suffered no injuries from their crashes when they had zero substances in their system. Among road users with three substances present, the share of the uninjured fell to just 17.6% - less than half of those without substances present. A similar trend holds for those with minor injuries (KABCO scale of C, the orange bars in **Figure 8**) – as substance count increases the share of minor injuries decreases in turn.

Among moderate, non-incapacitating injuries (KABCO scale of B, the gray bars in **Figure 8**) an increase in share is clear by moving from zero substances to one – a greater share of moderate injuries as substances become present. Yet moving up to additional substances beyond one does not seem to have a significant effect on this classification of injury. However, the share of severe, incapacitating injuries (KABCO scale of A, yellow bars in **Figure 8**) increases significantly as the quantity of substances present increases. Findings suggest a positive relationship between severe injury and the quantity of substances used among all road users involved in a motor vehicle crash.

Figure 8: Injury severity (colored bars) by quantity of substances present in motor vehicle crash patient

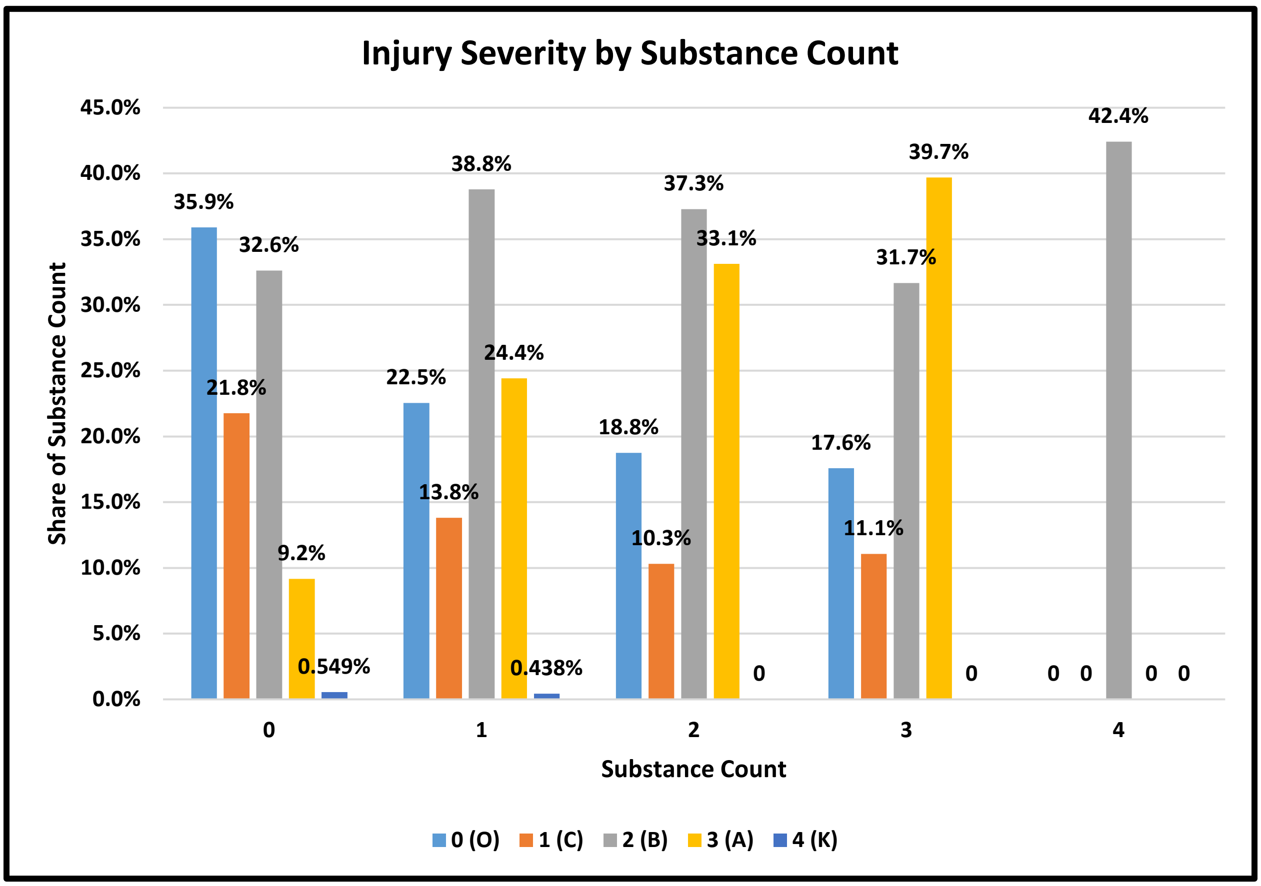


*Table 8.1: Supplemental table of injury severity by substance count**

		KABCO Injury Severity					
Substance Count		0 (O)	1 (C)	2 (B)	3 (C)	4 (K)	n
0	Count	118,108	71,580	107,288	30,136	1,805	328,917
	Share of Substance	35.9%	21.8%	32.6%	9.16%	0.549%	
1	Count	1,647	1,009	2,835	1,785	32	7,309
	Share of Substance	22.5%	13.8%	38.8%	24.4%	0.438%	
2	Count	180	99	358	318	-	960
	Share of Substance	18.8%	10.3%	37.3%	33.1%	-	
3	Count	35	22	63	79	-	199
	Share of Substance	17.6%	11.1%	31.7%	39.7%	-	
4	Count	-	-	14	-	-	33
	Share of Substance	-	-	42.4%	-	-	

**0 (O) = No apparent injury; 1 (C) = reported/not evident; 2 (B) = non-incapacitating injury; 3 (A) = incapacitating injury; 4 (K) = fatal; "-" indicates cell count of less than 10*

Injury severity by polysubstance combinations

