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2021 Report of Deaths and Injuries Involving Off-Highway Vehicles with More than Two Wheels

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John Topping, M.S.
Directorate for Epidemiology
Division of Hazard Analysis
U.S. Consumer Product Safety Commission
4330 East West Highway
Bethesda, MD 20814

Executive Summary

Off-Highway-Vehicle-Related Fatalities Reported

- As of September 2021, the year 2018 is the most recent year of reporting for fatalities that CPSC considers complete. CPSC staff is aware of 2,211 deaths associated with Off-Highway Vehicles (OHVs) that resulted from 2,156 incidents during the 3-year period from 2016 through 2018.

- Of the OHVs involved in those 2,211 reported deaths, CPSC staff classifies 1,591 as All-Terrain Vehicles (ATVs), 506 as Recreational Off-Highway Vehicles (ROVs), and 47 as Utility-Terrain Vehicles (UTVs). For the remaining 67 deaths, CPSC staff does not know the vehicle classification, but staff concludes that the vehicle is either an ROV or UTV.

- CPSC staff divided these 2,211 reported deaths across various age groups: under 12 years (6%), 12-15 (7%), 16-24 (15%), 25-34 (15%), 35-44 (13%) 45-54 (15%) and 55+ (29%). Children under 12 represent about half (48%) of the fatalities among the combined under-16 age group.

- CPSC staff observed that OHV overturns and/or collisions (*e.g.*, with other vehicles or stationary objects, such as trees) were the most common fatality hazards.

Off-Highway-Vehicle-Related Emergency Department-Treated Injury Estimates

- Over the full 5-year period from 2016 through 2020, CPSC staff estimates that there were 526,900 emergency department-treated injuries associated with OHVs (ATVs, ROVs, and/or UTVs) in the United States. This corresponds to an estimated annual average of 105,400 emergency department-treated injuries over the period.

- Although these estimated injuries do not trend in a single direction over the period, there is a statistically significant decrease estimated from 115,500 in 2016, to 95,000 in 2018, followed by a significant increase to an estimated 112,300 in 2020.

- CPSC staff divided injuries during the 2016 through 2020 period across various age groups: under 12 years (13%), 12-15 (13%), 16-24 (23%), 25-34 (20%), 35-44 (13%) 45-54 (9%) and 55+ (8%). This distribution of estimated injuries appears to be more heavily weighted towards younger ages than the distribution of reported fatalities.

- In the most recent year 2020 estimated OHV-related emergency department-treated injuries for all ages, CPSC staff found that:

    - The most common diagnoses were fractures (30%) and contusions/abrasions (18%).

    - The affected body parts were primarily: the head and neck (30%), the arm (shoulders to fingertips, 30%), the torso (20%), and the leg (20%).

    - Victims were more frequently identified as male (68%) than female (32%).

    - Most were treated and released (78%) or hospitalized (19%).

    - Hospitalizations (meaning cases treated and admitted or transferred to another hospital) were found significantly increased in the year 2020, compared with the 4 prior years.

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Introduction

This report presents the information collected by U.S. Consumer Product Safety Commission (CPSC) staff on deaths and injuries related to the use of various off-highway vehicles (OHVs) with more than two wheels. These OHVs correlate with one of three vehicle classifications: "All-Terrain Vehicles" (ATVs), "Recreational Off-Highway Vehicles" (ROVs), and "Utility-Terrain Vehicles" (UTVs). Below, we describe these classifications in additional detail.

For this report, CPSC staff defines an "ATV" as an off-road, motorized vehicle having three, four, or more low-pressure tires, a straddle seat for the operator, and handlebars for steering control.

ROVs and UTVs have many features in common, such as four or more tires designed for off-road vehicles. However, ROVs and UTVs have many features that distinguish them from ATVs, such as non-straddle or "side-by-side" seating, automotive-type controls for steering, throttle, and braking (*e.g.*, steering wheel and pedals).[1]

For this report, CPSC staff defines "ROVs" as motorized vehicles designed for off-highway use with the following features: four or more pneumatic tires designed for off-highway use; bench or bucket seats for two or more occupants; automotive-type controls for steering, throttle, and braking; and a maximum vehicle speed greater than 30 miles per hour (mph). ROVs are also equipped with rollover protective structures (ROPS), seat belts, and other restraints (such as doors, nets, and shoulder barriers) for the protection of occupants. (ROV NPR, 79 *Fed. Reg*. 68,964, November 19, 2014).

In this report, CPSC staff defines "UTVs" as motorized vehicles designed for off-highway use with the following features: four or more pneumatic tires designed for off-highway use; bench or bucket seats for two or more occupants; automotive-type controls for steering, throttle, and braking; and a maximum speed of 25 mph or less. UTVs are generally equipped with larger cargo beds and may be equipped with ROPS, seat belts, and other restraints.

In the late 1980s, the major ATV distributors agreed to stop distributing three-wheel ATVs (U.S. CPSC, 2006). A very small proportion of ATVs, ROVs, and UTVs are sold with more than four wheels (5 or 6), and have never held more than a very small market share. As such, nearly all ATVs, ROVs, and UTVs in use today are four-wheeled vehicles.

This report does *not* address *every* vehicle with off-road capability. The report *excludes,*[2] for example, dune buggies, sand rails, and golf carts, as well as licensed motor vehicles, such as "sport utility vehicles" (SUVs) and jeeps. Similarly, this report *excludes* two-wheeled off-highway vehicles (*e.g.*, dirt bikes and/or off-road-capable motorcycles).

This report *includes* information related to deaths involving ATVs, ROVs, and UTVs in incidents from 2016 through 2018, based on data available to CPSC staff as of September 2021. This report also presents the national estimates of hospital emergency department-treated injuries related to ATVs, ROVs, and UTVs from January 1, 2016, through December 31, 2020.

[1] Definition from ANSI/ROHVA 1 *American National Standard for Recreational Off-Highway Vehicles.*

[2] However, incidents involving collision or other interaction with an ATV, ROV, or UTV, are included, regardless of the type of the other vehicle.

Off-Highway Vehicle Fatalities[3]

This section details the OHV deaths from incidents during the years 2016 through 2018. The data are based on fatalities reported through the Consumer Product Safety Risk Management System (CPSRMS), as well as the National Electronic Injury Surveillance System (NEISS). Data in CPSRMS are anecdotal, and collection of the data is ongoing. Among the various types of reports included in CPSRMS are death certificates from the 50 states and the territories. Due to a lag in time that exists between when a fatality occurs and when it gets reported to CPSC, staff considers the latest 3 years of data, 2019 through 2021, to be incomplete. As such, this report includes deaths from 2016 through 2018.

Reported Deaths

As of September 24, 2021, CPSC staff received reports of 2,156 fatal off-highway vehicle incidents during the 3-year period from 2016 through 2018, which resulted in a total of 2,211 deaths. Due to delayed onset of death, the year of incident may precede the ultimate year of death. Due to multiple-fatality incidents, the total number of fatal incidents is not the same as the total number of deaths. Table 1 presents the current count of reported fatal incidents by year and off-highway vehicle classification.

