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Vehicle-Moose Accidents in Newfoundland*

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ABSTRACT: **During 1987 and 1988, in Newfoundland, there were 661 motor-vehicle accidents involving a moose; 133 people were injured and three died. This constitutes a major problem for the provincial health-care system.**

In 95 per cent of the patients who were involved in fifty-five primary collisions (the vehicle hit only the moose), the injury-severity score was less than 9 (mean and standard deviation, 3.2 ± 4.6). There were thirty-six secondary collisions: in eighteen, the vehicle hit other objects after avoiding the moose (group A), and in the other eighteen, the vehicle hit the moose and then hit other objects (group B). In group A, the mean injury-severity score was 4.2 ± 2.9 and in group B, it was 19.6 ± 27.1. The three patients who died were in group B. There were more injuries to the thorax, thoracolumbar spine, and abdomen in group B than in the single-collision groups (primary-collision group and group A).

More than 10,000 accidents occur each year in Newfoundland as a result of a motor vehicle hitting a moose or hitting another object in an attempt to avoid a moose. Despite warning signs for motorists where these accidents tend to happen, many occur each year, as moose run rampant across the province.

Eriksson et al. recognized the difference in the pattern of injury seen as a consequence of the unusual collision between an automobile and a moose compared with that seen in typical motor-vehicle accidents. In accidents involving a moose, there was a higher prevalence of injuries to the head and neck, as well as critical injuries to the brain, than in typical motor-vehicle accidents.

The impetus for this study came from the management of three patients who were involved in a collision between a vehicle and a moose. One patient had an open fracture of the skull with a depression of the anterior cranial fossa into the orbit (a so-called reverse blow-out fracture) after the hoof of a moose came through the windshield and hit the patient's forehead. In another accident, the driver sustained a unilateral burst fracture of the atlas; the passenger had only abrasions of the face and forearms.

The aim of the study was to assess the cause of death and various injuries that are incurred in vehicle-moose accidents. In addition, the epidemiology and cost to the Department of Health of these accidents were analyzed.

Methods

The records of all motor-vehicle accidents involving a moose that occurred in 1987 and 1988 were obtained from the Newfoundland Department of Environment and Lands, Wildlife Division. The circumstances, including time, place, and date of the accidents were compiled. The data for ninety-one of the 133 patients who had been injured were obtained from hospitals and clinics across the province. The remaining forty-two victims did not go to a health-care facility, perhaps because the injuries were so minor. Autopsy reports were obtained for the three patients who died. The injuries were graded according to the injury-severity scale[1]. A cost-analysis for the patients was performed.

We initially categorized the patients into two groups. One group was composed of patients who had been driving or riding in a vehicle (automobile or motorcycle) that had hit only a moose (primary-collision group). In the secondary-collision group, the patients had been driving or riding in a vehicle that had either hit other objects when the moose was avoided or had hit the moose but then went off the road and hit other objects. After the results had been analyzed, the secondary-collision group was subdivided into two groups. In group A, the driver avoided the moose and then hit other objects, and in group B, the driver hit the moose and then hit other objects (double collision).

Results

During the two-year period of the study, approximately 24,000 motor-vehicle accidents were reported, of which 661 (3 per cent) involved a moose; 133 people were injured, including three who died. Most accidents occurred in the summer and fall; they were infrequent during the winter and early spring (Fig. 1).

