Safety of children on off-road vehicles; A scan of recent evidence on helmet use and injury in children

We searched PubMed, the medical research search engine, for any research on children and helmets published in 2010-13 with a focus on off-road vehicles. We have some of the article summaries below but here are the key messages.

1. On an off-road vehicle, children seem to be at greater risk of being seriously hurt than adults. Extreme caution should be taken when a child is riding an off-road vehicle, even with an adult.
2. Young men in their teens and twenties have the highest risk of injury on off-road vehicles.
3. Helmet use in children is associated with fewer head/brain injuries and less severe head/brain injuries in collisions involving motor vehicles (car-bicycle, ATV and other off-road vehicles).
4. Helmet use in children is associated with fewer injuries to the rest of the body (chest, spine, legs).
5. Parents’ opinions about wearing a helmet predict whether children wear helmets.
6. The type of helmet seems important. Helmets are designed with specific types of injury in mind so the helmet should match the activity. However it seems that a helmet is always better than no helmet.


The effectiveness of helmets in bicycle collisions with motor vehicles: A case-control study.

Bambach MR, Mitchell RJ, Grzebieta RH, Olivier J.

Source
Transport and Road Safety (TARS) Research, University of New South Wales, Australia. Electronic address: m.bambach@unsw.edu.au.

Abstract
There has been an ongoing debate in Australia and internationally regarding the effectiveness of bicycle helmets in preventing head injury. This study aims to examine the effectiveness of bicycle helmets in preventing head injury amongst cyclists in crashes involving motor vehicles, and to assess the impact of 'risky cycling behaviour' among helmeted and unhelmeted cyclists. This analysis involved a retrospective, case-control study using linked police-reported road crash, hospital admission and mortality data in New South Wales (NSW), Australia during 2001-2009. The study population was cyclist casualties who were involved in a collision with a motor vehicle. Cases were those that sustained a head injury and were admitted to hospital. Controls were those admitted to hospital who did not sustain a head injury, or those not admitted to hospital. Standard multiple variable logistic regression modelling was conducted, with multinomial outcomes of injury severity. There were 6745 cyclist collisions with motor vehicles where helmet use was known. Helmet use was associated with reduced risk of head injury in bicycle
collisions with motor vehicles of up to 74%, and the more severe the injury considered, the greater the reduction. This was also found to be true for particular head injuries such as skull fractures, intracranial injury and open head wounds. Around one half of children and adolescents less than 19 years were not wearing a helmet, an issue that needs to be addressed in light of the demonstrated effectiveness of helmets. Non-helmeted cyclists were more likely to display risky riding behaviour, however, were less likely to cycle in risky areas; the net result of which was that they were more likely to be involved in more severe crashes.


Pediatric "off-road vehicle" trauma: determinants of injury severity and type.

Sandler G, Soundappan SS, Manglick MP, Fahy FE, Ross F, Lam L, Cass D.

Source

Department of Academic Surgery, Prevention, Education, and Research, The Children's Hospital at Westmead, South Wales, Australia.

Abstract

OBJECTIVES:
This study aimed to describe the determinants of the severity and type of injuries sustained by children hurt in off-road vehicle (ORV) accidents.

METHODS:
This was a retrospective clinical study for which data were obtained from the trauma database at the Children's Hospital at Westmead covering the 10-year period between January 1, 1998, and December 31, 2007. Data points collected included age, sex, Injury Severity Score (ISS), body region injured, type of vehicle, accident setting, mechanism of injury, estimated speed, position of the rider, use of a helmet and/or protective clothing, and hospital length of stay. The study end points were determinants of injury severity and type. Statistical analysis of the collected data was done with the standard statistical software package, SPSS.

RESULTS:
A total of 288 children (242 male [84%] and 46 female [16%] patients) presented for ORV-related trauma. Helmets significantly diminished the chance of sustaining a head injury occasioning a skull fracture. Jumping was associated with increased ISS and a higher chance of sustaining an abdominal and/or thoracic injury. Older children were more likely to sustain pelvic and spinal injuries, be injured while traveling at high speed, and be injured while going over a jump. Mean ISS was significantly lower if trauma was sustained while riding a mini motorcycle in any setting and any ORV at home.

