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Off-road vehicle fatalities: A comparison of all-terrain vehicle and snowmobile accidents in Sweden

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ABSTRACT

This study investigates accident fatalities involving two types of off-road vehicles: snowmobiles and all-terrain vehicles (ATVs). All snowmobile fatalities in Sweden from the 2006/2007 season through the 2011/2012 season, and all ATV fatalities from 2007 through 2012, were retrospectively examined. A total of 107 fatalities—57 snowmobile-related and 50 ATV-related—were found. Most deaths occurred on weekends (71% of the snowmobile-related and 72% of the ATV-related). A majority of the fatalities were males (91% and 94%), with the largest share in the age group 40–49 years (19% and 24%). The most common causes of death were blunt trauma (56% and 66%), drowning (30% vs 6%), and traumatic asphyxia (9% vs 14%). Among victims who were tested (95% vs 92%), a very high share was found to be inebriated (59% vs 61%), and mean blood alcohol concentration was also high (1.9 vs 1.7 g/l). Forty-seven percent of snowmobile-related fatalities and 48% of ATV-related fatalities had a blood alcohol concentration above 1.0 g/l. This means that there was a very strong association between off-road vehicle fatalities and drunken riding; steps to prevent riding while intoxicated seem to be the most important preventive measure. Automatic measures such as alcolocks are probably the most effective. The obvious at-risk group to target is middle-aged men with high alcohol consumption.

1. Introduction

Previous literature on the nature of vehicular crashes and fatalities has mostly focused on road traffic incidents, while only limited interest has been paid to off-road vehicle crashes and fatalities. It is however of interest to examine fatalities associated with off-road vehicles due to the rising popularity of such vehicles. In Sweden, for example, the two most popular off-road vehicles are the snowmobile and the all-terrain vehicle (ATV); for every 100 passenger cars registered there are currently ~5 snowmobiles [1] and ~2 ATVs registered (Johan Strandroth, Swedish Transport Administration, personal communication 2013).

Since its introduction to the Swedish public in the 1960's, the snowmobile has been steadily increasing in popularity and has shifted from being used mostly for work purposes to being used mostly for leisure activities. The number of registered snowmobiles has grown from ~177,000 in year 2006 to ~223,000 in 2011 [1]. ATVs have also grown in popularity; the number of registered ATVs increased from ~36,000 in year 2007 to 91,000 in 2012 [1]. Because ATVs are designed to move in rough terrain, they are used in forestry, farming and hunting. The main explanation for their increasing popularity, however, is their use as recreational vehicles [2].

The increasing use of these vehicles, however, has had some drawbacks. Many riders do not have the special skills needed to handle off-road vehicles. In addition, both snowmobiles and ATVs are related to a significant share of deaths occurring outside of the designated terrain, such as driving a snowmobile into open water or through ice, or driving an ATV into the roadside environment while driving on a road. Furthermore, fatalities with both of these vehicle types are highly related to alcohol inebriation [3–5].

The aim of this study was to analyze recent trends regarding fatal crashes involving off-road vehicles, and to compare and contrast commonalities and risk factors regarding the two main types of off-road vehicles.

2. Materials and methods

All fatalities related to the use of either snowmobiles or ATVs that were examined at any of the six Departments of Forensic Medicine in Sweden were included. The time period studied included ATV-related deaths from 1 January 2007 through 31 December 2012, and

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snowmobile-related deaths from the 2006/2007 season through the 2011/2012 season.

A complete autopsy was performed in each case. Police reports (presenting the vehicle, its damages and defects, the circumstances of the crash, and background data on the victim, etc.) and hospital records (in case of initial survival; presenting the condition of the victim on arrival, clinical findings, therapeutic measures, etc.) were studied. Furthermore, the medico-legal autopsy reports (presenting injuries, gross and microscopic pathoanatomical findings, toxicological findings, cause and manner of death, etc.) were reviewed.

The laws and regulations regarding medico-legal autopsies, stating that all unnatural deaths must be subjected to a medico-legal autopsy, ensure that there are few, if any, missing cases.

3. Results

A total of 107 deaths were included in this investigation.

3.1. Snowmobile-related deaths

We identified 57 snowmobile-related deaths during the study period, an average of 9.5 annual fatalities. No obvious time trend was detected (Fig. 1). All fatal events occurred from October through May with a peak in April (26%) (Fig. 2). A large proportion (71%) of the deaths occurred on weekends (Friday through Sunday) with the highest share on Saturdays (41%).

3.1.1. Victims

Of the 53 (93%) fatalities where it was documented, 46 (90%) were riders and 7 were (10%) passengers. Most fatalities occurred in the age groups 30–39 years (19%) and 40–49 years (19%) (Fig. 3). The majority (91%) of victims were males.