Table 1
Reported Fatal Incidents Associated with Off-Highway Vehicles
By Vehicle Classification and Incident Year, 2016-2018

Vehicle Classification	Number of Fatal Incidents Per Year			**Total Incidents**
	2016	2017	2018	
ATV	565	520	481	**1,566**
ROV	142	175	161	**478**
UTV	15	16	15	**46**
Unknown (ROV or UTV)	17	25	24	**66**
Total	**739**	**736**	**681**	**2,156**

Sources: CPSRMS and NEISS.

Counts of total reported deaths and fatal incidents for 2016 and 2017 have not changed relative to the tabulation prepared last year (Topping, December 2020). However, some prior incident vehicle classifications have been updated, based upon more recent reporting and/or investigations of those same incidents. For example, relative to the previous assessment of year 2017 fatal incidents, this current report classifies 7 fewer incident vehicles as "Unknown (ROV or UTV)" and 7 more as "ROV." It is plausible that some of the more recent year 2018 fatalities may be reclassified in the future, if additional information becomes available regarding the vehicles involved.

[3] Staff includes reported incidents involving a collision of an ATV, ROV, and/or UTV in this report, even if the occupants of those vehicle types survived, so long as some person, such as a pedestrian bystander or an occupant of another type of vehicle (*e.g.*, bicycle, dirt bike), suffered fatal injury. Six single-fatality incidents reported collision of both an ATV and ROV, but staff allocated these incidents only to the classification corresponding to the type of vehicle occupied by the deceased (4 ROV, 2 ATV), to ensure mutual exclusivity and correct incident totals. Staff classified fatalities reported as an "ATV," absent further information collection, as ATVs, although staff is aware that this descriptor is not always accurate as reported in death certificates and other sources. Therefore, some of the "ATV" fatalities classified in this report may have involved other types of off-highway vehicles. Most of the incidents classified specifically as an "ROV" or a "UTV" were so classified with the benefit an in-depth investigation and review in collaboration with CPSC engineering staff. Some combination of information collected, such as VIN, make, and/or model, photographs, and/or other descriptions supported each such determination.

One incident may result in deaths of multiple persons. Such is the case for at least 51 of the fatal incidents (2% of 2,156), of which 48 are double fatalities (2 deaths per incident), two are triple fatalities (3 deaths per incident), and one is a quadruple fatality (4 deaths from a single incident). Table 2 presents these 51 multiple-fatality incidents by number of deceased persons per incident and the type of off-highway vehicle.

Table 2
***Multiple* Fatality Reported Incidents Associated with Off-Highway Vehicles**
By Vehicle Classification and Number of Deaths per Incident, 2016-2018

	Incident Count			
	Number of Deceased Persons Per Incident			
Vehicle Classification	Two (Double Fatality)	Three (Triple Fatality)	Four (Quadruple Fatality)	**Total Multiple Fatality Incidents**
ATV	25			**25**
ROV	21	2	1	**24**
UTV	1			**1**
Unknown (ROV or UTV)	1			**1**
Total	**48**	**2**	**1**	**51**

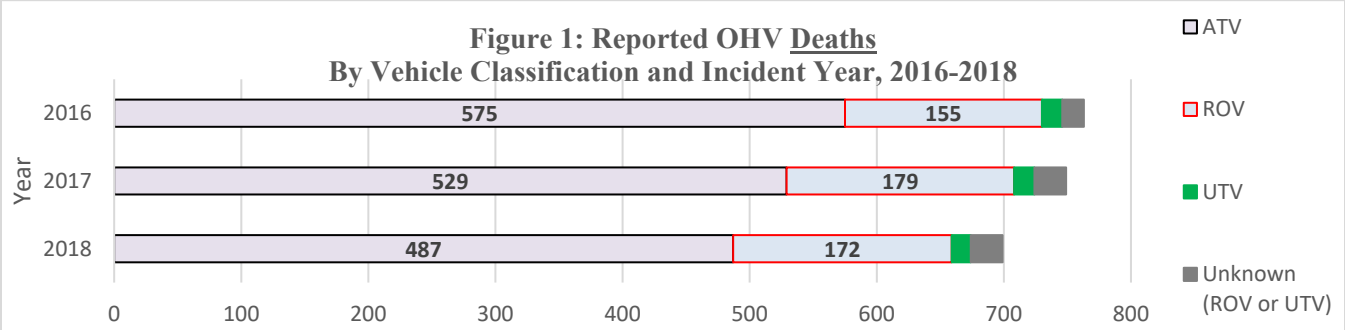
Sources: CPSRMS and NEISS.

Accounting for these multiple-fatality incidents, Table 3 and Figure 1 present the resulting number of deaths by vehicle classification and incident year.

Table 3
Reported Deaths Associated with Off-Highway Vehicles
By Vehicle Classification and Incident Year, 2016-2018

	Number of Deaths Per Incident Year			
Vehicle Classification	2016	2017	2018	**Total Deaths**
ATV	575	529	487	**1,591**
ROV	155	179	172	**506**
UTV	16	16	15	**47**
Unknown (ROV or UTV)	17	25	25	**67**
Total	**763**	**749**	**699**	**2,211**

Sources: CPSRMS and NEISS.



Sources: CPSRMS and NEISS.

Reported Deaths by Incident State

Table 4 (on next page) lists the number of fatal incidents and deaths due to off-highway vehicle incidents in each state and the percentage that each state represents in relation to all deaths resulting from incidents in the 3-year period (2016-2018).[4] States are listed in descending order of the number of reported deaths. The following states had the highest reported deaths associated with incidents occurring in this period: Texas (139), West Virginia (114), Pennsylvania (112), Kentucky (104), and California (101). Together, these five states accounted for 570 deaths from 558 fatal incidents, or 26 percent of the total 2,211 deaths from the 2,156 reported incidents.

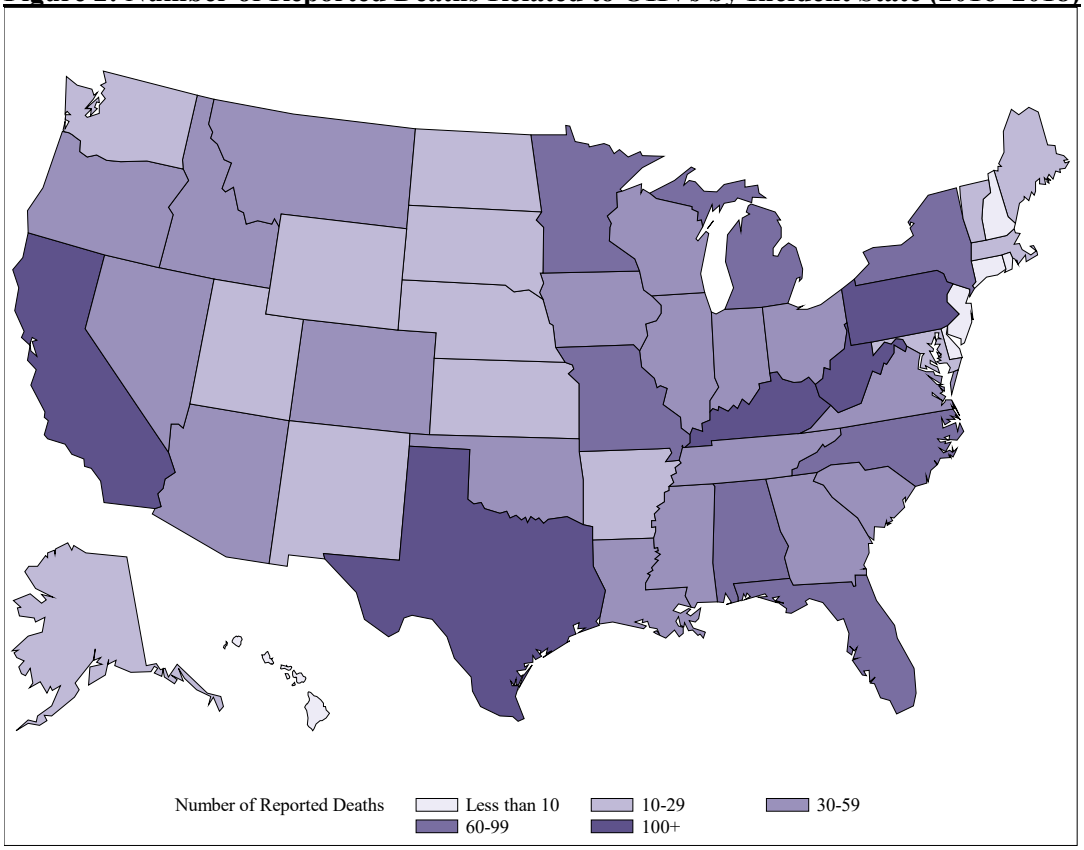
When reviewing state-level fatal incident and death counts for the period 2016 through 2018, staff notes:

