

Heavy Trucks and Road Crashes

Daniel R. Mayhew
Herb M. Simpson
Douglas J. Beirness

Traffic Injury Research Foundation
171 Nepean Street, Suite 200
Ottawa, Ontario K2P 0B4

March 2004

Table of Contents —●

Executive Summary	ii
Introduction	1
Magnitude	2
Trends	3
Characteristics	7
People Killed and Injured	7
Victim Type	7
Type of Occupant	8
Age of Victim	8
Gender	9
Type of Heavy Truck	9
Number of Vehicles	9
Season	10
Day of Week	11
Hour of Day	11
Contributing Factors	12
Alcohol Use	13
Fatigue	15
Inattention/Distraction	15
Improper Driver Actions	17
References.....	18



Executive Summary —●

Magnitude

- ❑ In Canada in 2001, 524 persons died and a further 11,574 were injured in collisions involving a heavy truck.
- ❑ Heavy truck crashes account for almost one-fifth of all motor vehicle deaths and 5% of all the injuries.
- ❑ The per-vehicle fatality and injury rates for heavy trucks are much higher than for all types of vehicles.
- ❑ Heavy trucks also have higher per-distance rates of fatal crash but lower rates of injury crashes than for all types of vehicles.
- ❑ Most of the deaths (87% of them) and injuries (74% of them) in collisions involving heavy trucks were among people other than the truck occupants.

Trends

- ❑ From 1994 to 2001, the number of people killed and injured in collisions involving a heavy truck have declined (by 12% and by 7%) but so has the number of all motor vehicle deaths and injuries (by 15% and by 10%).
- ❑ Given the similarities in these trends, it is not surprising that the contribution of heavy trucks to the death and injury toll has remained basically unchanged over the past eight years – 17%-19% and 5%, respectively.
- ❑ In Canada, per-vehicle fatality and injury rates have decreased among all vehicles suggesting that factors influencing these downward trends for heavy trucks are likely not specific to them.

Characteristics

People Killed and Injured

- ❑ In heavy truck crashes in 2001, only 13% of the deaths and 26% of the injuries were truck occupants, 74% and 69% were people in other passenger vehicles.
- ❑ Most occupants of heavy trucks killed and injured were drivers (82% and 83%); 72% and 67% of the occupants of passenger vehicles who were killed and injured in heavy truck crashes were drivers.



- ❑ Most occupants of heavy trucks killed and injured were middle aged; other people killed and injured in heavy truck crashes were more likely to be younger or older.
- ❑ Males accounted for most heavy truck occupant deaths and injuries – 97% and 90%, respectively.
- ❑ Tractor-trailers were involved in 70% and 45% of the heavy truck deaths and injuries in 2001; single unit trucks were involved in 30% of the deaths and 53% of the injuries.
- ❑ A heavy truck colliding with another vehicle accounted for most of the deaths and injuries (72% and 64%).
- ❑ Single-vehicle crashes accounted for the majority of the deaths (53%) and injuries (51%) among occupants of heavy trucks.
- ❑ More deaths from crashes involving heavy trucks occur during the fall (29%) and summer (28%); heavy truck injuries are more equally distributed across the seasons with slightly more occurring in the summer (27%) and winter (27%).
- ❑ More deaths from crashes involving heavy trucks occur on Wednesday (18%) and Friday (21%); more injuries occur on Friday (19%) and Thursday (18%).
- ❑ More of the deaths and injuries occur during the day than during the night.

Contributory Factors

- ❑ The incidence of drinking is relatively low among fatally injured drivers of heavy trucks, and among heavy truck drivers in injury collisions; drinking driving was generally more characteristic of passenger vehicle drivers than of drivers of heavy trucks.
- ❑ Fatigue or falling asleep at the wheel were reported infrequently but more often for heavy truck drivers involved in single-vehicle fatal and injury crashes than those in multiple-vehicle crashes.
- ❑ In multiple-vehicle fatal collisions involving heavy trucks, fatigue was reported more often for drivers of passenger vehicles than for those of heavy trucks; the incidence of fatigue was low for both drivers of heavy trucks and passenger vehicles in injury collisions.
- ❑ Inattention or distraction were more frequently cited for heavy trucks drivers in single-vehicle fatal and injury collisions than those in multiple-vehicle collisions.
- ❑ In multiple-vehicle heavy truck fatal collisions, heavy truck drivers were less likely than passenger vehicle drivers to have been cited for inattention/distraction; in injury collisions, the incidence of distraction and inattention was similar for drivers of heavy trucks and passenger vehicles.
- ❑ Heavy truck drivers were generally less likely than drivers of passenger vehicles to have taken improper driving actions, especially in fatal crashes.
- ❑ The contributory factor most often cited in single-vehicle heavy truck fatal and injury crashes was “driving too fast for conditions” – 17% and 16%, respectively.



- In multiple-vehicle injury collisions, the driver of the passenger vehicle was reported less often to be “following too closely” than the driver of the heavy truck.



Introduction —●

This report examines the magnitude and characteristics of, and trends in, collisions involving heavy trucks (those greater than 4,500 kg, including tractor trailers) in Canada. The primary focus is on those crashes that involve injury and death because these are the most costly from a health and social perspective and the available data are more complete and reliable than for crashes involving property damage only.

Data for the analyses were drawn from Transport Canada's "Traffic Accident Information Database" (TRAID), and from the Traffic Injury Research Foundation's "Fatality Database", which is funded jointly by Transport Canada and the Canadian Council of Motor Transport Administrators (CCMTA).