The number of accidents was counted for each one-hour period before and after sunrise and sunset (Fig. 2). There was a small peak in the number of accidents two

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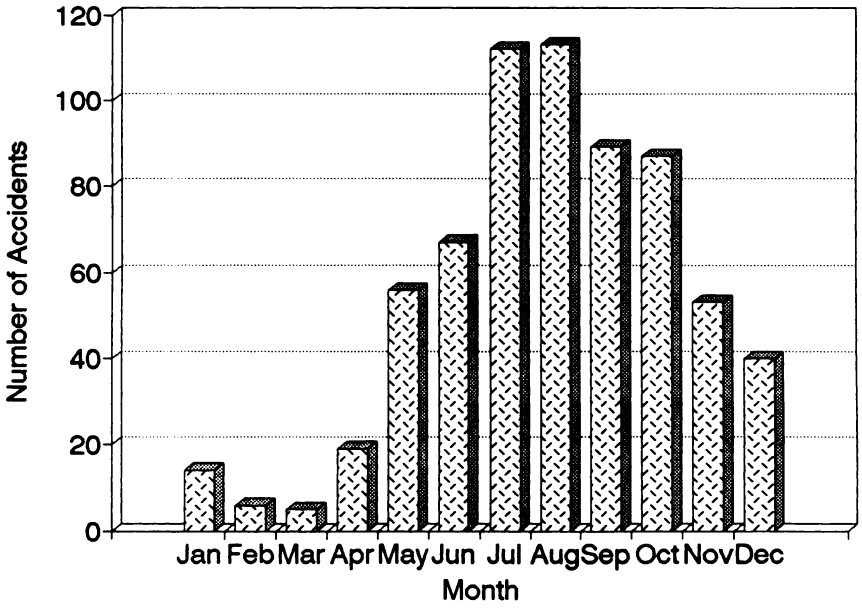

FIG. 1

Number of vehicle-moose accidents according to month.

hours after sunrise in the summer months and a large peak from two to four hours after sunset all year round (Fig. 2).

Most injuries were to the head, neck, and upper extremities. Abrasions, lacerations, and contusions accounted for more than one-half of the injuries, and concussions also were common. Very few patients had injuries to the chest, abdomen, thoracolumbar spine, or lower extremities.

Of the ninety-one patients for whom data could be obtained, fifty-five had been involved in a primary collision. The injury-severity score in this group was 3.2 ± 4.6 (mean and standard deviation); fifty-two patients (95 per cent) had a score of less than 9, two patients had a score of between 9 and 15, and one had a score of 33 (Fig. 3). This demonstrated the relatively minor degree of injury.

In the thirty-six patients who had been involved in a secondary collision, there were more injuries to the thoracolumbar spine, abdomen, and chest. The three patients who died were in this group. Twenty-six (72 per cent) of the patients had an injury-severity score of less than 9, and the other ten (28 per cent) had injuries that were much more severe (Fig. 4).

The eighteen patients in group A (other objects were hit after the moose was avoided) had an injury-severity score of 4.2 ± 2.9 (mean and standard deviation). The eighteen patients in group B (the moose and other objects were hit) had a mean score of 19.6 ± 27.1 (Fig. 5). Thus, there was an increased risk of more severe injuries in the double-collision group, but the severity of injury varied consider-

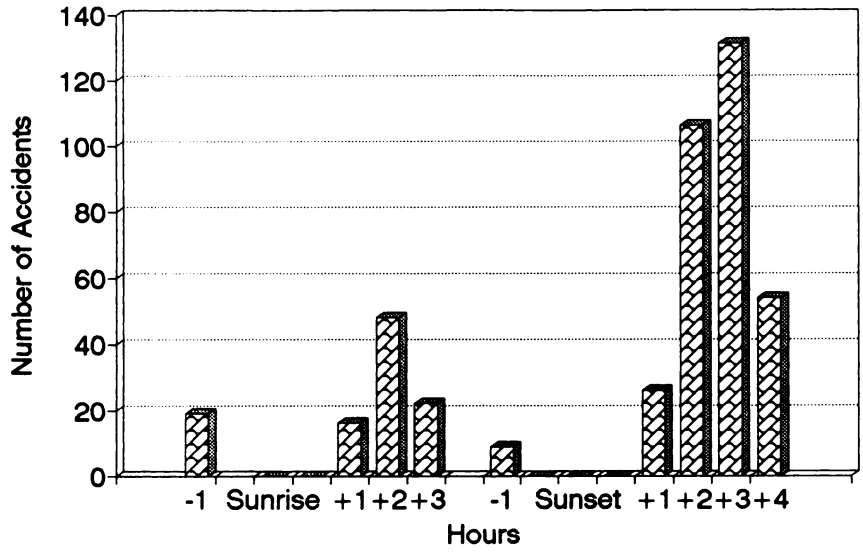

FIG. 2

Number of accidents in each hour before and after sunrise and sunset (two-year totals).