- Consistent with CPSC staff's previous annual reports on ATV-related deaths and injuries, the counts shown in Table 2 have *not* been adjusted for demographic characteristics (*e.g.*, total population, age structure of population).

- *Unlike* CPSC staff reports on ATVs published prior to December of 2020, these counts reflect the state and year in which the *incident* occurred, rather than the state and year in which the deaths occurred.

Figure 2 (below) represents the first and third columns of Table 4 (on next page). As the legend shows, the darker-shaded states had more reported deaths related to OHVs between 2016 through 2018, than states displayed in lighter shades.

Figure 2: Number of Reported Deaths Related to OHVs by Incident State (2016–2018)



Sources: CPSRMS and NEISS.

[4] No fatal incidents in the District of Columbia, Puerto Rico, or other U.S. territories were reported for the period, so these locations are not included in Figure 2 or Table 4.

Table 4
Reported Fatal Incidents and Deaths Related to OHVs by Incident State
For the Incident Period January 1, 2016 through December 31, 2018

State	Reported Fatal Incidents 2016–2018	Reported Deaths from Incidents 2016–2018	Percent of All Reported Deaths from Incidents 2016–2018
Texas	139	139	6.3%
West Virginia	111	114	5.2%
Pennsylvania	110	112	5.1%
Kentucky	99	104	4.7%
California	99	101	4.6%
Florida	76	79	3.6%
North Carolina	77	78	3.5%
New York	72	73	3.3%
Alabama	63	68	3.1%
Michigan	62	63	2.8%
Missouri	62	62	2.8%
Minnesota	58	61	2.8%
Wisconsin	58	59	2.7%
Arizona	54	59	2.7%
Oklahoma	57	58	2.6%
Ohio	56	56	2.5%
Mississippi	54	55	2.5%
Indiana	53	55	2.5%
Louisiana	52	53	2.4%
Illinois	50	51	2.3%
Virginia	48	48	2.2%
Idaho	43	46	2.1%
Georgia	44	45	2.0%
Colorado	43	44	2.0%
Tennessee	41	42	1.9%
Oregon	36	36	1.6%
South Carolina	36	36	1.6%
Montana	35	35	1.6%
Iowa	33	33	1.5%
Nevada	32	33	1.5%
Alaska	28	29	1.3%
New Mexico	25	26	1.2%
Washington	25	26	1.2%
Nebraska	24	25	1.1%
Arkansas	23	24	1.1%
South Dakota	23	24	1.1%
Kansas	23	23	1.0%
Maine	18	18	0.8%
North Dakota	18	18	0.8%
Maryland	17	18	0.8%
Utah	17	18	0.8%
Wyoming	17	18	0.8%
Vermont	12	12	0.5%
Massachusetts	11	11	0.5%
New Jersey	9	9	0.4%
Connecticut	6	6	0.3%
New Hampshire	4	4	0.2%
Rhode Island	2	3	0.1%
Delaware	1	1	<0.1%
Hawaii	0	0	<0.1%

Note: State rankings are based on total reported deaths resulting from ATV, ROV, and/or UTV incidents in this period.
Sources: CPSRMS and NEISS.

Reported Deaths of Children Compared with All Ages

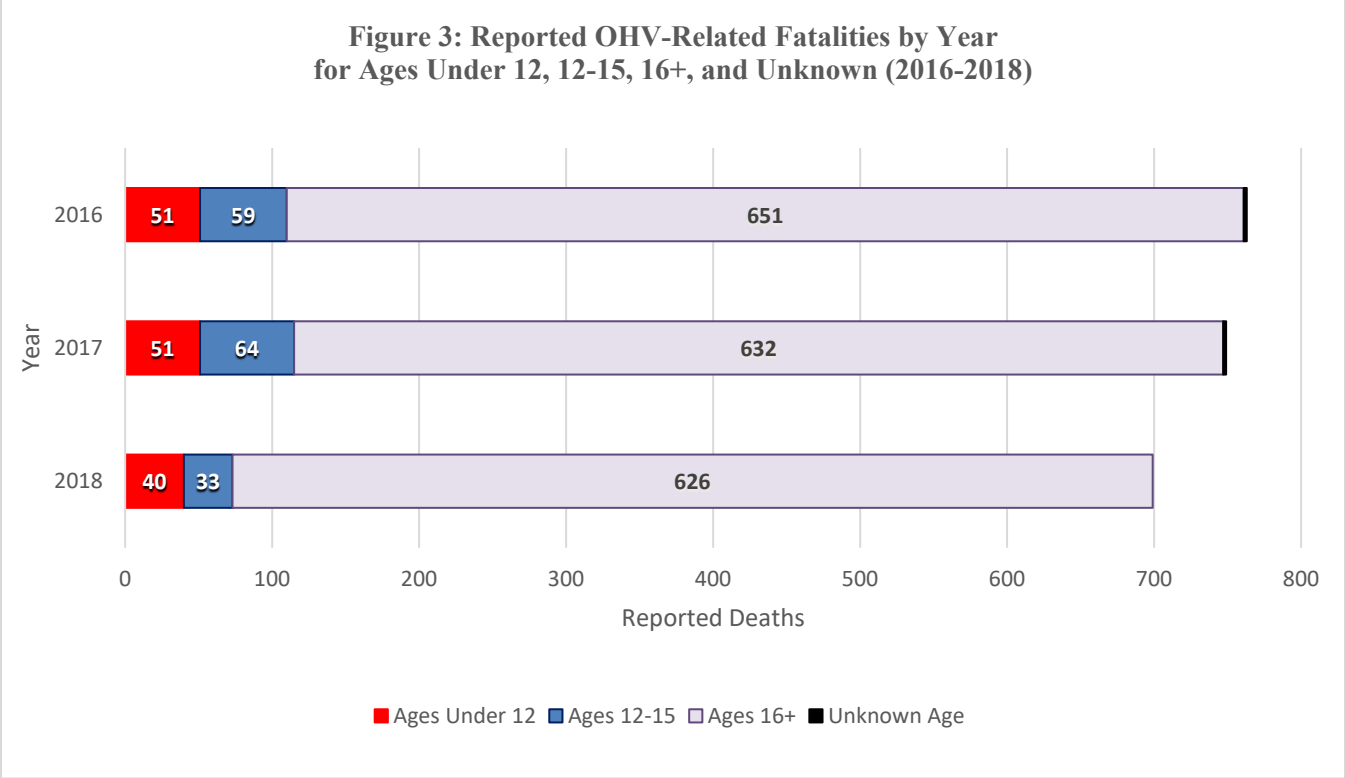
A review of the reported OHV-related fatalities indicates that 298 decedents in the timeframe (13% of the 2,211 total), were younger than 16 years of age, and 142 (6%) were younger than 12 years of age. Forty-eight percent of the *child* fatalities (*i.e.*, children under 16 years of age) were children younger than 12 years of age. Table 5 shows the total number of reported fatalities, by year, among children younger than 16 years; the corresponding percentage of the total number of reported fatalities for the year; the total numbers of fatalities by year for children younger than 12 years of age; and the corresponding percentage for all ATV-related fatalities of children younger than 16 years of age.

