American Journal of
Preventive Medicine

RESEARCH BRIEF

Drone and Other Hobbyist Aircraft Injuries Seen in U.S. Emergency Departments, 2010–2017

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Introduction: Recreational radio-controlled hobbyist aircraft—particularly "drones"—have become increasingly popular in the last decade. The purpose of this study is to describe injuries associated with hobbyist drones and compare them with injuries associated with other hobbyist aircraft.

Methods: In this 2018 cross-sectional analysis of National Electronic Injury Surveillance System data for 2010–2017, case narrative fields were searched to identify emergency department visits related to hobbyist aircraft injuries. The incidence of hobbyist aircraft injuries was estimated, and summary statistics, chi-square tests, and *t*-tests were used to describe and compare the demographic and clinical characteristics of drone and other hobbyist aircraft-related cases.

Results: An estimated 12,842 hobbyist aircraft injuries presented to U.S. emergency departments during 2010–2017. An increased incidence attributable to drone-related injuries emerged in 2015. Overall, most injuries involved male patients aged 50 years on average. Propeller injuries were the leading mechanism. An estimated 270 patients required hospital admission. Patients injured by drones were younger (mean, 34 years vs 58 years; $p<0.001$) and more likely to be female than patients injured by hobbyist planes. Drone-related injuries were more likely than plane-related injuries to result from blunt trauma (e.g., being struck or falling during aircraft retrieval; 40.5% vs 7.9%, $p<0.001$). Helicopter-related injuries more closely resembled drone-related injuries than plane-related injuries.

Conclusions: Hobbyist aircraft-related injuries are increasing, particularly drone-related injuries. Tailored injury prevention measures and product safety materials are needed to address all hobbyist aircraft-related injuries, with a particular focus on drone-related injury prevention measures.

Am J Prev Med 2019;57(6):826–829.

INTRODUCTION

Recreational hobbyist aircraft—including planes (winged aircraft), helicopters (with a single set of horizontal rotor blades), and drones (with multiple sets of horizontal rotor blades)—have become increasingly popular in the last decade.[1] Nearly 2 million hobbyist aircraft were sold in 2016, with sales projected to exceed 4 million by 2020.[2]

Multiple drone-related injuries have been reported in the lay press,[3] and a few case reports have been published outlining drone-related severe injuries, such as a 13-year-old struck by a racing drone suffered a depressed skull fracture,[4] and a 9-year-old struck by a drone's propeller suffered an ocular globe rupture.[5] To date, there has been no nationwide examination of drone-related injuries.

The objectives of this study were to examine recent trends in hobbyist aircraft-related injuries, describe the epidemiology of those injuries, and compare injury patterns associated with drones to those seen with other hobbyist aircraft.

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0749-3797/$36.00
https://doi.org/10.1016/j.amepre.2019.06.023

METHODS

This retrospective study utilized the U.S. Consumer Product Safety Commission (CPSC) National Electronic Injury Surveillance System (NEISS) data for 2010–2017. NEISS collects data on product-related injuries presenting to a probability sample of U.S. hospital emergency departments.[6] When an injured patient presents to a participating emergency department, NEISS records detailed information about the event.

There is no CPSC product code specific to hobbyist aircraft, so computerized searches were used to identify case narratives, including any words or word roots potentially associated with hobbyist aircraft (Table 1). Subsequently, the full narrative for each identified case was reviewed independently by the 3 investigators—blinded to each other's reviews—to characterize the case as "definitely," "probably," "probably not," or "definitely not" related to a hobbyist aircraft. Cases were included in the primary analysis if any 2 investigators characterized the case as definitely or probably related to a hobbyist aircraft.

Data extracted for each case included the patient's age and sex, the location where the injury occurred, the injured body part, the diagnosis, the patient's disposition, and the type of aircraft involved.

The number of hobbyist aircraft-related injuries and annual population-based injury rates were estimated using survey data procedures as described in the NEISS user manual.[7] Case characteristics were summarized descriptively with 95% CIs. Chi-square and *t*-tests were used as appropriate to compare characteristics of drone-related cases to those of plane- or helicopter-related cases. An α value of 0.01 was used to establish statistical significance because of the considerable weighted sample size. All analyses were conducted using Stata MP, version 11.2.

Two sensitivity analyses were performed: (1) a liberal approach repeating the above analyses but also including cases that only 1 investigator characterized as hobbyist aircraft related and (2) a conservative approach repeating the analyses but including only those cases that all 3 investigators characterized as hobbyist aircraft related.

The University of Texas IRB affirmed this analysis did not constitute human subjects research.

Table 1. NEISS Narrative Field Text Words and Word Roots Searched to Identity Hobbyist Aircraft Injuries

Search string	Related terms
Radio con	Radio control, radio controlled
Radio-con	Radio-control, radio-controlled
Remote con	Remote control, remote controlled
Remote-con	Remote-control, remote-controlled
Model air	Model aircraft, model airplane
Model-air	Model-aircraft, model-airplane
Heli	Helicopter
Plane	Plane, airplane
Toy air	Toy aircraft, toy airplane
Propel	Propeller
Drone	Drone

NEISS, National Electronic Injury Surveillance System.

