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A comparison of injuries sustained from recreational compared to organized motorized vehicle use in children ☆

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ABSTRACT

Purpose: To examine the injury severity and patterns of injury for pediatric motorized recreational vehicle (MRV) drivers injured during organized events (OE) compared to recreational use (RU).
Methods: All pediatric MRV injuries between 2006 and 2012 in our institutional trauma registry were studied for mechanism of injury, initial evaluation, and treatment. Injuries with an Abbreviated Injury Scale ≥2 were categorized by body region and diagnosis.
Results: Out of 589 collisions, 92 (16%) occurred during an OE. Compared to RU drivers, OE drivers were more likely to wear helmets (92% vs. 40%, $p < 0.001$) and other protective equipment (79% vs. 6%, $p < 0.001$). There was no difference in rates of hospital admission, rates of surgical intervention, injury severity scores, rates of intensive care unit admission, or lengths of stay. There were no differences in injuries by body region or injury type, except that dislocations were more common in OE drivers (2% vs. 0%, $p = 0.038$).
Conclusion: Despite higher rates of helmet and protective gear use, pediatric MRV drivers participating in OEs sustain similarly severe injuries as drivers using MRVs recreationally. No differences were observed in body regions involved or outcomes. Public perception that OE use of MRV for children is safe should be addressed.

The use of motorized recreational vehicles (MRVs) such as motorbikes and all-terrain vehicles (ATVs) continues to be a source of significant preventable morbidity and mortality among children in the United States (US) [1–3]. From 2001 through 2010, 36,000 children <15 years of age presented to hospital emergency departments (ED) every year with ATV-related injuries and 28% of these patients had fractures [3]. For motorbike-related collisions, nearly 50% of drivers require hospitalization and 33% require surgery [1]. Safety concerns regarding motorbike and ATV use have prompted multiple organizations including the American Academy of Pediatrics, the American Academy of Orthopedic Surgeons, and the US Consumer Product Safety Commission to make safety recommendations for their use such as meeting minimum age requirements, taking courses in hands-on safety courses provided by MRV vendors, and wearing protective equipment [4–6].

Despite these safety concerns, drivers do not perceive MRVs as being dangerous [7]. In fact, ATVs were originally marketed as inexpensive and entertaining toys for the whole family and most pediatric ATV drivers use their vehicles for recreational exploration and off-road navigation on private property [6,8–11]. Many MRV drivers do not comply with safety recommendations because they perceive that all MRVs, including ATVs and motorbikes, are safe and that safety recommendations are unnecessarily restrictive [7].

In contrast to recreational use, a subset of MRV drivers participate in organized events (OE), where there is adult supervision present and greater compliance with safety recommendations such as minimum age requirements and helmet use that are mandated by the event organizers. Common perception is that MRV use during OE is safer and less likely to lead to injury. The purpose of this study was to determine if there is a difference in injury severity or injury patterns of patients presenting to a tertiary care, level 1 trauma center with injuries following recreational use as compared to organized use of MRVs.

1. Materials and methods

This study was performed at Nationwide Children's Hospital, a 420-bed free-standing tertiary care pediatric academic medical center in Columbus, Ohio operating as a referral base for central, northwest, and southeast Ohio. This study was approved by the institutional review board at Nationwide Children's Hospital. We performed an electronic

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search of the institutional trauma registry for trauma events involving patients presenting to our institution either as a transfer from other institutions or through our emergency department (ED) between 2006 and 2012. All events during which the patient was driving an MRV, excluding vehicles that were electric powered, during the reported trauma were included. Data from each patient's chart were abstracted for patient age, gender, race, geographic location of trauma, presentation as a transfer from an outside hospital, mode of arrival, vehicle type, injury date, Glasgow Coma Scale score (GCS) on admission, Injury Severity Score (ISS), ED disposition, use of a helmet, use of other protective equipment, and any surgical procedures that were performed. Surgical procedures included those performed in the ED as well as in the operating room (OR). For trauma events in which the patient was admitted, we reviewed charts for admission service, length of stay, days of ventilator support, days in the intensive care unit (ICU), and disposition following discharge. For each event, injuries defined by the International Classification of Diseases, Ninth Revision, Clinical Modification codes were recorded with body region involved and severity as defined by the Abbreviated Injury Score (AIS). Injuries with AIS of 1 were excluded. Based on narrative descriptions of the event in the chart, trauma events were categorized as OE or RU. Events were defined as OE when the event occurred at a dedicated track site for MRV activities under adult supervision. Events were defined as RU when the event description did not reference a specific organized event site or did not describe adult supervision during the event.

OE and RU events were compared based on demographics, initial clinical evaluation, treatments, body region where the injury occurred, and select diagnoses. Additionally, subgroup analyses were performed comparing OE and RU event groups within ATV drivers and motorbike drivers and ATV use to motorbike use within OE and RU event groups. Categorical variables were evaluated using chi-square and Fisher's exact tests where appropriate, while continuous variables were evaluated using Wilcoxon rank-sum tests. All analyses were performed using SAS 9.3 (Carey, NC) and $p < 0.05$ was considered statistically significant.