Table 5
Reported OHV-Related Fatalities and Percentages for Children Under 16 and 12 Years of Age
For the Incident Period from January 1, 2016 through December 31, 2018

	All Ages	Under 16 Years of Age		Under 12 Years of Age		
Year	Deaths	Deaths	Percent of All Ages	Deaths	Percent of All Ages	Percent of Children Under 16
2016	763	110	14%	51	7%	46%
2017	749	115	15%	51	7%	44%
2018	699	73	10%	40	6%	55%
Total	**2,211**	**298**	**13%**	**142**	**6%**	**48%**

Sources: CPSRMS and NEISS.

Figure 3 shows the corresponding total number of reported fatalities, by year, split into mutually exclusive age groups of children younger than 12 years, children 12-15 years, persons age 16 and over, and decedents of unknown age.



Sources: CPSRMS and NEISS.

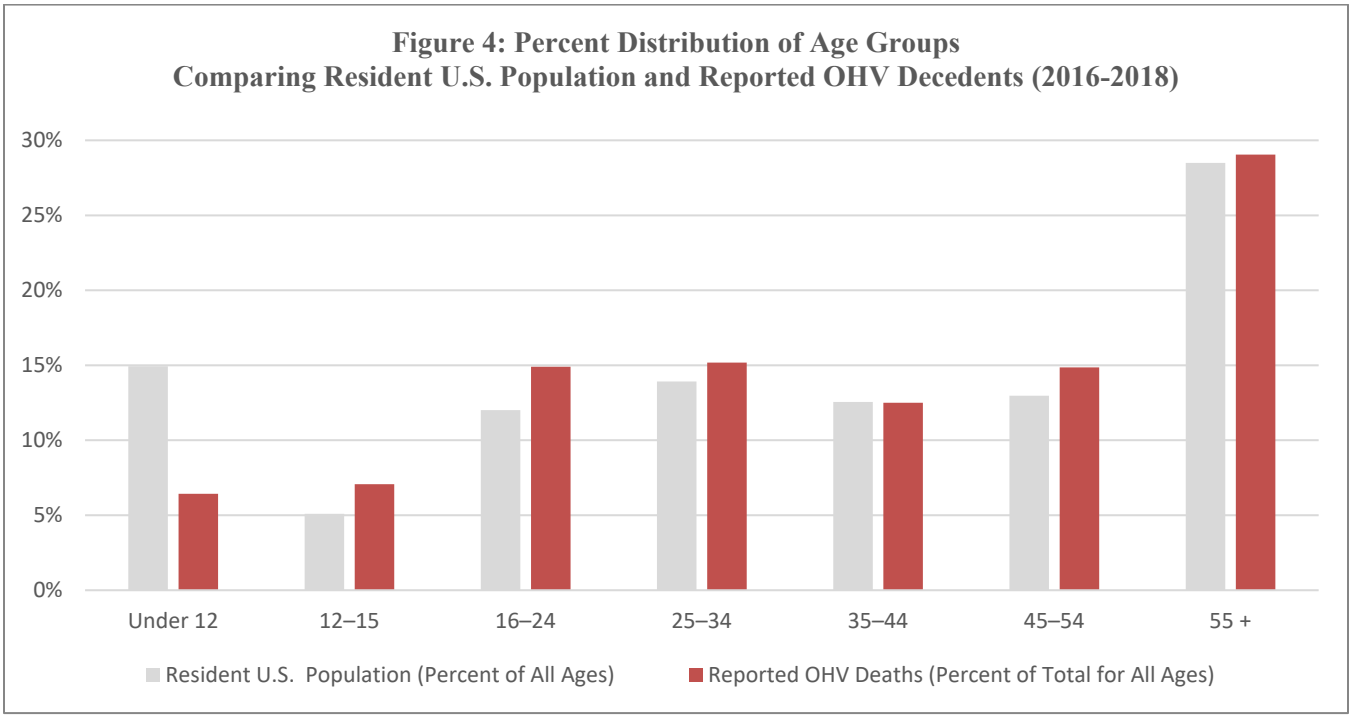
Reported Deaths of Various Age Groups

Table 6 presents the distribution of fatalities by year, and by various age groups over the period. Figure 4 presents the percent distributions of age groups during the 3-year period among both the resident U.S. population and reported OHV fatalities.

Table 2
Reported OHV-Related Fatalities by Age Groups
For the Incident Period from January 1, 2016 through December 31, 2018

Year	All Ages	Age Group (in years of age)							
		Under 12	12-15	16–24	25–34	35–44	45–54	55 +	Unknown
2016	**763**	51	59	107	118	89	124	213	2
2017	**749**	51	64	123	107	85	100	217	2
2018	**699**	40	33	99	110	102	104	211	0
Total	**2,211**	**142**	**156**	**329**	**335**	**276**	**328**	**641**	**4**

Sources: CPSRMS and NEISS.



Sources: U.S. Census Bureau, CPSRMS, and NEISS.

Comparing age group distributions for reported OHV fatalities against population, the largest imbalances are observed among child age groups. Within this period, disproportionately fewer fatalities are reported among children in the younger age group (ages under 12), when compared to their population representation. In contrast, disproportionately higher fatalities are reported in the older child age group (ages 12 to 15), when compared to their population representation. The 16-24 and 45-54 age groups are also observed to be reported in a greater proportion of OHV fatalities than their representation among the population. Staff does not know whether this merely corresponds to differences in OHV usage or other factors for the various age groups.