Figure 9 (and supplemental **Table 9.1**) displays the relationship between polysubstance combinations and the injury severity of the road user involved in a motor vehicle crash. When analyzed in this fashion, some of the cell counts become relatively small and must be redacted – which explains why **Figure 9** appears to be missing some bars. For example, some dual polysubstance combinations do not appear in **Figure 9** at all, like hallucinogens and stimulants – because there were fewer than ten crashes involving such a combination. For other combinations, like alcohol and stimulants, just one injury severity score within that combination had a large enough sample to be displayed.

Though the disaggregation of the data may create a few small numbers, the results are still useful and provide meaningful insight. For example, **Figure 9** makes clear that road users positive for two substances involved in a motor vehicle crash were much more likely to sustain more severe injuries (gray and yellow bars) than less severe injuries (light blue and orange bars). Trends in injury severity between substance combinations remained relatively steady with non-incapacitating and incapacitating injuries representing most of the crash outcomes. Results here generally reflect and support analyses presented above which examined hospital charges and substance combinations – more severe injuries resulted in higher hospital charges. **Figure 9** also complements **Figure 8** which showed that road users with no substances present were much more likely be uninjured in a motor vehicle crash. **Figure 9** shows the inverse: road users with the presence of any combination of substances were much less likely to be uninjured in a motor vehicle crash. Once more, no fatalities appear in **Figure 9** – this lack of data is likely due to difficulties in obtaining a chemical sample or assessing the behavior of the decedent.