Magnitude

Recent figures published by Transport Canada show that 2,778 persons died and a further 221,158 were injured in motor vehicle crashes in Canada during 2001 (1). Almost one-fifth of these deaths (524) involved a heavy truck, as did 5% of all the injuries (11,574).

Heavy trucks are overrepresented in fatal crashes. In 2001, they accounted for 4% of the registered vehicles in Canada but 19% of all fatalities (1, 2). Moreover, the fatality rate for heavy trucks is much higher than it is for all types of vehicles – heavy trucks have a fatality rate of 8.0 (number of fatalities per 10,000 registered vehicle), compared to a rate of 1.5 for all types of vehicles.

Heavy trucks are also overrepresented in injury collisions but not to the same extent as in fatal ones. They have an injury rate of 177 (number of injuries per 10,000 registered vehicles), compared to a rate of 122 for all types of vehicles.

Even if the amount of travel is taken into consideration, heavy trucks have higher rates of fatal crashes. On a per-distance basis, heavy trucks have a fatality rate that is more than twice the rate for all vehicles -- 21 fatalities per billion vehicle-kilometres traveled by heavy trucks, compared to a fatality rate of 9 for all vehicles.

By contrast, heavy trucks have lower per-distance rates of injury crashes. They have 462 injuries per billion vehicle-kilometres, compared to an injury rate of 713 for all vehicles.

Not surprisingly, most of the deaths (87% of them) and injuries (74% of them) in collisions involving a heavy truck were among people other than the truck occupants. Only 13% of the deaths and 26% of the injuries were to the occupants of a heavy truck. Trucks weigh 20-30 times as much as passenger vehicles (3) and a great deal of their travel is on high-speed highways. These factors increase the severity of a crash involving a heavy truck and the probability of serious injury or fatality for occupants of passenger vehicles, for motorcyclists, bicyclists and pedestrians.

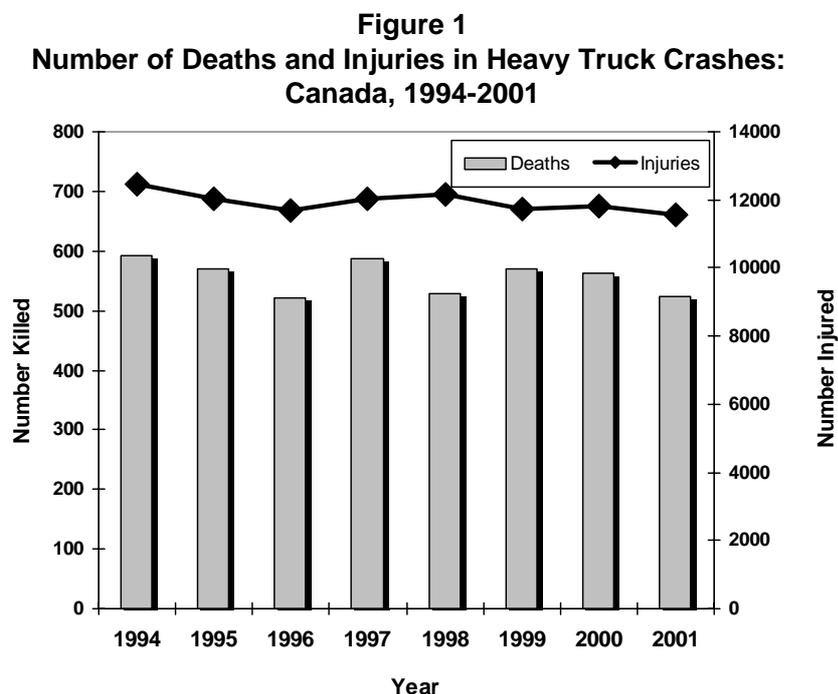


Trends

The number of people killed in collisions involving a heavy truck declined by 12%, from 592 in 1994, to 524 in 2001 (see Figure 1). This compares to a slightly greater decline of 15% among all motor vehicle deaths.

The number of people injured in collisions involving a heavy truck also declined by 7% over this 8-year period – from 12,448 in 1994 to 11,574 in 2001 (see Figure 1). By comparison, all motor vehicle injuries declined by 10%.

Given the similarities in the trends in deaths and injuries involving heavy trucks and those involving all types of vehicles, it is not surprising that the contribution of heavy trucks to the death toll has remained basically unchanged over the past eight years – 17% to 19% (Figure 2). Heavy trucks have also accounted for about 5% of the injury toll in each of these years.

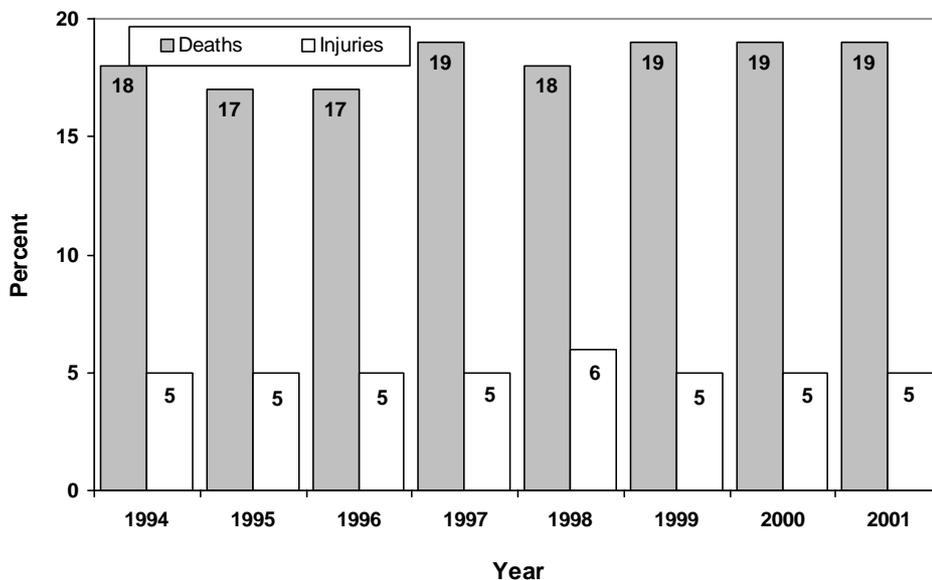


Trends in death and injury rates (based on registered vehicles or distance travelled) cannot be examined for two reasons. Historically consistent data on the registrations of heavy trucks are not available in Canada – i.e., the method of reporting the number of registered trucks changed in 1999: the earlier data include all commercial