Observed OHV Hazard Patterns

Overturning is a common hazard for all types of OHVs. An overturning vehicle report may indicate the vehicle overturning forward, backward, sideways (rollover), or in an unknown direction. Forward and backward overturns often occur while descending or ascending steep terrain. On flat terrain, when an OHV operator attempts to make a sharp turn, the OHV may roll over due to factors such as high rate of speed, change in the terrain surface type (*e.g*., from gravel to sand), and/or improper loading. Rollovers may also occur due to slanted or uneven terrain. Rollovers are especially consequential for ROVs. Based on 801 investigations of ROV fatal incidents,[5] staff determined that more than two-thirds involved rollover of the ROV. About one-fifth of ROV fatalities in the same investigated sample involved an attempt on *level* terrain to make a turn prior to rollover. Staff's review of historical ATV data[6] found that the involved ATV overturned in at least 65 percent of fatal incidents, but this includes incidents with other events (such as collisions) that may have preceded the overturning of the ATV. Staff's review finds overturns as the *primary* hazard in about 38 percent of ATV fatalities.

Collisions (with other vehicles, stationary objects, such as trees, people, or animals) are also a frequent hazard among all OHV fatalities. Collisions are particularly common among ATV fatalities. Staff's review of ATV data finds collisions to be the *primary* hazard in about 37 percent of fatalities. This does not include collisions that may have resulted because of other hazards. A majority of these ATV collisions (at least 61%) are with a stationary object, such as trees, guard rails, and mailboxes. Staff found that many collisions (over 30%) occur with other vehicles. Less frequently, collisions involve the ATV striking animals (4%), or pedestrian bystanders (less than 1%). Similarly, collisions contribute to UTV fatalities. For ROVs, staff noted collisions (of any type) in about 16 percent of the sample of 801 investigated fatalities.

Staff notes that hazards are not mutually exclusive. OHV fatality reports describe scenarios of overturning and collision, or other combinations of hazards in the same report. Staff *less* frequently observes fatality hazards, such as ***drowning*** from falling into a body of water, ***fire*** (typically an ROV), or falling or ***being ejected*** *without substantial* preceding events (*e.g*., collision or overturn).

OHV occupant ejection ultimately occurs in the majority of fatalities. For ROVs, staff assessment of the 801 IDIs found that more than 80 percent of decedents were ultimately ejected (whether fully or partially) from the ROV. For ATVs that have no seat belts or other restraints, fatally injured persons commonly do not remain seated on the ATV after the injury incident.

[5] CPSC staff analyses conducted in support of ROV Termination Package and Congressional Report, June, 2020.

[6] Based on analysis of deaths in the All-Terrain Vehicle Death database for the years 2010 through 2013. when every death in the database had the primary hazard coded.

Off-Highway Vehicle-Related Emergency Department-Treated Injuries[7]

Based on CPSC's NEISS data involving five product codes applicable to off-high vehicles within the scope of this report, staff estimates 526,900 emergency department-treated injuries from 2016 through 2020 (an annual average of 105,400 injuries). These product codes cover ATVs, ROVs, and UTVs, and perhaps some other unspecified off-highway vehicles. CPSC staff is confident in using *totals* from these codes to characterize OHV injuries, so long as the vehicle types are combined. However, estimates corresponding to individual product codes only indicate the proportion staff was able to classify under that code; therefore, they should not be presumed to be a complete representation of all injuries corresponding to the specified vehicle type. For example, only about 3 percent of the OHV injury cases were classified based on available information under the 5044 product code for UTVs and ROVs. Given prior studies and other sources suggesting such vehicles may commonly be reported as "ATVs," staff expects the distributions of injuries specific to ROVs and/or UTVs may be considerably greater, and thus, the percentage actually involving such vehicles is unknown. Without the benefit of a full-scale follow-up study, at present, staff is limited to presenting the injury estimates in terms of the product codes only, either individually or combined. Table 7 presents the 2016 through 2020 injury estimates and sample sizes by product codes.

Table 7
Estimates of OHV-Related Emergency Department-Treated Injuries by Product Codes
January 1, 2016, through December 31, 2020

Product Code	Description of Product Code	Sample Size*	5 Year Total (2016-2020)	Annual Average	Percentage
5044	Utility vehicles [and Recreational Off-Highway Vehicles (ROVs)]	376	21,600	4,300	4%
3285	All-terrain vehicles (three wheels only; exclusively off-road)	115	6,300	1,300	1%
3286	All-terrain vehicles (four wheels, excluding dune buggies; exclusively off-road)	7,014	352,100	70,400	67%
3287	All-terrain vehicles (number of wheels not specified; excluding dune buggies; exclusively off-road)	3,903	145,500	29,100	28%
3296	All-terrain vehicles (more than four wheels; exclusively off-road)	32	**	**	**
Combined	**Total (All of the above)**	**11,430**	**526,900**	**105,400**	**100%**

Source: U.S. CPSC's NEISS

* As multiple vehicles can occasionally be involved with a single injury, a very small proportion of these cases involve two or more of the above product codes. Therefore, the sum of the sample sizes for each individual product code above very slightly exceeds the combined sample size of 11,430 cases.

** This estimate does not meet NEISS reporting criteria. For a NEISS estimate to satisfy all reporting criteria, the coefficient of variation (CV) cannot exceed 0.33, there must be at least 20 sample cases, and there must be at least 1,200 estimated injuries. The four estimates reported for other product codes in this table have coefficients of variation (CVs) ranging from 10 percent to 24 percent.

[7] Based on analysis of data from the U.S. CPSC's NEISS.

Table 8 shows estimates of OHV-related injuries treated in hospital emergency departments nationwide between January 1, 2016 and December 31, 2020, with a focus on children's injuries. In this analysis, staff compared the latest (2020) injury estimates to a middle year (2018, as well as a base year (2016).[8]

Table 8
Annual Estimates of OHV-Related Emergency Department-Treated Injuries
For All Ages, Children under 16 and Under 12 Years of Age
January 1, 2016, through December 31, 2020

Year	All Ages	Under 16 Years of Age		Under 12 Years of Age		
	Estimated Number of Injuries	Estimated Number of Injuries	Percent of All Ages	Estimated Number of Injuries	Percent of All Ages	Percent of Children Under 16
2016	115,500	30,700	27%	15,800	14%	52%
2017	108,100	28,300	26%	13,300	12%	47%
2018	95,000	24,800	26%	12,900	14%	52%
2019	96,000	25,800	27%	12,900	13%	50%
2020	112,300	30,400	27%	14,300	13%	47%
Total	**526,900**	**140,000**	**27%**	**69,300**	**13%**	**49%**

Source: U.S. CPSC's NEISS
Note: The coefficients of variation (CVs) for the injury estimates in this table range from about 10 percent to 16 percent. See Appendix A for an explanation of the use and calculation of CVs.

For the "All Ages" age group, the estimated 18 percent *decrease* from 115,500 injuries in 2016, to 95,000 injuries in 2018, reflects a statistically significant injury reduction (p-value=0.0321). However, the estimated 18 percent increase between 2018 and 2020 is also statistically significant (p-value=0.0372). The estimated 17 percent injury increase between just the final two years 2019 and 2020, is also statistically significant (p-value=0.0243). Although there are statistically significant changes within the period, the net differences between the start and end years of the overall 2016 through 2020 period are *not* statistically significant.

For the "Under 16 Years of Age" and the "Under 12 Years of Age" groups, none of the year-to-year changes observed within the period correspond to statistically significant differences.

On average, over the period 2016 through 2020, children "Under 12 Years of Age" represent an estimated 13 percent of emergency department-treated injuries for all ages, or 49 percent of injuries to children under 16.