Figure 9: Injury severity by polysubstance combinations

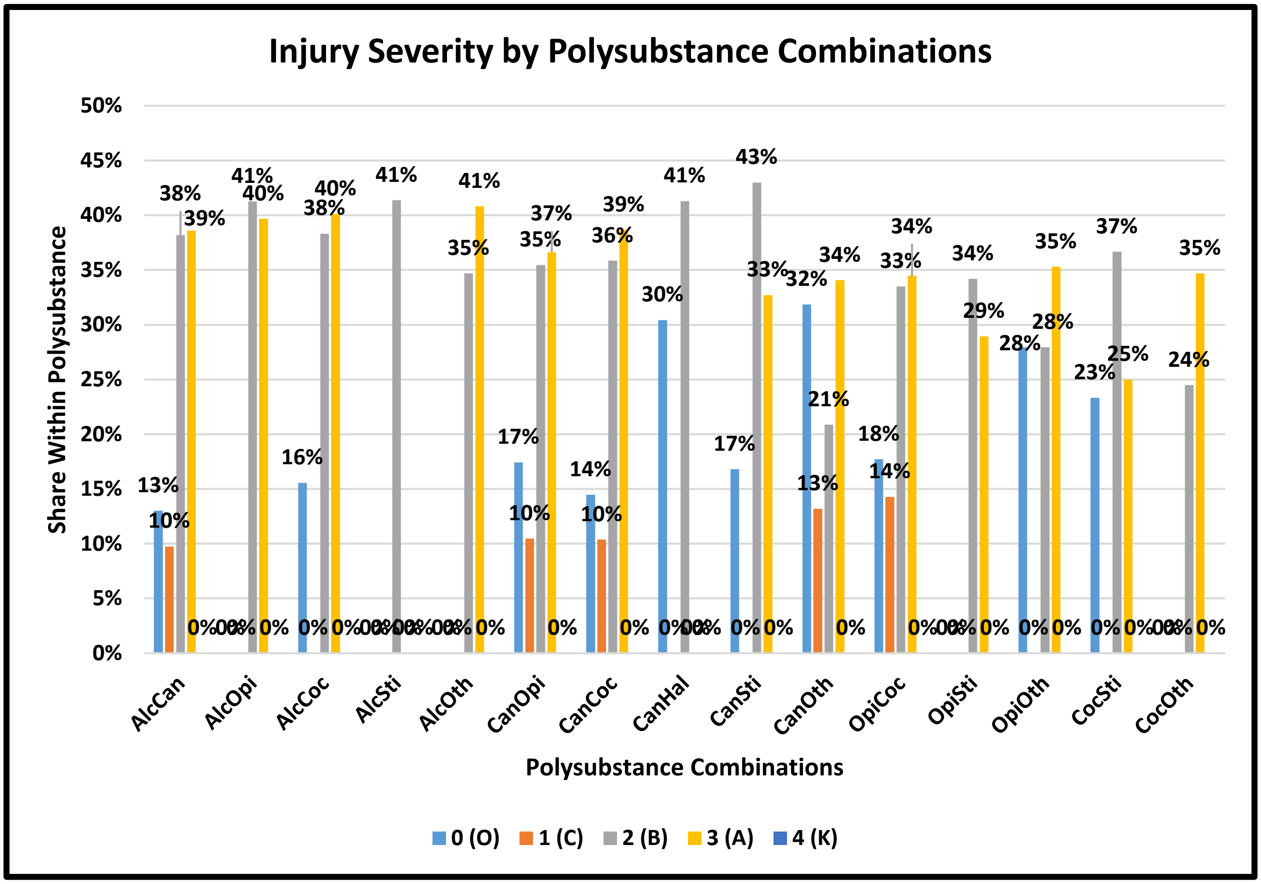


Table 9.1: Supplemental table of injury severity by polysubstance combinations

	AlcCan	AlcOpi	AlcCoc	AlcSti	AlcOth	CanOpi	CanCoc	CanHal	CanSti	CanOth	OpiCoc	OpiSti	OpiOth	CocSti	CocOth
0 (O)	13%	-	16%	-	-	17%	14%	30%	17%	32%	18%	-	28%	23%	-
1 (C)	10%	-	-	-	-	10%	10%	-	-	13%	14%	-	-	-	-
2 (B)	38%	41%	38%	41%	35%	35%	36%	41%	43%	21%	33%	34%	28%	37%	24%
3 (A)	39%	40%	40%	-	41%	37%	39%	-	33%	34%	34%	29%	35%	25%	35%
4 (K)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