vehicles not just heavy trucks; the more recent data include heavy buses. As well, data on vehicle-kilometres driven are only available as far back as 2000. Such trend data, however, are reported in the United States, and they show that the number of registered heavy trucks and the number of kilometres traveled by heavy trucks have increased since 1994 – by 19% and 22%, respectively (4). Over this period, the per-vehicle death rate for heavy trucks remained basically unchanged (each year about 7 deaths per 10,000 heavy trucks) but the injury rate decreased by 17% -- from an injury rate of 202 in 1994 to a rate of 167 in 2001 (see Figure 3). Both the per-mile death and injury rates also decreased over this eight-year period – 17% and 19%, respectively (see Figure 4).

Figure 2
Percent of All Motor Vehicle Deaths and Injuries Accounted for by Heavy Trucks: Canada, 1994-2001



If similar trends exist in Canada, it can be assumed that the safety record of heavy trucks has improved. Factors that account for such improvements, however, are likely not specific to heavy trucks but have affected all vehicles. This is because reductions in deaths and injuries in crashes involving heavy trucks do not appear to have improved more than that of all vehicles – i.e., from 1994 to 2001, decreases of 21% in the per-vehicle fatality rate and 15% in the per-vehicle injury rate among all vehicles in Canada, reductions comparable to the declines in death and injury rates for heavy trucks in the United States.



Figure 3
Number of Deaths and Injuries per 10,000 Heavy Trucks
United States, 1994-2001

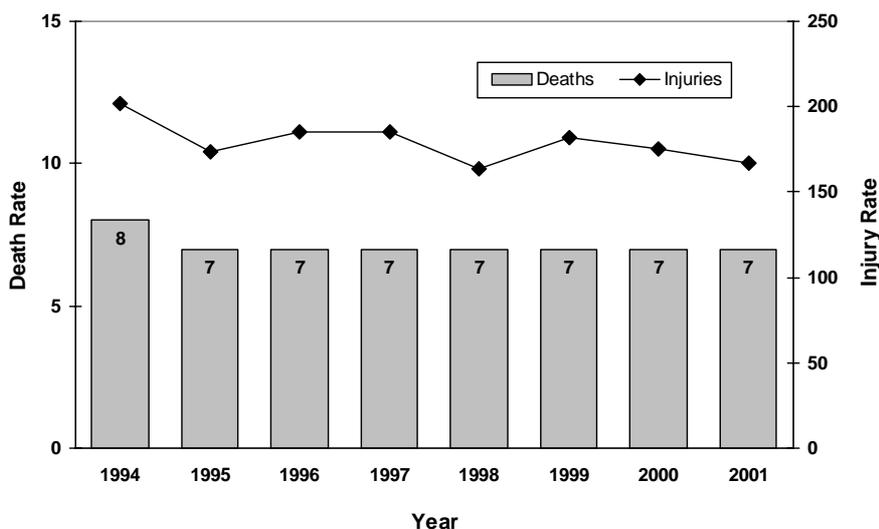
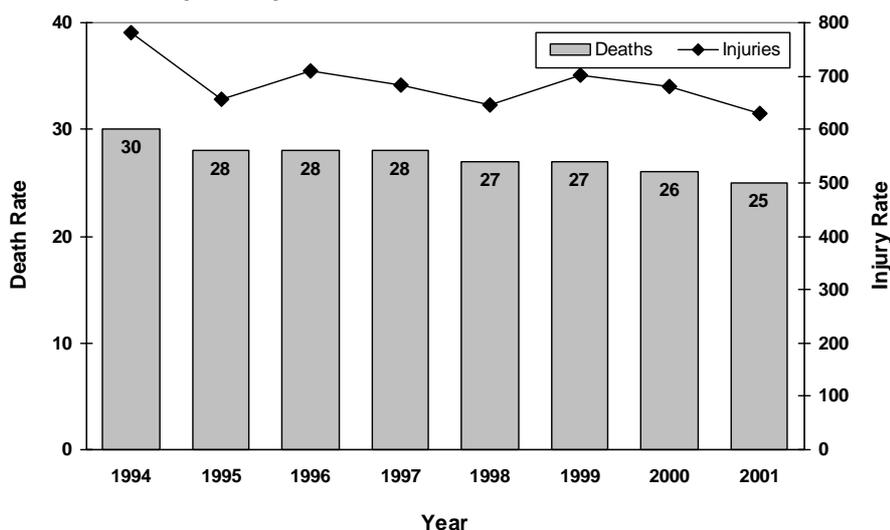


Figure 4
Number of Deaths and Injuries per Billion-Vehicle Miles Traveled
by Heavy Trucks: United States, 1994-2001



Other noteworthy trends include:

- 457 of the deaths in heavy truck crashes in 2001 involved people other than the truck occupants. This is lower than the 518 deaths in 1994 (see Figure 5).
- 8,587 of the injuries in heavy truck crashes in 2001 involved people other than the truck occupants. This is lower than the 9,404 injuries in 1994.
- Most of the deaths and injuries in heavy truck crashes are among people other than truck occupants and this has been the case for the past eight years. In each of these years, about 90% of the deaths and 75% of the injuries in heavy truck crashes are among people other than the truck occupants (see Figure 6).