Males were injured more frequently than females, regardless of age. For all ages, the estimated distribution of injuries based on available sex classifications is 69 percent male and 31 percent female. Among children under the ages of 12 and 16, about 65 percent and 66 percent, respectively, were identified as male.

Table 9 breaks down the estimated numbers of OHV-related, emergency department-treated injuries by age groups, from 2016 through 2020.

[8] See the methodology section in Appendix A for a discussion of the rationale for choosing 2016 as the base year.

Table 9
Annual Estimates of OHV-Related Emergency Department-Treated Injuries by Age Group
January 1, 2016, through December 31, 2020

	Age Group (in years of age)							
Year	**Under 12**	**12–15**	**16–24**	**25–34**	**35–44**	**45–54**	**55+**	**Total**
2016	15,800	14,900	26,400	24,900	15,400	9,200	8,900	115,500
2017	13,300	15,000	24,800	21,800	13,000	10,000	10,200	108,100
2018	12,900	11,900	21,500	18,600	12,700	8,600	8,600	95,000
2019	12,900	12,900	24,000	17,800	12,000	8,100	8,200	96,000
2020	14,300	16,100	24,100	23,700	15,600	9,700	8,700	112,300
Total	**69,300**	**70,800**	**120,800**	**106,800**	**68,700**	**45,700**	**44,600**	**526,900**

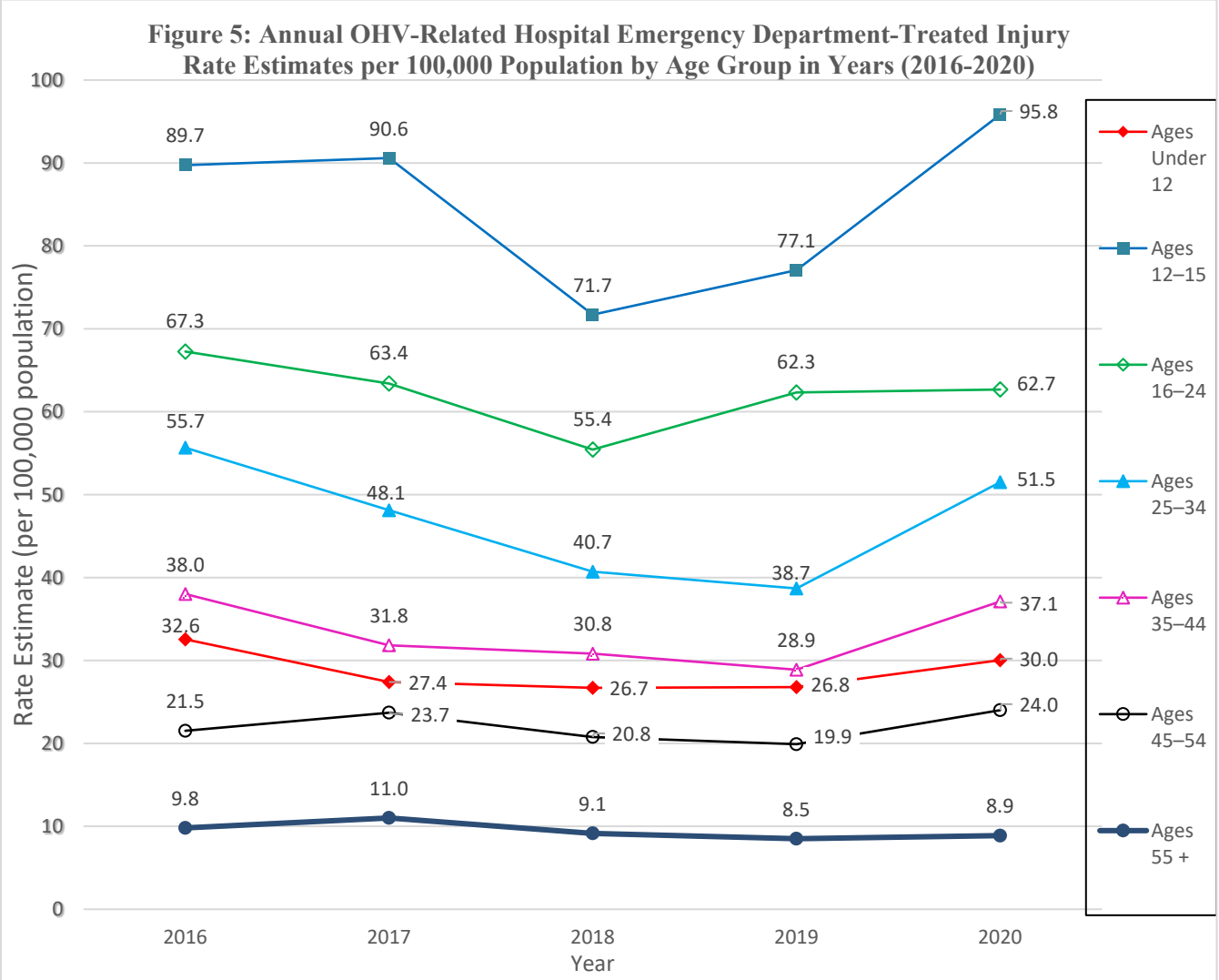
Source: U.S. CPSC's NEISS
Note: Rows may not sum to the annual totals due to rounding and the exclusion of cases with unknown victim age.
The coefficients of variation (CVs) for the injury estimates in this table range from about 10 percent to 18 percent.

Staff's analysis of information in Table 9 (above) supports the following:

- Only three of these age groups exhibit any statistically significant year-to year differences within the period 2016 through 2020. Between the years 2018 and 2020, there are statistically significant estimated increases for ages 12-15 (+35%), ages 25-34 (+28%), and ages 35-44 (+23%) (p-values= 0.0176, 0.0404, and 0.0225, respectively).
- The 25-34 years age group also exhibited a statistically significant estimated increase (+33%) when comparing the last 2 years of the period 2019 and 2020 (p-value=0.0009). The estimated decrease (25%) between 2016 and 2018 (start and middle years) was also statistically significant for this 25-34 years age group (p-value=0.0053).
- When comparing the start year 2016 against the final year 2020, no trend or statistically significant differences were detected for any of the age groups.

Differences in population sizes among age groups and across time likely influence the number of injuries for each age group. According to data from the U.S. Census Bureau,[9] the number of persons aged 55 years or older increased from an estimated 90.6 million to 98 million during this 5-year period. Child age group populations held steady throughout the period, with almost 17 million 12-15-year-old teens, in addition to about 48 million children under 12 years of age. The remaining age groups were comparable, somewhere between about 38 and 46 million, depending on the year and age group. To facilitate comparisons normalized by population size, Figure 5 (below) presents annual estimated injury rates per 100,000 persons within each age group. Except for children under 12 years of age, younger age groups throughout the period have injury rates estimated to be greater than that of their elders.

[9] U.S. Census Bureau. https://www.census.gov/programs-surveys/popest/technical-documentation/research/evaluation-estimates/2020-evaluation-estimates/2010s-national-detail.html Monthly National Population Estimates by Age, Sex, Race, Hispanic Origin, and Population Universe for the United States: April 1, 2010 to December 1, 2020.