RESULTS

An estimated 12,842 hobbyist aircraft injuries presented to U.S. emergency departments between 2010 and 2017. Figure 1 shows both the crude and population-based incidence of injuries over the study period. In 2015, drone-related injuries began adding to the total number of injuries, with some offsetting reductions in-plane- and helicopter-related injuries beginning in 2016. Similarly, overall population-based injury rates increased from a low of 37 injuries per 100,000 people in 2012 to 63 injuries per 100,000 people in 2017, and drone-related injuries (specifically) increased from <1 injury per 100,000 people in 2013 to 35 injuries per 100,000 people in 2017.

Table 2 shows the characteristics of the included cases. Overall, most injuries were sustained by white male adults aged 50 years on average, and slightly more than half of the injuries occurred at home. Propeller and rotor blade injuries were most common (74.2%)—predominately lacerations or avulsions of fingers and hands. Most patients were discharged from the emergency department, but an estimated 270 patients required hospital admission.

Patients injured by drones were younger (34 years vs 58 years, $p<0.001$) and more likely to be female (13.1% vs 0.4%, $p<0.001$) than patients injured by planes, and drone-related injuries were more likely than plane-related injuries to involve the head, face, or trunk instead of an upper extremity (26% vs 5%, $p=0.005$). Drone-related injuries were significantly more likely than plane-related injuries to result from blunt trauma (40.5% vs 7.9%, $p<0.001$), including being struck by an aircraft (29% vs 7%) or being injured during aircraft retrieval (e.g., a fall; 12% vs 1%). Notably, however, retrieval-related severe injuries were seen across all aircraft types. For example, a 31-year-old male fell 12 feet retrieving his drone from a tree, a 63-year-old male fell >8 feet retrieving his helicopter from a roof, and a 42-year-old male fell and fractured his third cervical vertebrae retrieving an airplane from a tree.

The location of the injury, mechanisms of injury, injured body parts, and types of injuries associated with helicopter-related injuries did not differ significantly from those associated with hobbyist drones.

The sensitivity analyses produced results nearly identical to those of the primary analysis (Appendix, available online).

DISCUSSION

The incidence of hobbyist aircraft injuries has increased during the last 5 years, which appears related to the growing number of drone-related injuries, despite a

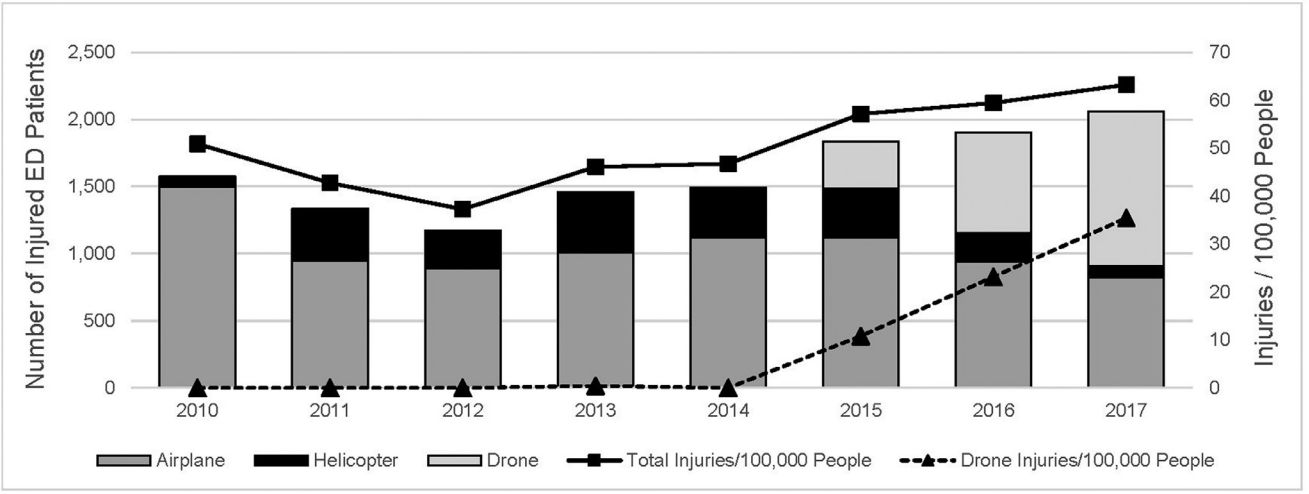

Figure 1. Estimated number of hobbyist aircraft-related injuries presenting to U.S. emergency departments, 2010–2017.
ED, emergency department.

partially offsetting decrease in helicopter- and plane-related injuries.