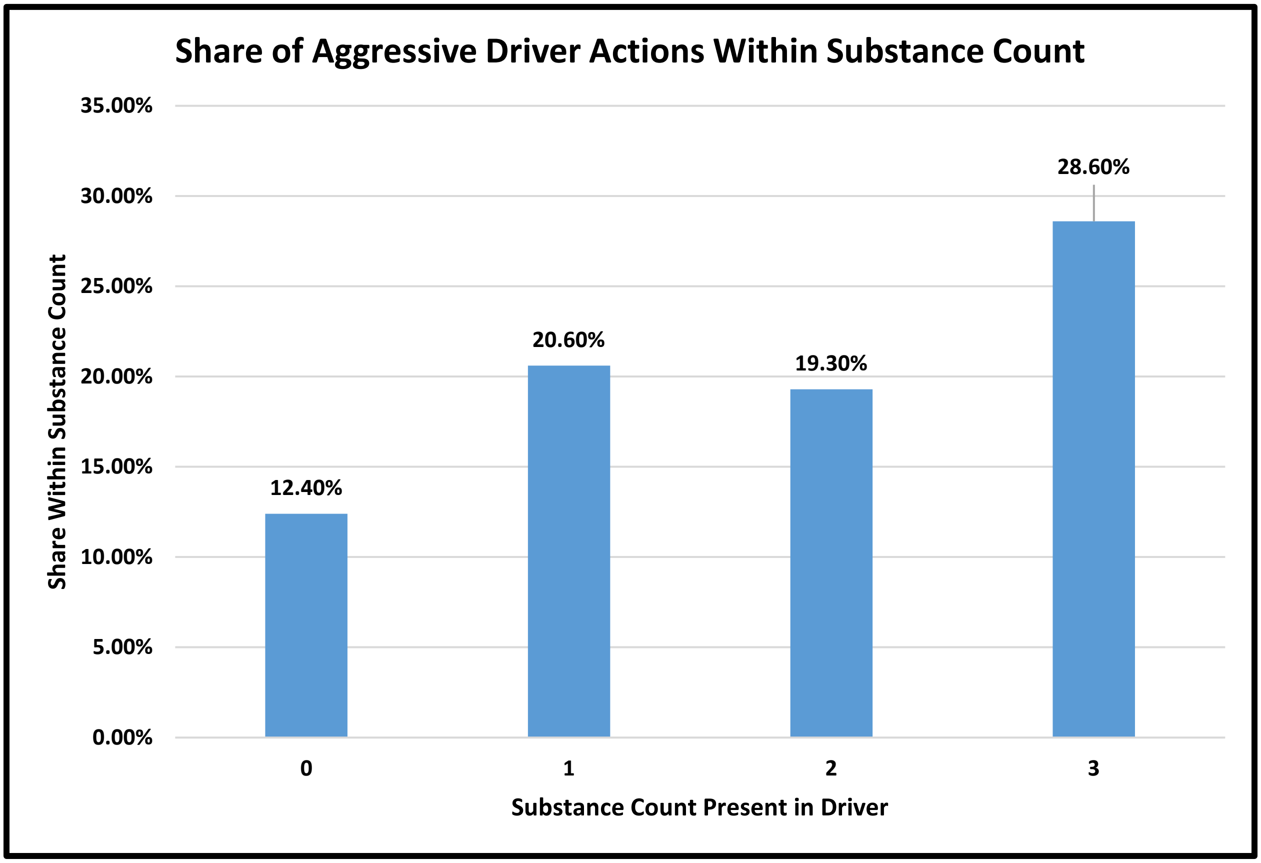
**0 (O) = No apparent injury; 1 (C) = reported/not evident; 2 (B) = non-incapacitating injury; 3 (A) = incapacitating injury; 4 (K) = fatal; "-" indicates cell count of less than 10*

Substance use and aggressive driving

Another potentially useful line of inquiry lies in examining driving behaviors of those involved in motor vehicle crashes. The linked crash and hospital data provide an opportunity to study not just driving behavior like aggressive actions, but also the association between those actions and the presence of specific substances and substance combinations. Aggressive driver actions were considered the following: disregarded control devices, evading police vehicle, failed to yield, followed too closely, improper backing, improper lane change, improper passing, improper turn, too fast for conditions, and wrong way/side. Among the linked data, 42,376 cases were identified as a crash involving an aggressive driver action. Among those, 1,754 (4.1%) were later diagnosed as positive for having an intoxicating substance in their system. Among those aggressive, crashed drivers with a substance in their system, 245 (14%) were positive for two or more substances. Some 185 had two substances, 57 had three, and 3 more made up the remainder.