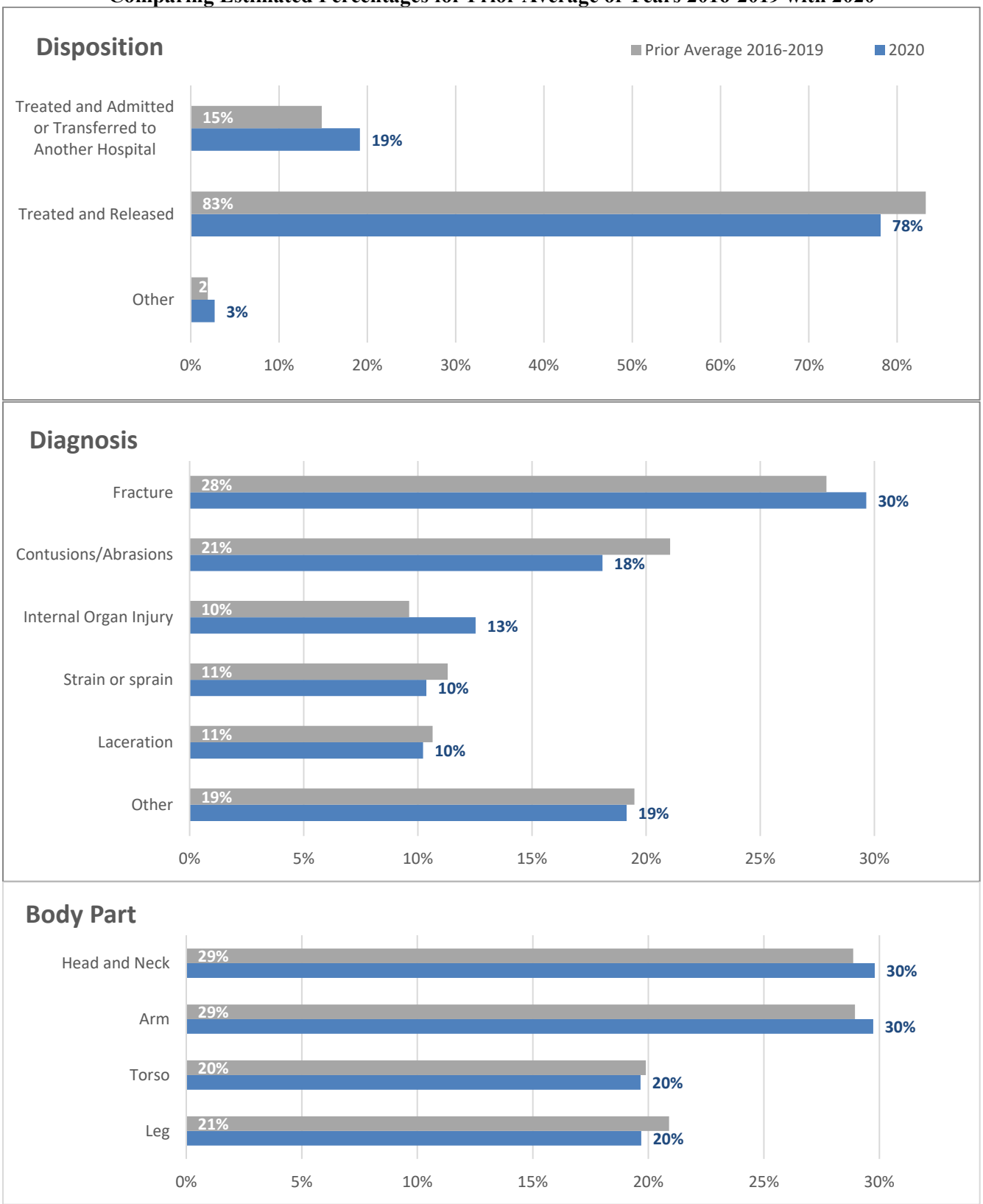
Sources: U.S. Census Bureau and U.S. CPSC's NEISS

Figure 6 provides the estimated percentage of relevant OHV-related, emergency department-treated injuries for *all ages* for the most recent year 2020, and on average for the prior 4 years 2016 through 2019, broken down, respectively, by disposition, diagnosis, and body part.[10] Any fatal injury reports in NEISS are also included in the earlier fatality section of this report. Of the 5-year total 526,900 estimated emergency department-treated injuries, staff categorized a majority as "treated and released" (estimated at 83% on average for 2016-2019 and 78% for 2020). Consequently, there was a statistically significant increase[11] in injuries "treated and admitted" or "treated and transferred" from about 15 percent, on average, for the years 2016 through 2019, to about 19 percent of all injuries in 2020. The remaining treatment disposition percentages are spread across several categories, such as "left without being seen," "held for observation," "fatality," and "unknown." In both periods, the most common diagnoses were fractures (30% for 2020) and contusions/abrasions (18% for 2020). Staff categorized the remaining diagnoses in groups labeled variously as: lacerations, sprains/strains, internal organ injuries, and other (which includes concussions). Most injuries for 2020 were located on the head and neck (30%) or the arm (shoulders down, also 30%).

[10] Beginning 2018, NEISS allowed the coding of up to two diagnoses and body part codes per injury. For this analysis, the first diagnosis and body part codes were considered "primary." A small proportion of cases are associated with more than one diagnoses and body part categorization.

[11] Estimates of hospitalizations, after combining cases that were "treated and admitted" ""treated and transferred," reflect statistically significant difference when comparing 2020 against any of the prior 4 years: 2016, 2017, 2018, and 2019 (p-values=0.017, 0.0182, 0.0083, 0.0043).

Figure 6: OHV-Related Emergency Department-Treated Injury for All Ages, By Disposition, Diagnosis, and Body Part Comparing Estimated Percentages for Prior Average of Years 2016-2019 with 2020



Sources: U.S CPSC's NEISS

Discussion

Substantial uncertainties exist regarding the classification of NEISS OHV injury data into ATVs versus UTVs and ROVs. Although staff could determine that about 27 percent of fatal OHV incidents were not ATVs, all but 4 percent of the OHV NEISS injury data was classified as an "ATV," and thus, coded under an ATV product code. Investigations are attempted for fatal incidents, but not the injury cases that may very plausibly have contributed to a lesser rate of UTV/ROV vehicle identification among injuries. Thus, the rate of UTV and ROV injuries, in actuality, may be greater than 4 percent. However, it is also plausible that ATVs that expose riders to their surroundings, in actuality, may have a greater proportion of involvement among nonfatal injuries. It is not clear whether differences in exposure (as a function of riders and miles and time) account for the difference. After reaching a high of 812,000 in 2004, ATV sales declined steadily until 2018, to an estimated 205,000.[12] Only more recently have ATV sales increased by an estimated 1.8 percent between 2018 and 2019, the last year for which we have data. Except for the financial crisis years 2009 and 2010, combined ROV and UTV sales increased steadily from 164,000 in 2004, to 474,000 in 2019. Combined ROV and UTV sales first exceeded ATV sales in 2011, and they have done so every year since. However, product life for these products is uncertain, and use of these products is even more unclear. Accordingly, in the end, the effect of exposure is unclear.