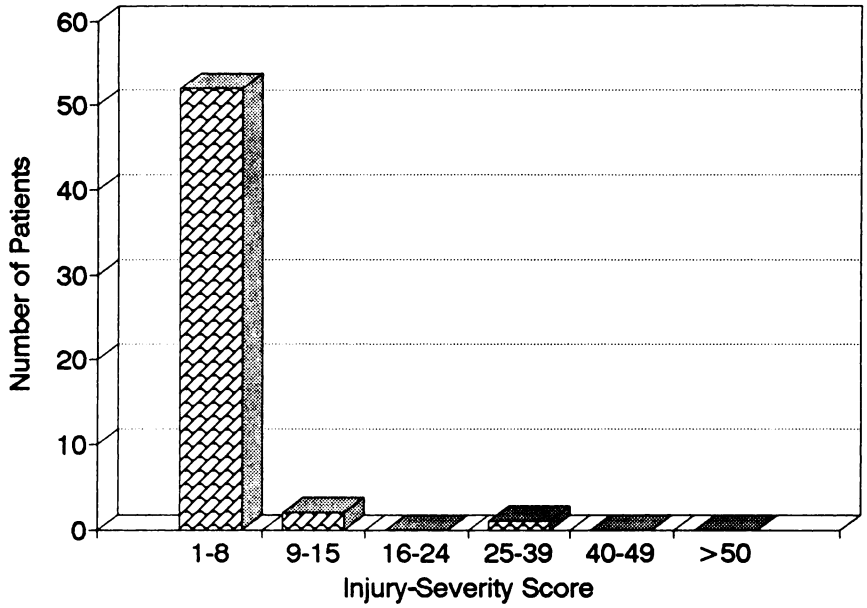

FIG. 3

Injury-severity scores of patients who were involved in a primary collision.

ably. When group B was compared with the other two groups with use of a modified Student t test, the difference in the severity of injuries was significant ($p < 0.05$).

The three people who died were either found to be dead at the scene or were dead on arrival at the emergency room. One person had a fracture-dislocation of the cervical spine at the level between the fourth and fifth cervical vertebrae. She was a passenger in the front seat of a subcompact automobile that was traveling, at 8 PM, at a speed of eighty kilometers (approximately fifty miles) per hour. The driver hit a moose at the top of a hill and then went into a ditch. The other two people who died were the driver and passenger in a subcompact automobile that was traveling, at 3 AM, at a speed of 110 kilometers (approximately sixty-eight miles) per hour. Both were dead on arrival, with severe open fractures of the skull and cerebral lacerations. They, too, were involved in a double collision; after hitting the moose, the automobile went out of control and hit a tree. Both patients had traces of illegal drugs and of alcohol in the blood.

The seating pattern was known for sixty-seven of the injured people. Sixty-one were seated in the front seat and six, in the rear seat. The seating position was unknown for the remaining people. None of the passengers who were