2. Results

2.1. Total cohort

A total of 589 events involving 581 drivers, with 8 drivers presenting during two or more separate events, met the inclusion criteria, and 92 of these events involved OE. Table 1 describes the demographics, initial assessment, and outcomes between OE and RU events. OE events were more likely to involve male drivers and drivers who self-identified as white race. There was no significant difference in overall injury severity as measured by trauma level, GCS on arrival, ISS on arrival, likelihood of undergoing a surgical procedure, length of stay longer than 24 hours, admission to the ICU, need for mechanical ventilation, or mortality between OE and RU riders. Among RU riders, females were less likely than males to wear a helmet (22% vs. 45%, $p < 0.001$); but among OE riders, females were as likely as males to wear a helmet (100% vs. 92%, $p = 1.000$). There were three deaths, including one ATV driver who presented in cardiac arrest, one go-cart driver with bilateral pulmonary lacerations and hemopneumothoraces, and one Gator tractor driver who was crushed by an ATV rollover and who incurred a comminuted and depressed skull fracture.

There was a total of 872 severe injuries and 145 (17%) of these injuries were associated with trauma during an OE. Table 2 presents comparative data regarding differences in body regions injured during each event for 10 body regions and differences in the frequency of injury for select injury types. There was no difference in injuries by body region or injury diagnosis comparing OE to RU traumas except for extremity dislocations (2% vs. 0%, $p = 0.038$).

2.2. Subanalysis of vehicles driven

Tables 3 and 4 describe the demographics, initial assessment, and outcomes between OE and RU events for patients driving ATVs and

Table 1
Comparative demographic, presentation, and outcome information on all motorized recreational vehicle trauma events by event type.

	OE	RU	*p*-Value
Total	92 (16)	497 (84)	
Demographics			
Male gender	86 (93)	384 (77)	<0.001*
Age, years	13 (11–15)	12 (9–14)	0.015*
White race	89 (97)	447 (90)	0.045*
Vehicle type			
All-terrain vehicle	17 (18)	293 (59)	<0.001*
Motorbike	72 (78)	143 (29)	
Go cart/other	3 (3)	61 (12)	
Wore helmet during trauma	85 (92)	197 (40)	<0.001*
Wore other protective equipment during trauma	73 (79)	31 (6)	<0.001*
Initial assessment			
Presented to our institution as an interhospital transfer	68 (74)	328 (66)	0.137
Mode of arrival			
Helicopter	26 (28)	121 (24)	0.454
Ambulance	55 (60)	293 (59)	
Private vehicle	11 (12)	83 (17)	
GCS on arrival to initial hospital ≤12[a]	3 (3)	13 (3)	0.727
Injury Severity Score	5 (4–9)	5 (4–10)	0.929
Outcomes			
Underwent surgery	31 (34)	183 (37)	0.567
Intraabdominal surgery	0 (0)	2 (0)	1.000
Burn care and surgery	0 (0)	5 (1)	1.000
Intracranial procedure	0 (0)	5 (1)	1.000
Facial repair	1 (1)	19 (4)	0.342
Extremity fracture	28 (30)	124 (25)	0.269
Urologic procedure	0 (0)	5 (1)	1.000
Incision and drainage	1 (0)	23 (5)	0.152
Other procedure	1 (1)	8 (2)	1.000
Admitted[b]	70 (76)	388 (78)	0.625
Length of stay >24 hours	27 (29)	176 (35)	0.293
Admitted to an intensive care unit	5 (5)	45 (9)	0.271
Mechanical ventilation support	3 (3)	13 (3)	0.721
Deaths	2 (2)	1 (0)	0.065

OE: organized event. RU: recreational use. GCS: Glasgow Coma Scale score.
Reported as median (interquartile range) for continuous variables and frequency (percent) for categorical variables. Percents are calculated as a fraction of the total number of drivers within the OE or RU cohort.
[a] Information is missing for 9 events.
[b] Excludes 2 patients who were pronounced dead in the emergency department prior to consideration for admission.
* Indicates significant result at $p < 0.05$.

Table 2
Region of the body where injury occurred and types of injuries for all motorized recreational vehicle trauma events (Abbreviated Injury Score ≥2).

	Organized event ($N = 92$)	Recreational use ($N = 497$)	*p*-Value
Head	15 (16)	102 (21)	0.352
Face	3 (3)	31 (6)	0.336
Neck	0 (0)	2 (0)	1.000
Chest	7 (8)	35 (7)	0.846
Abdomen	11 (12)	48 (10)	0.500
Cervical spine	1 (1)	6 (1)	1.000
Thoracic spine	2 (2)	4 (1)	0.238
Lumbar spine	2 (1)	6 (1)	0.363
Arm	25 (27)	128 (26)	0.776
Leg	32 (35)	128 (26)	0.074
Fracture	56 (61)	301 (61)	0.956
Dislocation	4 (4)	5 (1)	0.038*
Strain or sprain	2 (2)	2 (0)	0.117
Concussion	11 (12)	45 (9)	0.383
Contusion	8 (9)	30 (6)	0.340
Intracranial hemorrhage	1 (1)	24 (5)	0.155
Laceration	0 (0)	9 (2)	0.367
Internal injury	12 (13)	65 (13)	0.993

Reported as frequency (percent). Percents are calculated as a fraction of the total number of drivers within the OE or RU cohort.