3.1.2. Injuries

Collisions with immobile objects and going through the ice were the most common mechanisms of injury (32% each) followed by being thrown from the vehicle (10%), being pinned under the snowmobile (9%), and collision with another vehicle (7%).

The most common mechanisms of death were blunt force trauma (56%), drowning (30%), traumatic asphyxia (9%), and hypothermia (5%). Blunt trauma to the head was a more common (66%) cause of death than blunt trauma to the chest (34%). A majority of cases with fatal chest injury involved rib fractures (82%).

3.1.3. Alcohol

Blood alcohol analyses were performed in 54 cases (95%), with alcohol detected in 32 (59%). The mean alcohol concentration in femoral vein blood was 1.9 g/l, and 47% of all fatalities had a blood alcohol concentration exceeding 1 g/l.

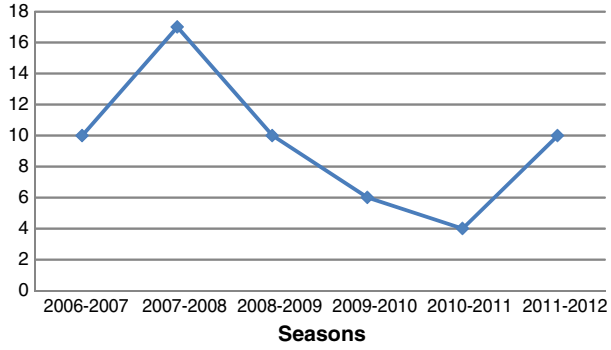

Fig. 1. Snowmobile-related fatalities per season, 2006/2007 through 2011/2012 (n = 57).

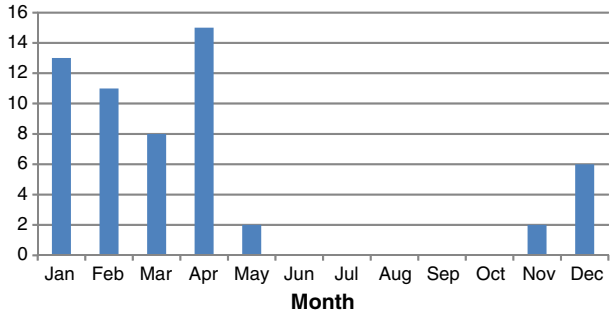

Fig. 2. Snowmobile-related fatalities per month, 2006/2007 through 2011/2012 (n = 57).

3.1.4. Helmet use

Documentation regarding helmet use was lacking in 42 cases (74%), but among the 15 cases where it was documented, 7 (47%) were wearing a helmet while 8 (53%) were not. Among those who *were not* wearing a helmet at the time of the crash, 5 (63%) suffered fatal head or neck trauma. Among those who *were* wearing a helmet, 2 (29%) individuals suffered such trauma, one of whom had not properly fastened the helmet.

3.2. ATV-related deaths

There were 50 ATV-related deaths from 2007 through 2012, an average of 8.3 annually. A peak was reached in 2011 with 11 deaths, but no obvious time trend was seen (Fig. 4). Fatal incidents were spread throughout the year (Fig. 5) with a peak in June–September (52%). A large proportion of the deaths (72%) occurred during weekends (Friday through Sunday), with a peak during Saturdays (38%).

3.2.1. Victims

Out of the 46 (88%) fatalities where documentation was available, 44 (96%) were riders and 2 (4%) were passengers. Most fatalities occurred in the age group 40–49 years (24%) (Fig. 6). Only three female victims were found, all of whom were in the age group 10–39 years.

3.2.2. Injuries

Driving the ATV into the roadside environment while driving on the road was the most common accident mechanism (26%), followed by being pinned under the ATV (22%), collision with an immobile object (20%), being thrown off (16%), collision with another vehicle (10%), going through the ice (2%), and being pulled by winch (2%). In one case, the mechanism of injury was unknown.

The most common mechanisms of death were blunt trauma (66%), traumatic asphyxia (14%), drowning (6%), natural death due to

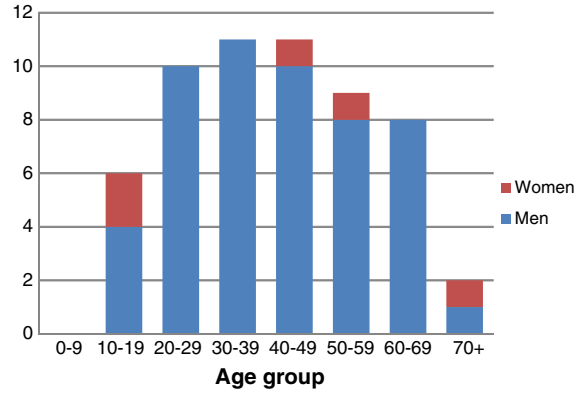

Fig. 3. Age and sex distribution among snowmobile-related fatalities, 2006/2007 through 2011/2012 (n = 57).