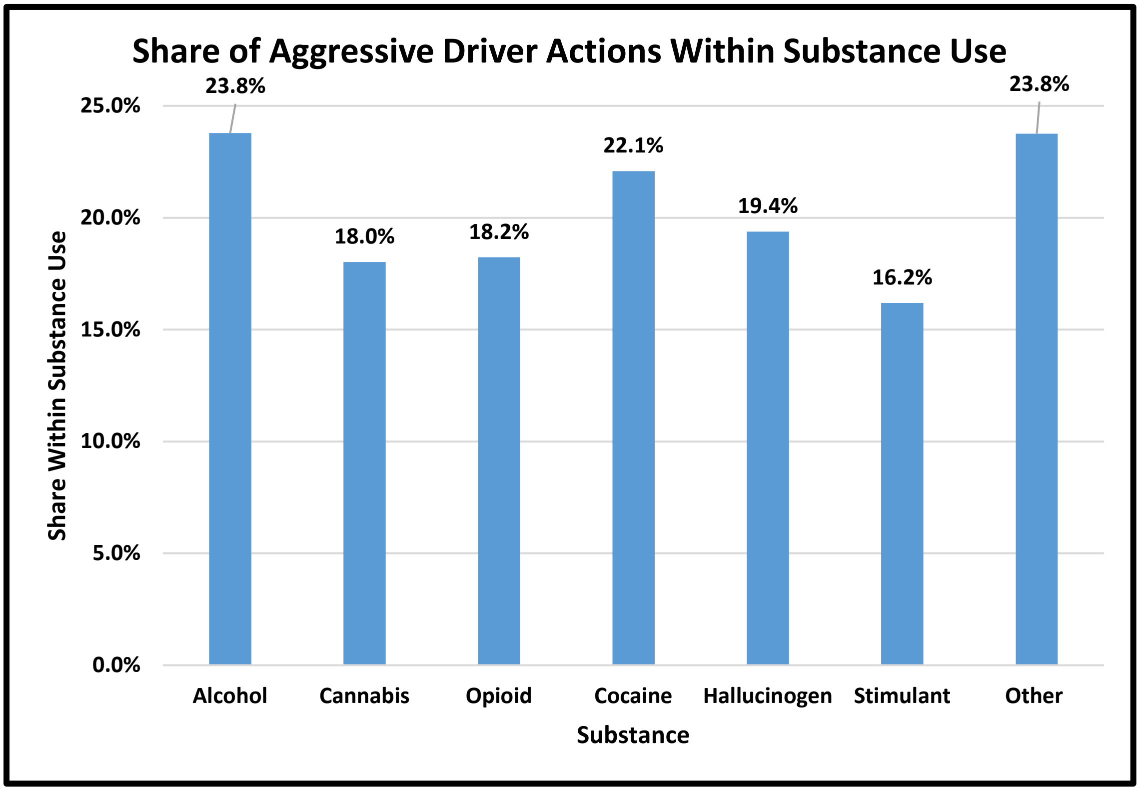
Figure 10 displays the share of drivers engaging in aggressive behavior by the number of distinct substances in their system who were involved in a motor vehicle crash. An association is clear between one or more substances and an increased occurrence of crashed drivers engaging in aggressive behavior. Crashed drivers with three substances in their system were four percentage points more than double the rate of other crashed drivers with no substances to have made an aggressive maneuver.

Figure 10: Substance count and share of aggressive driver actions



Where **Figure 10** conveyed aggressive driving by substance count, **Figure 11** conveys the share of aggressive driving behavior within substances. For example, nearly 24% of crashed drivers who had alcohol in their system were cited for taking an aggressive action. This is double the rate of crashed drivers who had no substances in their system (12.4%) as shown in **Figure 10**. Drivers with any substance present were significantly more likely to engage in aggressive behavior, with alcohol, cocaine, and “other” leading the pack.

