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Clinical Review

ALL-TERRAIN VEHICLE INJURY IN CHILDREN AND YOUTH: EXAMINING CURRENT KNOWLEDGE AND FUTURE NEEDS

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☐ **Abstract—Background: All-terrain vehicle (ATV)-related injuries remain a large public health problem in the United States and disproportionately affect American youth. Although children account for only 14–18% of ATV riders, they comprise 37–57% of those injured in ATV-related accidents. Since the U.S. Consumer Product Safety Commission began collecting data in 1982, 23% of ATV-related deaths have occurred in children. Objective: With this review, we outline the major risk factors for injuries among young ATV riders in the United States and suggest research-based interventions to successfully modify such risk factors. Discussion: We reviewed data from 16 published reviews regarding epidemiology and risk factors among ATV-related injuries in American children. All data pointed to young driver age and lack of appropriate safety equipment as major risk factors for such injuries. Although these risk factors are modifiable, legislation and programs designed to mitigate such risks have been unsuccessful. Among adults, the brief intervention model has become widely used among trauma patients exhibiting risky behaviors. Additionally, peer-to-peer interventions have demonstrated success with respect to drug and alcohol use in school-aged children. Both the brief and peer-to-peer interventions are promising avenues for decreasing risky ATV-related behavior in youths but have not been studied in this field. Conclusions: ATV-related injuries disproportionately affect American youths. Although risk factors for such injuries are modifiable, current methods for intervention (mainly legislation) have not been successfully implemented. The brief intervention and peer-to-peer interventions have shown promise in other fields and should be studied with respect to pediatric ATV use.** © **2017 Elsevier Inc. All rights reserved.**

☐ **Keywords—all-terrain vehicle injury; injuries in youth; injury prevention; brief intervention**

INTRODUCTION

In the United States, recreational all-terrain vehicles (ATVs) have grown in popularity, with the number of ATVs in use increasing from an estimated 5.6 million in 2001 to about 10.6 million in 2010 (1). With this recreational activity comes risk of injury. Although ATV-related injuries increased steadily throughout the 1990s and early 2000s, the most recent report from the U.S. Consumer Product Safety Commission (CPSC) indicates

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that the numbers of injured riders may have begun to decline in 2010. Nonetheless, in 2013, the most recent reporting year, there were an estimated 99,600 ATV-related injuries in the United States that required at least emergency department (ED) treatment (2). Overall, 620 ATV-related deaths were reported in 2011, 513 in 2012, and 426 in 2013 (2). Data collection for these years is ongoing; thus, these numbers are expected to increase.

American children seem to be the riders most vulnerable to injury. By one estimate, children account for only 14–18% of ATV riders, but 37–57% of those injured in ATV-related accidents (3). The CPSC reports that of the ATV-related injuries requiring emergency treatment in 2013, around 25% (25,000) were under the age of 16 years and 52% (51,400) were under the age of 25 (2). Moreover, since the CPSC began collecting data in 1982, 23% of ATV-related deaths were among youth < 16 years of age. Of those, 43% were among those younger than 12 years of age (2).

The Kids' Inpatient Database (KID) is a large database meant to yield national estimates of inpatient pediatrics hospitalizations as a part of the Healthcare Cost and Utilization Project. KID data from 1997–2006 indicate that hospital admissions for ATV injuries increased 240% among those under 18 years of age (4). However, two other large studies have demonstrated declines in the rates of such injuries after this time period (2,5). Shults and co-authors assessed data from 2001–2010 in the National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP) database. The NEISS-AIP is a nationally representative, stratified probability sample from approximately 66 hospitals in the United States. They demonstrated that ATV-related injuries among those aged < 16 years increased from 2001 to 2004, but then decreased from 2004 to 2010 (5). Similarly, the CPSC demonstrated a decrease in ATV-related ED visits in this age group from 2007–2013 (2).

Despite these promising trends, the reality of ATV-related injuries remains grim. The number of injured children is large, and in 2013, at least 62 ATV-related deaths occurred among children (2). Shults and colleagues estimated that children with ATV-related injuries were twice as likely to require hospitalization compared with children with injuries related to motor vehicle crashes (5). Furthermore, pediatric ATV-related injuries continue to rise in some regions of the country. In Arizona, for example, ATV-related injuries among those under 16 years of age rose 83% from 2004–2008, an increase higher than the corresponding increase of injuries occurring due to motor vehicle (35%) and motorcycle crashes (43%) (6).

In addition to injury and death, ATV-related injuries impose a large financial burden on the American health care system. According to national estimates, from 2000–2004, approximately $19,700 was spent per patient hospitalized for ATV-related injuries in the United States, though costs varied based upon specific injuries sustained (7). Adults and children sustaining intracranial injuries incurred the highest average charges – approximately $26,906 per patient (7). Using the KID, another study calculated national estimates of hospital charges among children aged ≤ 18 years admitted for ATV-related injuries in the year 2000. Aggregately, the cost of ATV-related trauma admissions in children that year totaled over 48 million dollars, with a mean hospital charge of $13,823 per pediatric admission (8). The economic burden of ATV-related injuries in children has been estimated in multiple other smaller studies. The average costs reported in such studies coincide with the KID's national estimates, ranging from $4240 to $21,805 per patient (6,9–11).

DISCUSSION

Demographics of ATV-Related Injuries

In their review of the NEISS-AIP data from 2000–2010, Shults and co-authors found that children aged 11–15 years accounted for approximately two-thirds of those ≤ 15 years evaluated in EDs nationally for ATV-related injuries (5). Multiple smaller studies have evaluated admission patterns among children after ATV-related injuries and demonstrate similar patterns with respect to age, with the mean ages of evaluated children ranging from 9 to 13 years (Table 1) (6,9–19,21–25). However, a large percentage of children admitted after ATV-induced trauma were much younger. A review of pediatric admissions (≤ 16 years) to a Level I trauma center in Dallas from 2007–2011 revealed that 18% of ATV-related injuries occurred in children younger than 6 years of age (16). Other institutional reviews have demonstrated similar findings, reporting that between 6% and 13% of ATV-related injuries requiring treatment are among children < 5 years of age (9,17,19).

Pediatric ATV riders admitted with injuries are overwhelmingly white males. The CPSC 2014 report indicated that 69% of ATV-related admissions occurred among males and 89.5% among Whites (26). Other studies cite males as comprising 50–86% of injured riders (Table 1) (6,9–19,21–25).

ATV-Related Behaviors

Young children injured while riding ATVs may be operating the vehicles themselves. In a convenience sample of 228 children at agricultural fairs in 2007, 67% of those < 16 years of age reported experience driving ATVs (27). In a study of pediatric ATV-related injuries, of 17 injured children aged 1–4 years, 5 (29%) were driving at the time of the injury. Among those in the study aged 1–15 years, 71% were drivers (17). Other reviews have found that the

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