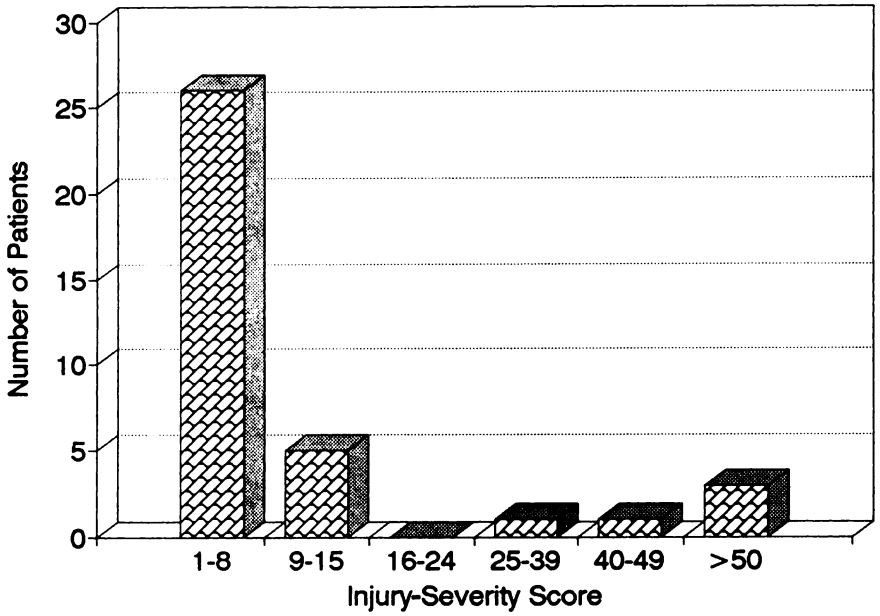

FIG. 4

Injury-severity scores of patients who were involved in a secondary collision.

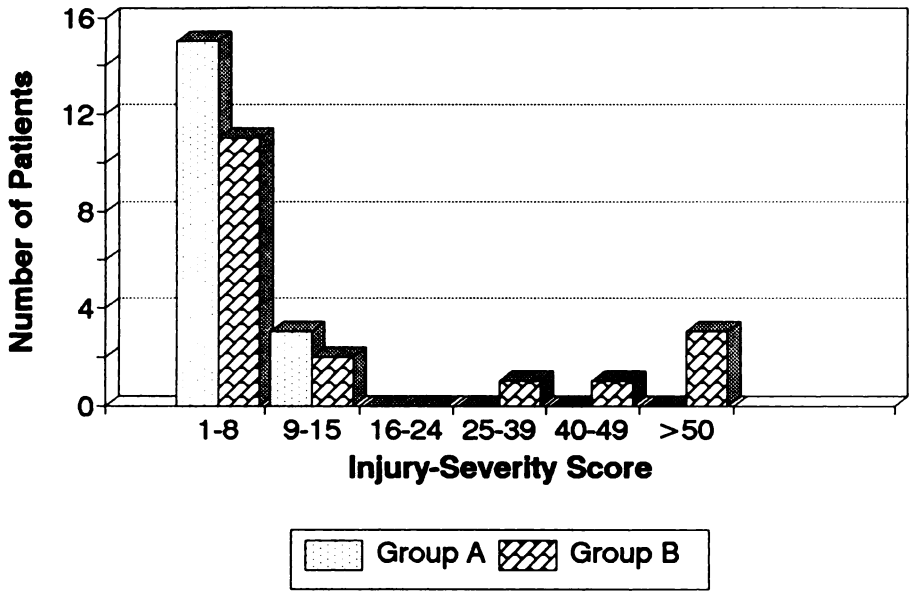

FIG. 5

Comparison of injury-severity scores between patients in group A and group B.

known to be in the rear seat had an injury-severity score of more than 8. The size of the automobile made no difference in the severity of injury. Three motorcyclists were involved in a primary collision with a moose; two sustained only minor injuries after they drove through the midsection of the moose. The third motorcyclist sustained contusions of the chest, a fracture of the clavicle, and an injury to the pancreas.