Due to the relatively modest influence (*i.e.*, small sample size) of the UTV/ROV product code on the overall OHV injury estimates, staff's injury analysis, limited to the combination of these five product codes, is overwhelmingly dominated by the ATV product code-related injury characteristics. For example, the disposition, diagnosis, and body part distributions for 2016 through 2019 and 2020, presented earlier in **Figure 6,** represent almost the same percentages as if staff omitted entirely the UTV/ROV product code cases.

Conversely, this may *not* represent the distribution for UTVs and ROVs, as suggested by an analysis restricted to cases specifically classified using the UTV/ROV product code (5044) for some body parts and diagnoses. More notably, analysis constrained to the UTV/ROV product code suggests statistically significant *increases* in injuries proportionally much greater than what is observed for OHVs overall when ATVs are included.

The product code 3287 for ATVs with an *unknown* number of wheels accounts for 28 percent of the total OHV injury estimates from 2016 through 2020. Based on the current distributions of other product codes specifying the numbers of wheels as 3, 4, or more, staff estimates that 2 percent of the vehicles may be imputed as vehicles having 3, 5, or 6 wheels, while the remaining 98 percent of vehicles may be imputed as 4-wheeled vehicles. Based on historical knowledge, we expect that some minority proportion of these cases correspond to misclassified ROVs and UTVs. Similarly, we expect some misclassifications among a minority proportion of cases coded as 4-wheeled ATVs (product code 3286). Although we can reliably impute vehicles for the number of wheels from current available data, staff can only compute adjustments for misclassification errors between ATV and ROVs/UTVs, based upon survey data. The reallocation of sample cases into the small UTV/ROV product category could substantially increase the UTV/ROV estimates. However, any resulting "corrected" estimates for UTVs/ROVs would be especially sensitive to variations in the rate of reallocation computed from that survey data.

Staff is aware that the more an estimate relies upon correction/adjustment, the more the estimate can be influenced by any imperfections with the method used for that correction/adjustment. Prior annual reports, which were primarily concerned only with estimates for ATVs, were less sensitive to any subtle inaccuracies in adjustment factors. However, the 2010 special study results are not applicable for the ROV/UTV data because:

1. substantial changes have occurred in the marketplace and market share for the various vehicle types since the time of prior surveys;
2. staff observed error frequency in vehicle classification from *fatality* incident data (*e.g.*, among investigated fatalities involving an ROV about 75 percent are described in their death certificates as an "ATV");

[12] Based on correspondence with staff from CPSC's Directorate for Economics.

3. relative magnitude of the uncorrected estimates for ROVs/UTVs have small sample sizes and can be more sensitive to any imperfections with those corrections.

Without the benefit of a more recent follow-up special study, staff cannot reliably produce an adjusted and corrected injury estimate specific to UTVs and/or ROVs. Until such a study is completed and results are available, this annual report will continue to present these injury estimates as combined OHV estimates.

Appendix A: Methodologies

This appendix describes the methodologies used to count OHV-related deaths and estimate injuries and other information to develop the report analyses.

OHV-Related Deaths

In-Scope OHV-Related Fatalities

All fatality data are based on reports received through the CPSRMS. OHV-related fatalities that staff considered to be in-scope in this report include any unintentional incident involving OHVs (ATVs, ROVs, and UTVs), whether or not the OHV was in operation at the time of the incident. Because of the difficulties inherent in distinguishing between occupational and non-occupational use, staff included occupational fatalities in both the death counts and the injury estimates. For example, staff may find it difficult to classify a fatality that occurs as a victim is riding next to a fence on a ranch, while examining the fence, and subsequently, becomes involved in an OHV-related fatality incident while taking a break from work to go on a recreational ride up a nearby hill.

ICD-10 codes (V86.X) characterizing the external cause of death as "ATV-related," include fatalities resulting from all specialty motor vehicles intended primarily for off-road use (World Health Organization, 2007). Thus, this set of ICD-10 codes captures other types of off-highway vehicles, such as dune buggies, ROVs, UTVs, and dirt bikes. By conducting in-depth investigations (IDIs), CPSC staff attempts to verify that the vehicles involved in these incidents were "ATVs," as defined by CPSC staff (*i.e.*, an ATV is a motorized vehicle intended for off-road use and having three, four, or more low-pressure tires, a straddle seat for the operator, and handlebars for steering control). In cases where staff cannot ascertain the specific type of off-highway vehicle, CPSC staff counts the death report as an ATV-related fatality. Staff's assumptions may result in an overestimation of ATV-related deaths.

In many cases, CPSC staff receives fatality reports for the same incident from multiple sources. The reports are about deaths counted in a previous annual report, or deaths reported for the first time in this annual report. For example, CPSC staff may receive a Medical Examiners and Coroners Alert Project (MECAP) report of a fatality that CPSC staff previously received via a news clip. Staff compares reports from all sources to identify and consolidate duplicate incidents reported in multiple sources so that incidents are counted only once in Table 1.

OHV-Related Injuries

Estimation of Emergency Department-Treated Injuries Associated with OHVs

Staff derived all injury estimates in this report from data collected through CPSC's NEISS, a probability sample of U.S. hospitals with 24-hour emergency departments with more than six beds (Schroeder and Ault, 2001a and 2001b). Thus, OHV-related injury estimates in this report represent hospital emergency department-treated injuries only. OHV-related injuries that were not treated in hospital emergency departments are not included in these estimates.

Staff defined an "in-scope injury case" to be any non-occupational, unintentional case involving an OHV, whether or not the victim was operating the OHV at the time of the incident, *i.e.*, the victim could have been a passenger or a bystander. Note that NEISS does not collect occupational injuries; thus, the definition of "in-scope, OHV-related injuries," differs slightly from the definition of "in-scope, OHV-related fatalities."

Staff did not use the adjustment factors from prior annual reports regarding ATVs, because those adjustment factors sought to exclude other types of off-highway vehicles misclassified as ATVs. Staff concluded that continued use of such adjustment factors would likely exclude cases that were really ROVs or UTVs.

Coefficients of Variation

A coefficient of variation (CV) is an expression of the standard deviation relative to the estimate itself. In this report, CVs for injury estimates are given as percentages. Schroeder and Ault (2001a) and Schroeder and Ault (2001b) discuss calculation of NEISS estimates and their variances. Levenson (2003b, 2005) and Garland (2011) discuss in greater detail adjustment factors and other concepts specific to variability associated with ATV estimates.

Injury Rate Estimates per 100,000 Population by Age Group

Injury rate estimates per 100,000 population by age group is calculated as the total estimated number of hospital emergency department-treated injuries associated with the corresponding age group and one or more of five OHV-related product codes (5044, 3285, 3286, 3287, and 3296) after dividing by the corresponding population estimates published by the U.S. Census Bureau, and then multiplying by 100,000.

Changes in Injury Estimates and Injury Rate Estimates

Consistent with the previous OHV Annual Report (U.S. CPSC, December 2020), relative changes in the annual injury estimates shown in Table 7 through Table 9 are assessed using the most recently available 5 years of NEISS injury data. The base year in this assessment is therefore 2016 to support assessment of the recent 5 years 2016-2020. Although classification of injuries specifically involving ROVs and UTVs are difficult to capture within NEISS, staff expects these data from the 5 most recent years to reflect OHVs' current usage more accurately than would an analysis spread across a longer historical timeframe.

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