Figure 5
Number of Non-Truck Occupant Deaths and Injuries in Heavy Truck Crashes: Canada, 1994-2001

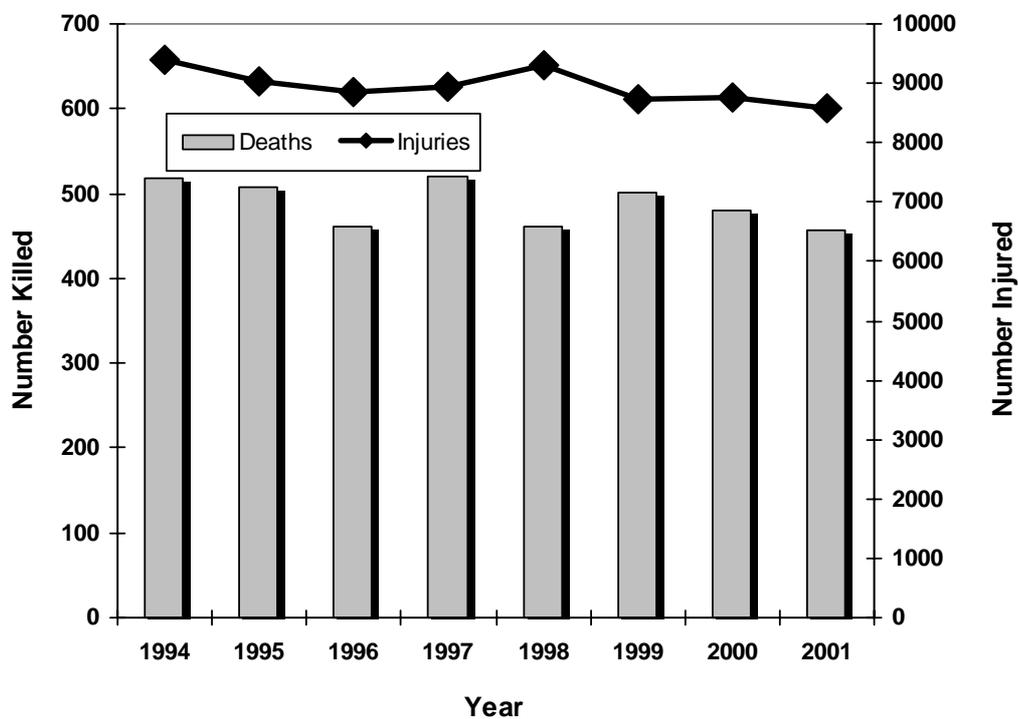
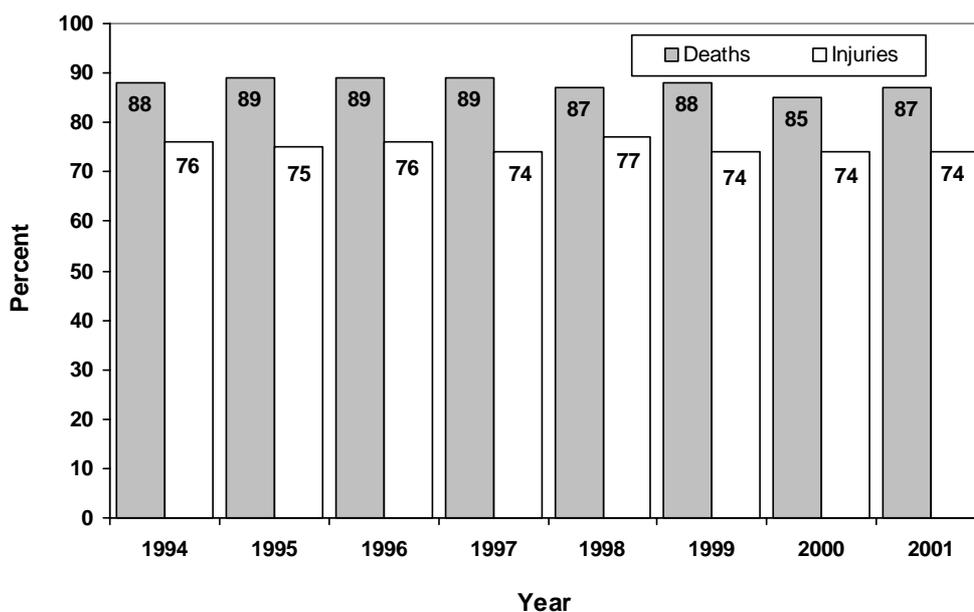


Figure 6
Percent of Deaths and Injuries in Heavy Truck Crashes That Were Non-Truck Occupants: Canada, 1994-2001



Characteristics

This section examines the characteristics of fatal and injury collisions involving heavy trucks. It initially focuses on people killed and injured in heavy truck crashes and describes: their age and gender, whether they were occupants of the heavy truck or other vehicle drivers, passengers, motorcyclists, pedestrians or bicyclists; the type of heavy truck and the number of vehicles involved in these deaths and injuries; and the season, day of week, and hour of day in which the death or injury occurred. The section then focuses just on the drivers in fatal and injury collisions involving heavy trucks and examines factors that might have contributed to the crash: alcohol use; fatigue and falling asleep at the wheel; inattention and distraction; and improper driver actions such as following too closely and speeding.