Figure 11: Aggressive driver behavior by substance use

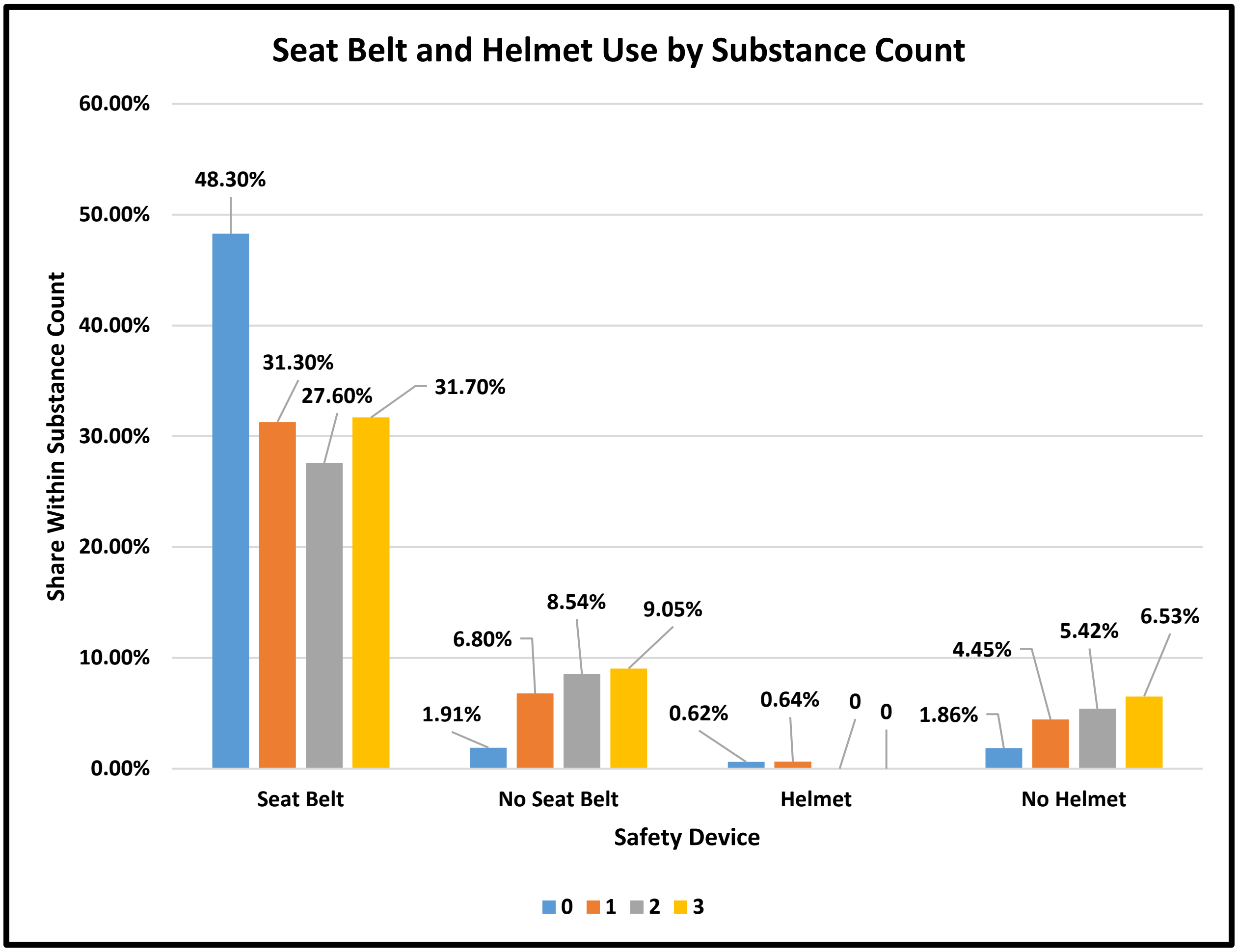


Substance use and risky behavior

Among motorcycle drivers who took an aggressive action prior to crashing, 729 (59%) were not wearing a helmet, while 505 were wearing a helmet. Among other motor vehicles 1,299 (3.8%) drivers who made an aggressive driving action were not wearing a seat belt at the time of the crash, while the remaining 34,103 were wearing one.

Figure 12 displays the proportional relationship between substances present in road users and their use of safety equipment. Shares were calculated using the entire population of each substance count cohort, rather than a qualifying attribute for a particular safety device – so the direction of trends in the data is more important than the magnitude of the share. This was done to more closely observe the effect substance use has on the propensity to engage in risky behavior. For example, beginning on the left side of **Figure 12**, close to 50% of all road users (not just those in cars) with no substances present were wearing a seat belt at the time of the crash. That share drops to around 30% with the presence of one, two, and three substances. Moving to the bar cluster second from the left of **Figure 12** we see that among all road users with one or more substances present, seat belt use becomes much less common. Not wearing a helmet is more common than wearing one, which is a fact that only grows with the introduction of substances. The far right bar cluster in **Figure 12** shows that not wearing a helmet increases in step with each additional substance. Road users with three substances present were three and half times more likely to not be wearing a helmet at the time of crash compared to those with no substances present.

Figure 12: Safety device use by substance count



Demographics of substance involved crashes

The final section of this report seeks to study the demographics of those involved in motor vehicle crashes. As this topic is expansive and complex, an exhaustive examination is not possible here. Instead, higher-level findings are presented to provide insights about the broader Illinois public and materials for further study.

Figure 13 (and supplemental **Table 13.1**) presents the presence of substances and polysubstances among all Illinois road users involved in a motor vehicle crash from 2016 through 2020. Each demographic is disaggregated by its share of those positive for polysubstances, the share of that individual demographic that was positive for polysubstances, its share of any substance, and the share of that individual demographic that was positive for any substance. For example, 3.8% of males in a crash were positive for a substance – but males made up over 69% of those who were in a crash and substance-positive. Males are also significantly overrepresented as positive for polysubstance crashes, taking up some 70% of incidents. The 25 to 34 age cohort has the largest share of its population that was positive for both any substance and polysubstance crashes. That same age cohort is also the largest age cohort in the linked data set, potentially contributing to its largest share of all substance and polysubstance crashes. Finally, though only about 15% of the population of Illinois, Blacks represent 27.5% and 27.1% of all substance and polysubstance crashes, respectively. The share of Whites positive for any substance and polysubstance crashes took the majority of incidents and at 56.5% and 58%, respectively, or about their share of the Illinois population. The Hispanic population is somewhat underrepresented relative to their Illinois population of about 18% in these data at about 12% of each set of incidents. Regarding the underrepresentation, the U.S. Census Bureau recently reported that almost 44% of Hispanics selected the other category in the 2020 Census or did not answer the race question at all because they did not identify with any of the categories (U.S. Census, 2023).