A cost-analysis (in Canadian dollars) of the initial emergency care and hospital admission was done, with $48 as the cost of an emergency assessment, $69 as the cost of an emergency assessment with a cast or minor operative procedure, $25 for each radiograph, and $635 (ward) and $920 (intensive care) per day for patients who were admitted. The cost of operative treatment or follow-up visits was not included. For the treatment of patients who were involved in a primary collision, the calculated cost to the Department of Health was approximately $19,000; for patients in the secondary-collision group, the cost was approximately $358,000. Thus, the total was more than $377,000 for the two groups over the two-year period.

Discussion

The moose, or elk (as it is called in Europe), is a large

FIG. 6

Damage to a vehicle after a moose was hit. The driver was unscathed except for a few scratches on the forearms and face.

animal. The male moose weighs an average of 450 kilograms (992 pounds), and the average female moose weighs 350 kilograms (772 pounds). They attain an average height, as measured from the tip of the hoof to the top of the scapula, of 180 centimeters (approximately six feet). Thus, the height from the ground to the undersurface of its abdomen is generally above the hood of an automobile. The calves remain with the mothers for about one year until the cows drive them off as the birth of the new calves approaches in the early summer. The fall is the mating season (rut). Male moose are very dangerous during this time because of the increase in their activity, which peaks at dawn and dusk. Moose like water and are able to dive for food. During the summer, they can be found around lake shores and swamps, but they head to dry ground in the winter. Newfoundland is a province with many lakes and swamps, and several roads cross these areas. All of these facts are associated with the increase in accidents during the summer and fall and in the first few hours after sunrise and sunset. Moose are said to be found near roads because of salt run-off, yet there are fewer accidents in the winter and spring than in the summer and fall.

Eriksson et al. analyzed sixty-three fatalities that occurred over a five-year period in Sweden and were due to what they termed game accidents. They found that most of the accidents were the result of a primary collision between the automobile and the animal, not of a secondary collision. Fatal injuries were mainly to the head and neck, as was found in our study. Eriksson et al. noted that this differed from the injuries seen in typical motor-vehicle accidents. In our study, more severe injuries and fatalities involved patients who were in a double collision. In patients who were in an accident in which only the moose or another object was hit, the injuries were more frequently minor.

Oosenbrug et al. studied accidents involving moose on the Avalon peninsula in Newfoundland in relation to traffic patterns from 1973 to 1985. Despite low volumes of traffic at night and in the early morning, the number of vehicle-moose accidents increased during these times. This was especially true of the first few hours after sunset. The morning and evening rush hours did not show an increased prevalence of accidents.

The difference in injuries compared with usual motor-vehicle collisions is thought to be due to the body habitus of the moose. The moose has very long legs, with the undersurface of the abdomen at or above the level of the hood of the automobile. When an automobile hits a moose, the automobile knocks the legs out from under it, and the momentum causes the body of the moose to fly up and hit the windshield, front pillars, and roof (Fig. 6). Thus, the rear seat is safer, and a larger automobile is not more protective. This mechanism of injury also accounts for the injuries to the head and neck and the unusual axial-load-type injuries to the cervical spine that have been seen in people involved in these accidents.

Most of the patients who were involved in a primary collision were treated for minor injuries, in an emergency department or clinic, and were released. Some of those who were involved in a secondary collision also had minor injuries and were released early. Others, however, had major injuries that necessitated admission to the hospital or the intensive-care unit, with a more prolonged stay. This accounts for the significant difference in cost between the two groups of patients.

Warning signs about moose have been placed in areas of increased accidents, and they alert the driver to slow down. Moose can run at speeds of fifty-six kilometers (approximately thirty-five miles) per hour, so they can enter or cross the road rapidly from the feeding ground at the side of the road. Road-clearing for fifty meters (thirty feet) on either side is done along the major highways in Newfoundland, to keep the feeding ground of the moose away from the roadside. Due to poor visibility, driving speed should be reduced at night. Most of the population of Newfoundland is aware of the dangers, but tourists usually are not. Prevention of vehicle-moose accidents involves public awareness of the problem.

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