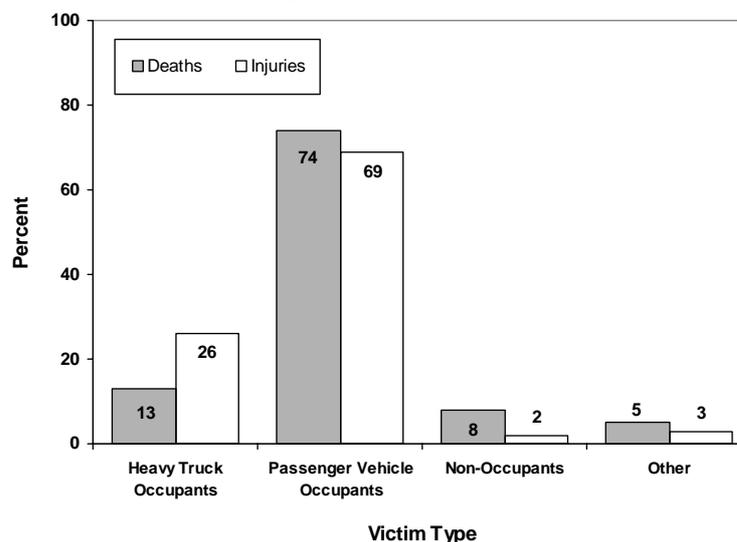
The analyses focus on fatal and injury collisions that occurred in 2001 in Canada.

People Killed and Injured

Victim Type

In heavy truck crashes in 2001, 74% of the deaths involved people in other passenger vehicles (cars, vans, SUVs, light trucks, buses), 8% were non-occupants (pedestrians), and 5% were people in other or unknown types of vehicles (e.g., motorcyclists, bicyclists). Only 13% of the deaths involved truck occupants (see Figure 7).

Figure 7
Percent of Deaths and Injuries in Heavy Truck Crashes by Occupant Type: Canada, 2001



A similar pattern emerged in injury collisions involving heavy trucks: 74% of the injuries were to other people; 26% of the injuries were to truck occupants.

Type of Occupant

Most occupants of heavy trucks killed and injured in 2001 were drivers (82% and 83%, respectively); by comparison, 72% and 67% of the occupants of passenger vehicles who were killed and injured in heavy truck crashes were drivers.

Age of Victim

Most occupants of heavy trucks killed and injured were middle aged (23% of those killed and 26% injured were aged 26-35; 27% of both those killed and injured were 36-45; and 21% killed and 18% injured were aged 46-55, respectively; (see Figures 8 and 9).

Other people killed and injured in heavy truck crashes were more likely to be younger or older than the heavy truck occupants killed – 29% of the other people killed as well as injured were under the age of 26, compared to only 10% and 18% of truck occupants; 26% of other people killed and 16% of those injured were over the age of 55, compared to 20% and 10% of truck occupants killed and injured.

Figure 8
Deaths in Heavy Truck Crashes
by Age of Victim: Canada, 2001

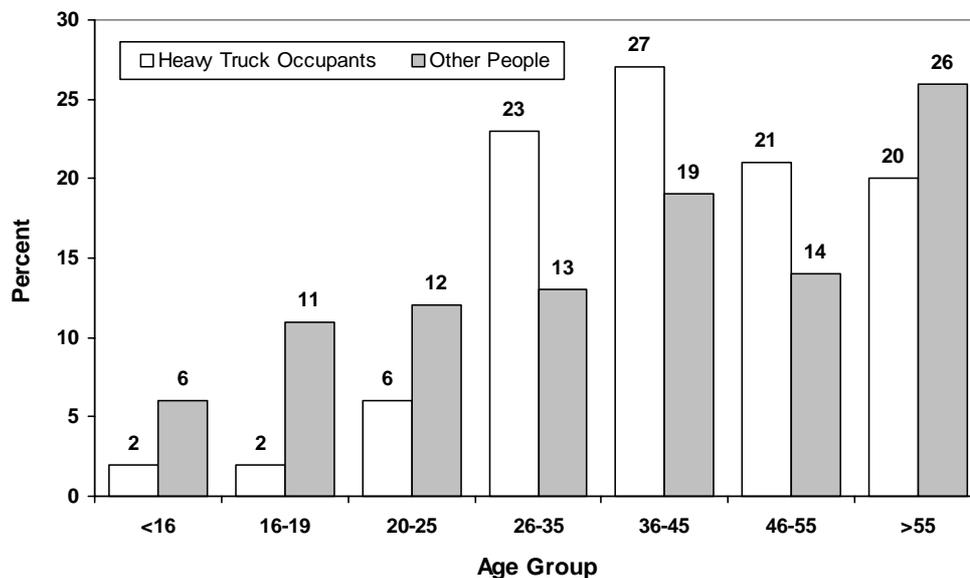
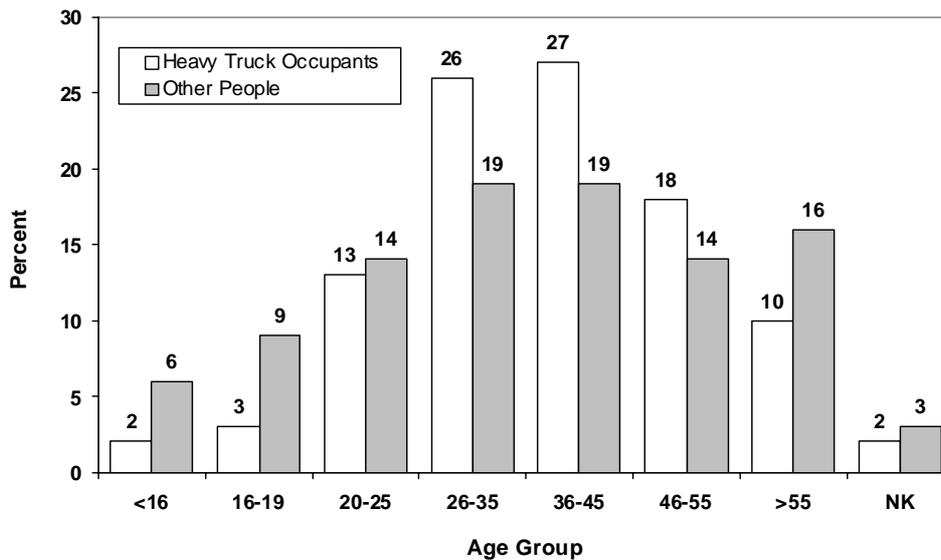