Figure 13: Substance use among all road users involved in a crash by demographics

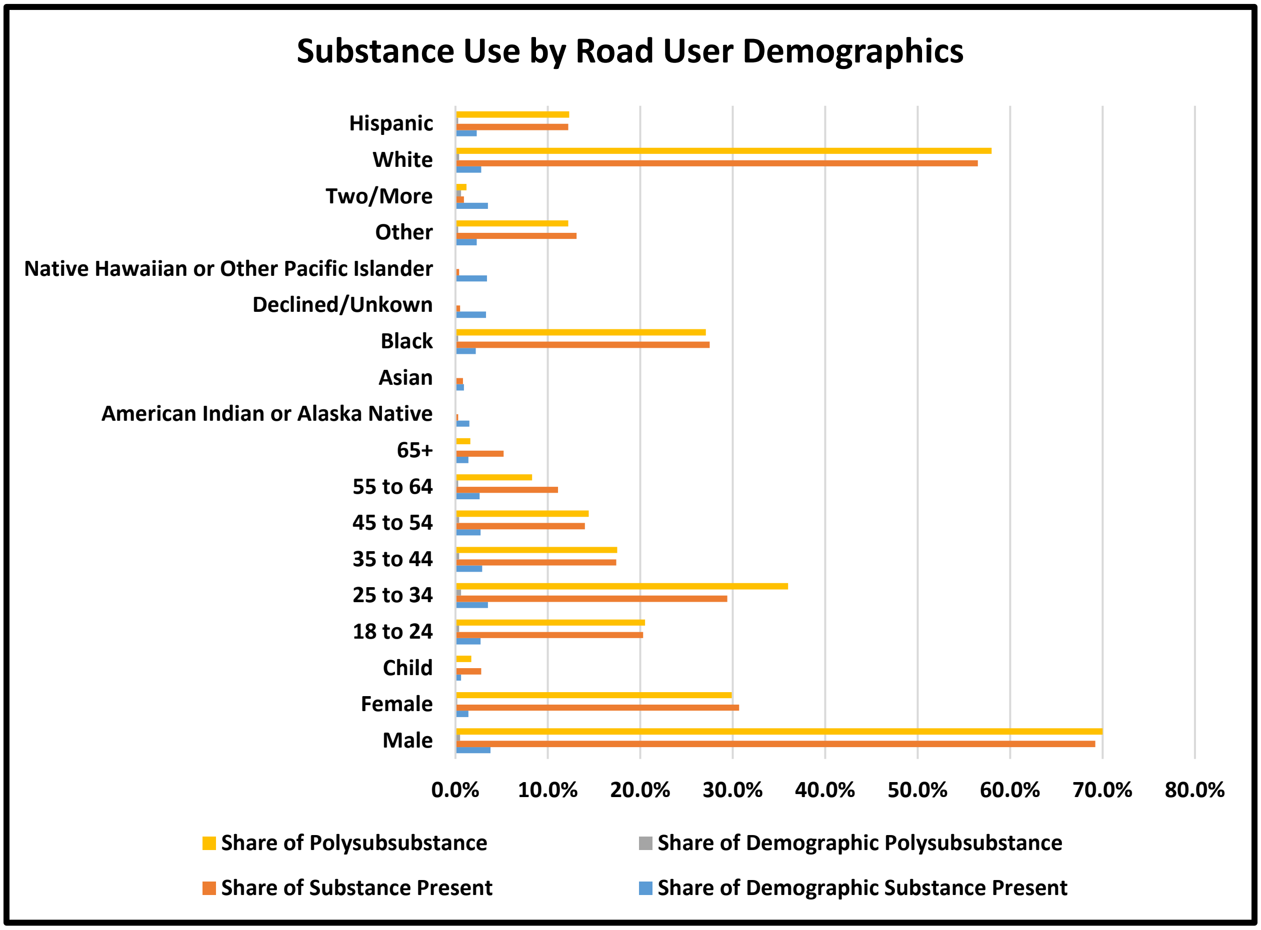


Table 13.1: Supplemental table of demographics

Variable	Population Total	Substance Present	Share of Demographic Substance Present	Share of Substance Present	PolySubstance	Share of Demographic Polysubsubstance	Share of Polysubsubstance
Male	156,185	5,885	3.8%	69%	835	0.5%	70.0%
Female	181,208	2,614	1.4%	31%	357	0.2%	29.9%
Child	39,905	234	0.6%	2.8%	20	0.1%	1.7%
18 to 24	62,896	1,722	2.7%	20.3%	245	0.4%	20.5%
25 to 34	72,270	2,496	3.5%	29.4%	429	0.6%	36.0%
35 to 44	50,457	1,476	2.9%	17.4%	209	0.4%	17.5%
45 to 54	44,436	1,190	2.7%	14.0%	172	0.4%	14.4%
55 to 64	36,810	945	2.6%	11.1%	99	0.3%	8.3%
65+	30,644	438	1.4%	5.2%	19	0.1%	1.6%
American Indian or Alaska Native	1,492	23	1.5%	0.3%	-	-	-
Asian	7,602	69	0.9%	0.8%	-	-	-
Black	104,006	2,340	2.2%	27.5%	323	0.3%	27.1%
Declined/Unkown	1,209	40	3.3%	0.5%	-	-	-
Native Hawaiian or Other Pacific Islander	1,014	34	3.4%	0.4%	-	-	-
Other	48,962	1,110	2.3%	13.1%	146	0.3%	12.2%
Two/More	2300	80	3.5%	0.9%	14	0.6%	1.2%
White	170418	4805	2.8%	56.5%	692	0.4%	58.0%
Hispanic	44585	1033	2.3%	12.2%	147	0.3%	12.3%

Discussion

This manuscript provides a high-level view of the state of substance use among those involved in a motor vehicle crash on Illinois roadways. Once more, the presentation of statistical analyses emphasizes the direction and proportionality of the presence of intoxicating substances in a road user involved in a crash. Though the data are representative of the population, they are likely undercounts of the true scale. This is especially true for fatal crashes, where the hospital file indicates just 37 of the 1,842 deceased were positive for a substance. The crash file indicates many more (314) of the deceased were impaired at the time of the crash, though the crash file provides no further substance use information. This lack of information regarding fatal crashes may be due to difficulties in testing and diagnosing substance use among the decedents.

By several measures the presence of any substance is related to increased risky behavior (decreased seat belt and helmet use, aggressive driving), more severe injuries, and higher hospital charges. The presence of additional substances (polysubstance use) intensifies the relationship as substance count increases.