CONCLUSIONS:
Further research (prospective, federal, and multi-institutional) is needed with a view to optimizing training schedules, rules, regulations, and licensing requirements for pediatric ORV riders.


Analysis of pediatric all-terrain vehicle trauma data in Middle Tennessee: implications for injury prevention.
Unni P, Morrow SE, L Shultz B.

Source
Department of Pediatric Surgery, and Surgical Services, Monroe Carell Jr Children's Hospital at Vanderbilt, Vanderbilt
University, Nashville, Tennessee 37232, USA. purmin.unni@Vanderbilt.edu

Abstract
BACKGROUND:
Trauma registries capture data about injuries that can be used to objectively guide injury prevention
initiatives. This article analyzes trauma registry data to describe the nature and distribution of all-terrain
vehicle (ATV) injuries in Middle Tennessee. A community injury prevention effort, based on this analysis,
is also presented.

METHODS:
A retrospective analysis of data (2007-2009) from the trauma registry of a Level I pediatric trauma center
in Middle Tennessee was conducted. Patients younger than 16 years with ATV-related injuries were
included in the analysis (n = 163). The key variables examined were demographics, injury
severity, helmet use, injury mechanism, length of stay, and patient's county of residence. In addition,
Geographic Information Systems software was used to examine the distribution of injuries and graphically
represent counties with highest injury rates in the youth population.

RESULTS:
ATV injuries were more prevalent among boys than girls (66% vs. 34%; p < 0.001). Approximately 64% of
the ATV injuries were in the age group 10 years to 15 years. Most injuries were either moderately severe
(44%) or severe (30%). Injury mechanism varied by age; younger children experienced more rollovers
while older children tended to be injured from ejections (p < 0.05). Helmet use was low (33%). Data from
this study suggest that helmet use resulted in fewer injuries to the head, neck, and face. Counties with
high rates of ATV injuries were targeted for ATV training programs. 4-H agents trained by the ATV Safety
Institute provided ATV training classes.

CONCLUSION:
Rural youth are clearly at greater risk for ATV injuries than urban populations. Young ATV riders are often
self-taught and lack the knowledge to ride ATVs safely. Organizations such as the 4-H, provide effective
injury prevention outreach.

LEVEL OF EVIDENCE:
Epidemiologic study, level III.


The epidemiology of injury in ATV and motocross sports.
Larson AN, McIntosh AL.

Source
Division of Pediatric Orthopedic Surgery, Mayo Clinic, 200 1st St SW, Rochester, MN 55905, USA. larson.noelle@mayo.edu

Abstract
Off-road motorsports are popular in rural and suburban areas, and allow for racing, recreation, and easy
access to backcountry destinations. This chapter will review the incidence and types of injuries sustained
in off-road motorsports. We completed a structured review of motocross and all-terrain vehicle (ATV)
injuries, assessing for injury rates, risk factors, and mortality figures. Information for this study was
obtained from a PubMed search under the terms 'motocross', 'motorcross', 'all-terrain vehicles', 'injury', 'motorcycle', 'ATV'. Abstracts and articles in the English language from 1980 onward were reviewed. Further statistics were obtained from the US Consumer Product Safety Commission publications. Operating vehicles off-road requires coordination, experience, and training. Motocross is an organized sport with national associations governing the competition of highly trained athletes. ATVs are used both recreationally and commercially, typically for farming and ranching. ATV use appears more dangerous than motocross, with a higher mortality rate, disproportionately for children. Both sports continue to have high rates of head, spinal cord, and extremity injury. Future prospective studies in off-road motorsports should evaluate the risk factors for injury and target specific areas for injury prevention. Improved training programs, use and improvement of safety helmets, and for ATV use, limiting access to minors, may improve the overall safety of off-road motorsports.

Copyright © 2012 S. Karger AG, Basel.


Recreational helmet use as a predictor of noncranial injury.
Al-Habib A, Attabib N, Hurlbert RJ.