Figure 9
Injuries in Heavy Truck Crashes
by Age of Victim: Canada, 2001



Gender

Males accounted for most heavy truck occupant deaths and injuries – 97% of those killed and 90% of those injured were male. Males also accounted for the majority of other people killed and injured in heavy truck crashes – 67% killed and 52% injured were male.

Type of Heavy Truck

Tractor-trailers were involved in 70% of the heavy truck deaths in 2001, and single-unit trucks were involved in 30%. The pattern reverses for injury collisions involving heavy trucks – tractor-trailers were involved in only 45% of the heavy truck injuries; single-unit trucks were involved in 53%; and both truck types were involved in 2%.

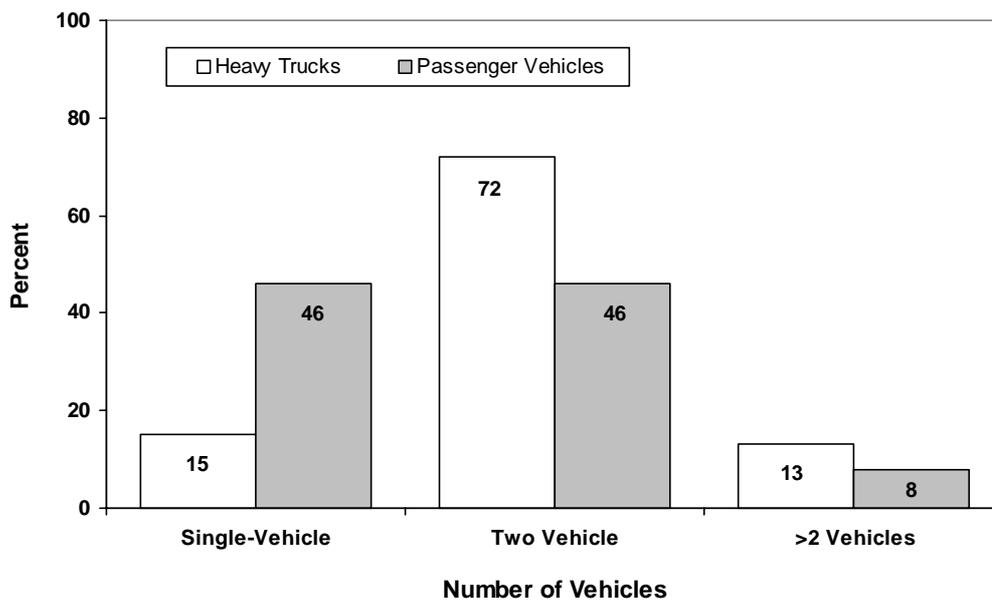
Number of Vehicles

A heavy truck in a collision with another vehicle accounted for 72% of the deaths in 2001; 13% of the deaths involved the heavy truck and two or more other vehicles, and 15% of the deaths involved the heavy truck striking a fixed object, a pedestrian/bicyclist or rolling over. By comparison, among deaths in all passenger vehicle crashes, 46% involved a single-vehicle, 46% involved two-vehicles and 8% involved more than two vehicles (see Figure 10).



With respect to injury collisions, a heavy truck in a collision with another vehicle accounted for 64% of the injuries; 21% involved the heavy truck and two or more other vehicles; and 15% of the injuries involved only the heavy truck. This pattern of results is very similar for all injury collisions involving a passenger vehicle: 62% of the injuries were in crashes involving two passenger vehicles; 14% were in crashes with more than two passenger vehicles; and 25% were in a single-vehicle crash.

Figure 10
Deaths in Heavy Truck Crashes and Passenger Vehicle Crashes by Number of Vehicles in the Crash: Canada, 2001