Cannabis, alcohol, cocaine, and opioids are the most frequently found substances, and commonly found in various combinations among road users involved in a motor vehicle crash. Analysis suggests that alcohol followed by cannabis and then opioids are the most frequently used single substances among all road users. Analysis also suggests that cannabis followed by cocaine and then alcohol are the most commonly combined substances. Further, cannabis and cocaine, cannabis and alcohol, cocaine and opioids, and cannabis and opioids are the most frequently occurring dual-substance combinations, respectively.

Males are overrepresented as positive for substance and polysubstance use among all road users. Those aged 25 to 34 had the highest share of their cohort diagnosed as positive for both substances and polysubstances – this cohort also represented the largest age group of crashed road users. Blacks represent about 27% of substance and polysubstance crashes but only about 15% of the Illinois population. While Whites were roughly proportionately represented but accounted for the majority of substance and polysubstance crashes across Illinois.

Further research is needed to better understand how substance use among road users breaks down along social and demographic stratifications. The data imply a poor accounting of the involvement of Hispanics involved motor vehicle crashes – this may be improved by changing the language of how questions of race and ethnicity are posed to patients. The source of Blacks being overrepresented in substance use crashes also needs to be investigated.

Language in the 2021 Bipartisan Infrastructure Law (BIL) directs the National Highway Traffic Safety Administration (NHTSA) to draft regulation requiring new motor vehicles in the U.S. to be equipped with impaired driving prevention technology (United States Department of Transportation). Though NHTSA has no hard deadline for issuing the regulation and it is unclear how far the agency will take its authority. Important to note, impaired driving detection technology installed in motor vehicles does not need to be limited to the detection of the chemical presence of an intoxicating substance. Technology is available that detects any type of driver behavior or action that is deleterious to driving skills, like drowsiness caused by fatigue or even distracted driving. Yet even the toughest of regulations blocking impaired driving from occurring will do little to stop impairment among other road users like pedestrians, cyclists, and even passengers. Still, the implementation of such prevention technology would undoubtedly spare human suffering and save lives.

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