Source
Division of Neurosurgery, Department of Clinical Neurosciences, University of Calgary, Alberta, Canada.

Abstract
BACKGROUND:
The effect of helmet use in the prevention of head injury has been clearly shown. However, the relationship between helmet compliance and other bodily (noncranial) injury has not been explored, yet may have important impact on strategies for injury prevention. The purpose of this study was to examine helmet use in an injured population to evaluate its association with noncranial trauma.

METHODS:
All entries in the Canadian National Trauma Registry were surveyed from 2000 to 2004 and limited to injuries sustained in recreational sports associated with helmet use.

RESULTS:
Over the 5-year period, 2,205 injuries met inclusion criteria. Cycling-related injuries were most frequent (43.5%). Alcohol consumption correlated significantly with lack of helmet use. Nonhelmeted individuals suffered significantly more noncranial injuries (85% vs. 68%, p < 0.0001) and had twice as many severe head injuries (Glasgow Coma Scale score ≤ 8) (odds ratio [OR]: 2.13, 95% confidence interval [CI]: 1.35-3.37) or any abnormal Glasgow Coma Scale score (OR: 1.96, 95% CI: 1.55-2.47). While controlling for age, sex, or type of sport activity performed, multivariate regression confirmed a reduction in associated noncranial injuries when helmets were used (OR: 0.86, 95% CI: 0.83-0.89).

CONCLUSIONS:
Within an injured population from sports-related activities, helmet use is associated with fewer noncranial injuries of all types suggesting reduced overall risk of injury in this group. In addition, use of helmets is associated with less frequent and less severe head injury. Alcohol consumption is related to increased risk of injury and is more prevalent in injured individuals who abstain from helmet use.

LEVEL OF EVIDENCE:
III, prognostic study
Retrospective review of all-terrain vehicle accidents in Alberta.
Pelletier JS, McKee J, Ozegovic D, Widder S.

Source
Trauma Services, the University of Alberta, Edmonton, AB.

Abstract
BACKGROUND:
All-terrain vehicles (ATVs) are frequently associated with injuries and deaths. In spite of this, very few guidelines, let alone legal restrictions, exist to guide users of these machines.

METHODS:
We conducted a standardized review of prospectively collected data from the Alberta Trauma Registry. All patients who were involved in ATV-related traumas from 2003 to 2008 with an Injury Severity Score (ISS) greater than 12 were included. The variables studied were age, sex, type of vehicle, purpose of use, person injured (driver or passenger), ISS, distribution of injuries, length of hospital stay, helmet use and death.

RESULTS:
We evaluated 435 patients with ATV-related injuries and ISS greater than 12. The average ISS was 22.8, with an overall mortality of 4.6%; 55% of patients were not wearing helmets, and most of the deaths (85%) occurred among these individuals. Helmet use was associated with a lower risk of mechanical ventilation and of injury to the head and/or cervical spine. Children accounted for 18.9% of all patients and 15% of deaths; 57% of them were wearing helmets at the time of their accidents.

CONCLUSION:
All-terrain vehicle use in Alberta carries a significant risk of injury and death, and there is an association between death and lack of helmet use. A minimum age for ATV use of at least 16 years and a legal requirement for helmet use may increase public awareness of these risks and decrease morbidity and mortality.

Performance analysis of winter activity protection headgear for young children.
Hoshizaki B, Vassilyadi M, Post A, Oeur A.

Source
Neurotrauma Impact Science Lab, University of Ottawa, Ottawa, Ontario, Canada. thoshiza@uottawa.ca

Abstract
OBJECT:
The purpose of this study was to evaluate how currently used helmets would perform for winter play activities, such as tobogganing. In Canada and northern parts of the US, the advent of winter is followed by an increase in visits to hospital emergency departments by young children presenting with head injuries resulting from winter activities. Sliding, skating, skiing, and snowboarding all involve risks of head injury from situations such as falling on ice or sliding into stationary objects. This study
compared the protective characteristics of helmets used by young children (< 7 years of age) participating in winter recreational activities.