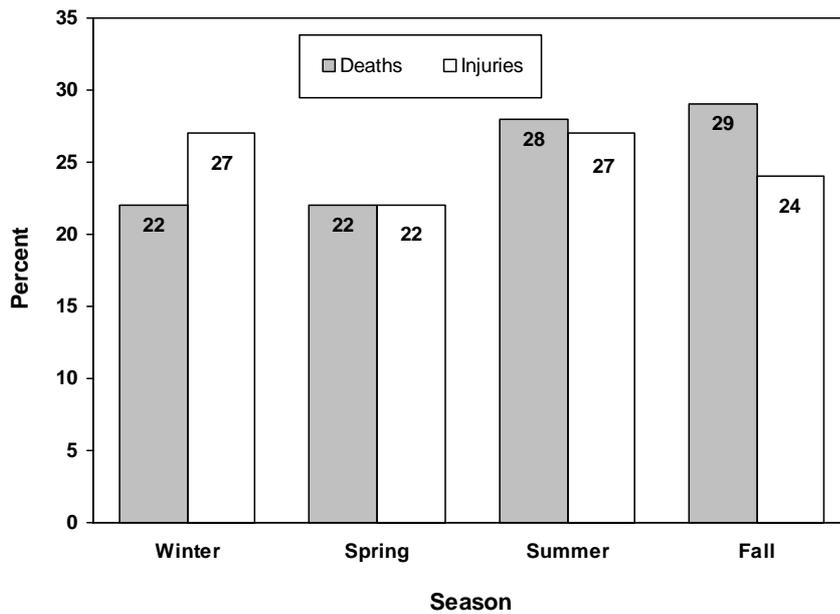
Among occupants of heavy trucks, single-vehicle crashes accounted for the majority of deaths (53%) and injuries (51%); by contrast, single-vehicle crashes accounted for only 41% of all passenger vehicle occupant deaths and 22% of the injuries (in all crashes).

Season

More deaths from crashes involving heavy trucks occur during the fall (29%) and summer (28%) than during winter (22%) and spring (22%). Injuries are more equally distributed across the seasons with slightly more occurring in the summer (27%) and winter (27%) than in the fall (24%) and spring (22%) (Figure 11).



Figure 11
Deaths and Injuries in Heavy Truck Crashes
by Season: Canada, 2001



Day of Week

More deaths from crashes involving heavy trucks occur on Wednesday (18%) and Friday (21%); fewer occur on Saturday (11%) and Sunday (8%) (Figure 12).

More of the injuries occur on Friday (19%) and Thursday (18%); fewer occur on Saturday (9%) and Sunday (6%).

Hour of Day

More deaths from crashes involving heavy trucks occur during the day (31% from 6 am to noon and 36% from noon to 6 pm) than during the night (19% from 6 pm to midnight and 14% from midnight to 6 am) (Figure 13).

More of the injuries also occur during the day (33% from 6:00 am to noon and 42% from noon to 6 pm) than during the night (17% from 6 pm to midnight and 8% from midnight to 6 am).



Figure 12
Deaths and Injuries in Heavy Truck Crashes
by Day of Week: Canada, 2001

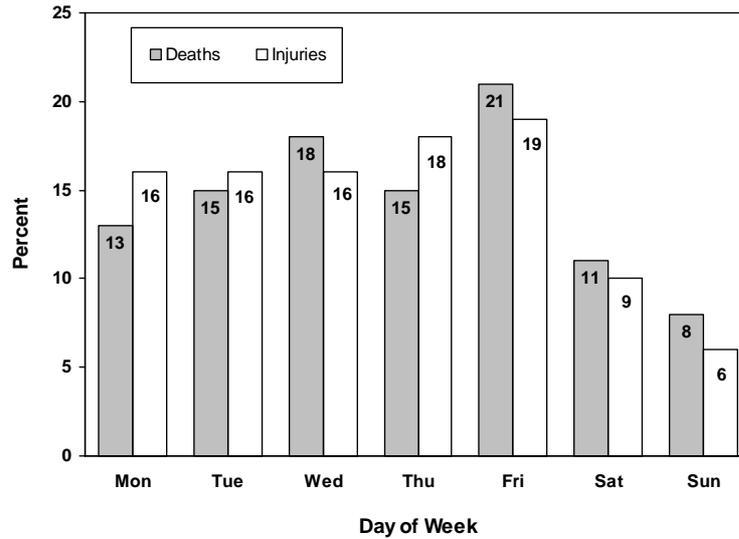
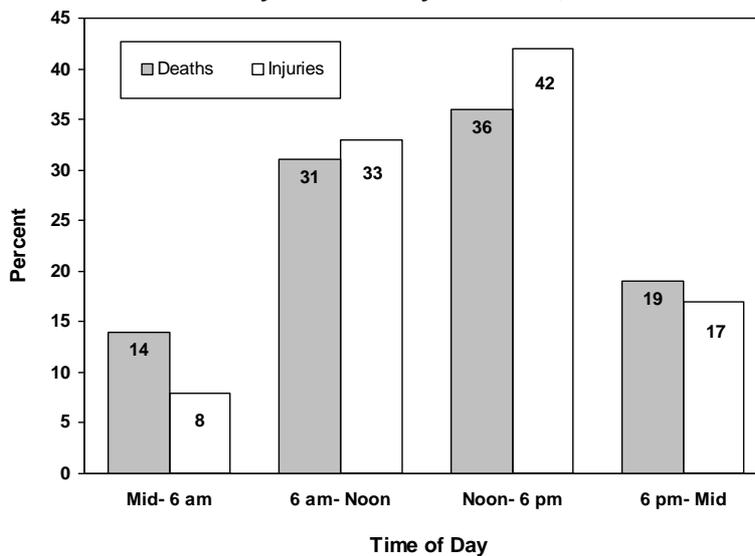


Figure 13
Deaths and Injuries in Heavy Truck Crashes
by Time of Day: Canada, 2001



Contributing Factors

Among the driver conditions of interest in understanding the factors that contribute to heavy truck crashes are alcohol use, fatigue, and driver inattention/distraction.

Objective and reliable data on alcohol use are available for drivers fatally injured in road crashes – body fluid samples, typically in blood, of most fatally injured drivers are tested in laboratories for the presence of alcohol (5). Such information is not routinely collected for drivers who survived a fatal crash or for those involved in injury collisions. Police investigating the injury collision, however, often identify drivers they judge to have been drinking.