The primary demographic difference between patients presenting with the drone- versus plane-related injuries was their age: those injured by planes tended to be in their 50s and 60s whereas those injured by drones tended to be in their 20s and 30s. This finding is consistent with a recent marketing analysis that reported that

Table 2. Characteristics of Hobbyist Aircraft Injuries Seen in U.S. Emergency Departments, 2010–2017

Characteristic	Overall % (95% CI)	Plane % (95% CI)	Helicopter % (95% CI)	Drone % (95% CI)
Reported patients, N	275[a]	168	51	55
Weighted national estimate, N[b]	12,847[a]	8,343	2,231	2,268
Age, years, mean	50.1 (46.7, 53.5)	**57.6 (53.7, 61.5)**	38.2 (33.2, 43.2)	34.0 (28.3, 39.8)
Sex				
Male	97.2 (95.0, 99.3)	**99.6 (99.1, 100)**	**98.3 (96.2, 100)**	86.9 (73.9, 100)
Location of injury				
At home	55.6 (46.1, 65.0)	53.9 (42.2, 65.6)	52.5 (38.7, 66.3)	65.0 (49.3, 80.6)
Other locations[b]	Omitted[c]	Omitted[c]	Omitted[c]	Omitted[c]
Not specified	34.8 (25.2, 44.4)	37.0 (25.3, 48.6)	36.4 (21.2, 51.6)	25.1 (11.0, 39.3)
Mechanism of injury				
Propeller	74.2 (68.6, 79.8)	**86.6 (81.4, 91.9)**	47.6 (29.9, 65.2)	54.8 (35.7, 73.9)
Blunt (e.g., struck, fall)	18.9 (13.0, 24.7)	**7.9 (3.5, 12.5)**	37.4 (21.2, 53.6)	40.5 (22.4, 58.6)
Other mechanisms[d]	Omitted[c]	Omitted[c]	Omitted[c]	Omitted[c]
Body part injured				
Arm/hand/finger	65.7 (57.2, 74.1)	**72.4 (61.8, 83.0)**	58.7 (43.1, 74.3)	47.9 (33.3, 62.4)
Head/face/trunk/other	34.3 (25.9, 42.8)	**27.6 (17.0, 38.2)**	41.3 (25.7, 56.9)	52.2 (37.6, 66.7)
Injury				
Laceration/amputation/avulsion	88.5 (84.1, 92.9)	**94.2 (90.7, 97.6)**	81.1 (65.9, 96.4)	75.1 (58.5, 91.8)
Fracture/sprain/strain/other	11.5 (7.1, 15.9)	**5.9 (2.5, 9.3)**	Omitted[c]	Omitted[c]
Disposition				
Treated and released	97.8 (96.1, 99.4)	97.3 (94.8, 99.7)	99.0 (97.4, 100)	98.4 (96.3, 100)

Note: Boldface indicates significant vs drone ($p<0.01$).
[a]One case (weighted 5 cases) was of indeterminate aircraft type.
[c]All displayed national estimates have unweighted cell sample sizes ≥20.
[b]Other locations include public places such as parks and fields.
[d]Other mechanisms include chemical exposures (e.g., fuel) and burns, injuries during repair/maintenance, and indeterminant mechanisms.

50% of drone pilots were aged between 18–44 years, with the most popular age range being 25–34 years.[8] These age differences might be important for tailoring hobbyist aircraft operating instructions and safety information, as well as for public safety campaigns.

Most injuries were due to the propellers or rotor blades causing lacerations or amputations. Propeller guards, hand protection, and safety goggles might help to decrease the number and severity of propeller-related injuries. As serious retrieval-related injuries were seen across all aircraft types, warnings about retrieval risks should be included with all hobbyist aircraft safety instructions.

Limitations

Some hobbyist aircraft injuries may have been missed because of the narrative wording. However, 2 sensitivity analyses aimed at addressing any bias associated with the identification of cases produced nearly identical results. Hobbyist drones and helicopters have become somewhat synonymous, so the distinction in the database is sometimes tricky, which might explain some of the shift from helicopter- to drone-related injuries seen in recent years. This analysis did not consider whether the person suffering the injury was the pilot of the hobbyist aircraft or a bystander, which is sometimes difficult to determine from the NEISS narrative. Exploring the reasons for the observed differences in injury characteristics was beyond the scope of this analysis.

CONCLUSIONS

Hobbyist aircraft-related injuries are increasing, particularly drone-related injuries. Patients with drone-related injuries are younger and more likely to be female than patients presenting with plane-related injuries, which might have implications for injury prevention messaging. Injuries related to aircraft retrieval can be severe no matter what type of aircraft is involved and should be addressed explicitly in all hobbyist aircraft safety instructions. Given the growing frequency of injuries, it would be useful for future analyses if CPSC created a product code specific to hobbyist aircraft. For context, 329 existing CPSC product codes were recorded less frequently than hobbyist aircraft injuries over the study period, including products like "paper cutters" (code 1654, n=111) and "coin-operated car wash equipment" (code 1735, n=22).

ACKNOWLEDGMENTS

Author contributions: JAJ, MRS, and LHB conceived and designed the study and collected the data; LHB conducted the analysis; all authors contributed to the interpretation of the data and drafting and revision of the manuscript; all authors have reviewed and approved the final manuscript as submitted.

There was no external funding for this study, and the authors have no conflicts of interest. No financial disclosures were reported by the authors of this paper.

SUPPLEMENTAL MATERIAL

Supplemental materials associated with this article can be found in the online version at https://doi.org/10.1016/j.amepre.2019.06.023.

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