**METHODS:**
Ice hockey, alpine ski, and bicycling helmets were impacted at 2.0, 4.0, 6.0, and 8.0 m/second at the front and side impact location by using a monorail drop rig.

**RESULTS:**
The results for the front impact showed that the ice hockey helmet protected the child significantly better at 2 and 4 m/second when considering both linear and angular peak acceleration. The bicycle helmet performed significantly better than the other 2 helmets at 8 m/second for the front location and only angularly for the side impacts.

**CONCLUSIONS:**
Depending on the impact velocity of the hazard, the type of helmet significantly affected the risk of brain injury.


**Implications of parental influence on child/adolescent helmet use in snow sports.**
Provance AJ, Engelman GH, Carry PM.

**Source**
Children’s Hospital Colorado and the University of Colorado-Denver, Anschutz Medical Campus, Aurora, Colorado 80045, USA. aaron.provance@childrenscolorado.org

**Abstract**

**OBJECTIVE:**
The main objective of this study was to assess the influencing factors in participants who do not use a helmet while skiing or snowboarding in the youth population.

**DESIGN:**
Cross-sectional survey.

**SETTING:**

**PARTICIPANTS:**
Children and adolescents between the ages of 6 to 17 years and their parents were enrolled in the study. Two hundred six children/adolescents participated.

**INDEPENDENT VARIABLES:**
Independent variables included age, gender, parental helmet use, ski/snowboard helmet past protection, and child/adolescent reason for wearing/not wearing helmet.

**MAIN OUTCOME MEASURES:**
Dependent variables included child/adolescent helmet use.

**RESULTS:**
Fifty-one percent were male and 49% were female. One hundred seventy-one (83%) reported that they wear a ski/snowboard helmet, and 35 (17%) reported that they did not wear a ski/snowboard helmet. There was a significant relationship between parental helmet use and child helmet use (P ≤ 0.0001). Of the 171 children/adolescents who reported wearing a helmet, 124 (72.5%) reported that wearing a helmet protected them in an accident. Of the 171 children/adolescents who reported wearing a helmet,
87.7% said that safety was the reason for wearing a helmet. The most common reason for not wearing a ski/snowboard helmet was comfort.

**CONCLUSIONS:**
Parent's helmet-wearing behavior was strongly associated with the child/adolescent's helmet-wearing behavior. The results demonstrate the overwhelming influence parental helmet use has on their child/adolescent's decision to wear a helmet.


**Examining Ontario deaths due to all-terrain vehicles, and targets for prevention.**

Lord S, Tator CH, Wells S.

**Source**
Doctor of Medicine Program, Toronto Western Hospital and University of Toronto, Toronto, Ontario, Canada.

**Abstract**

**BACKGROUND:**
All-terrain vehicle (ATV) use is increasingly popular among people of all ages. Although ATV use is known to cause significant morbidity due to head and neck trauma, there is a lack of published data detailing ATV-related fatalities. We examined all ATV-related fatalities in Ontario from 1996 - 2005 to determine the epidemiology and risk factors as a guide for improved injury prevention strategies.

**METHODS:**
All ATV-related fatalities from 1996 - 2005 in Ontario were examined through Coroner’s reports in the Office of the Chief Coroner of Ontario. Epidemiologic information and risk factors relating to the driver, environment, and vehicle were recorded.

**RESULTS:**
There were 74 ATV-related fatalities from 1996 - 2005. There was only one fatality per year in 1996 and 1997 and a peak of 16 per year in 2004 and 2005. Head and neck injuries were the commonest causes of death. Males comprised 90.5% of the cases. The highest risk was from age 15 - 29, and 21% of fatalities occurred in children under 16. Northeastern Ontario had the highest fatality rate.

**CONCLUSIONS:**
There was a major increase in the incidence of ATV-related fatalities in Ontario from 1996 - 2005 with the majority due to head trauma. Notable risk factors included alcohol use, riding at night, lack of helmet use, and excessive speed. We recommend the adoption of laws that focus on helmet requirements, a minimum driver age of 16, and certified training courses. Aggressive injury prevention efforts should be targeted toward males aged 15 - 29.