Similarly, in both fatal and injury collisions, the investigating police officer can report if in their judgment the driver was fatigued or falling asleep at the time of the crash as well as if they were inattentive or distracted.

The police officer can also identify improper driver actions for each driver – e.g., following too closely, driving too fast for conditions, failing to yield the right of way.

Alcohol Use

Data were combined over three years – 1999-2001 – because of the relatively small number of drivers of heavy trucks fatally injured each year (see Figure 14). Only 13% of fatally injured drivers of heavy trucks had been drinking, and among these drinking drivers, 75% had a blood alcohol concentration (BAC) over the legal limit of 80 mg%. In contrast, 36% of fatally injured drivers of passenger vehicles had been drinking and 84% of those who were drinking had BACs over the legal limit.

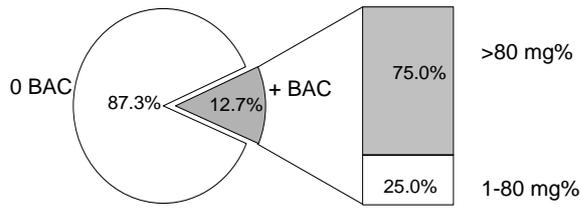
Fatally injured drivers of heavy trucks involved in single-vehicle crashes (see Figure 15) were slightly more likely to have been drinking than those involved in multiple vehicle crashes (14% compared to 12%). In the single-vehicle collisions, fatally injured drinking drivers of heavy trucks were much more likely than those in multiple-vehicle crashes to have BACs over the legal limit (83% compared to 63%).

In multiple-vehicle collisions (see Figure 16), the highest incidence of drinking was found among the fatally injured drivers of the passenger vehicles involved in the crash – 22% of them had been drinking compared to only 12% of the fatally injured drivers of heavy trucks.

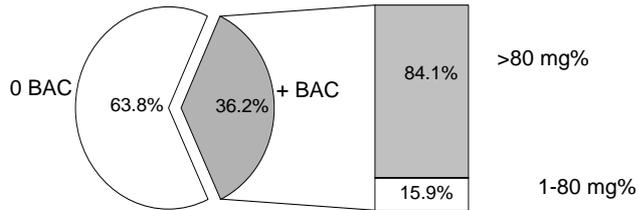
According to police investigating heavy truck collisions that resulted in an injury, only 4% of heavy truck drivers had been drinking as were a slightly higher 6% of all passenger vehicle drivers. The incidence of alcohol was the same for heavy truck drivers involved in single-vehicle and multiple-vehicle injury collisions (about 4%). In these multiple-vehicle collisions involving a heavy truck, 4% of the drivers of both passenger vehicles and heavy truck drivers were reported as having been drinking.



Fig 14
Alcohol Use Among Fatally Injured Drivers of Heavy Trucks and Passenger Vehicles: Canada, 1999-2001

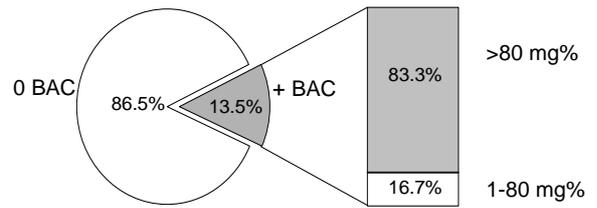


HEAVY TRUCK DRIVERS

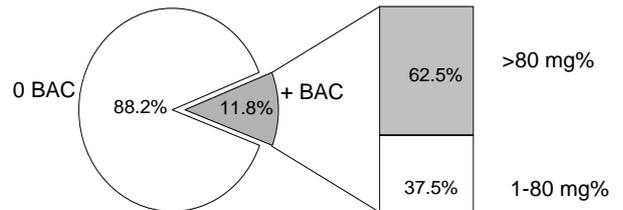


PASSENGER VEHICLE DRIVERS

Figure 15
Alcohol Use Among Fatally Injured Drivers of Heavy Trucks: Canada, 1999-2001

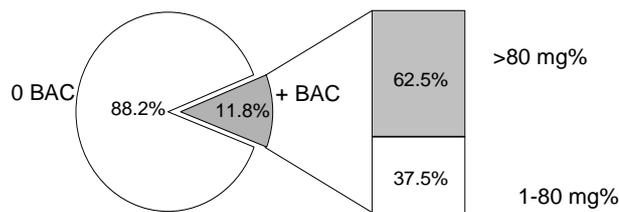


SINGLE VEHICLE CRASHES

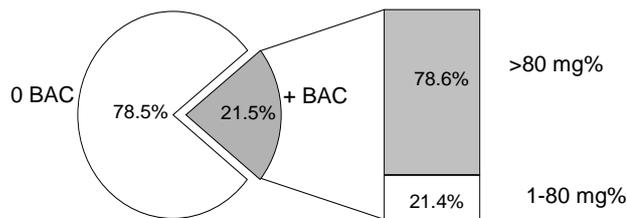


MULTIPLE VEHICLE CRASHES

Figure 16
Alcohol Use Among Fatally Injured Drivers in Multiple-Vehicle Crashes Involving Heavy Trucks: Canada, 1999-2001



HEAVY TRUCK DRIVERS



PASSENGER VEHICLE DRIVERS

Although the incidence of drinking driving is relatively low among fatally injured drivers of heavy trucks, and among heavy truck drivers in injury collisions, the fact that some heavy truck drivers had been drinking is of considerable road safety concern given the size and weight of their vehicle, and in some cases, the hazardous nature of their cargo.



Fatigue

The percent of fatal crashes involving a variety of driver conditions and actions is shown in Table 1 (comparable data on injury crashes are presented in Table 2). These tables require some explanation. The left hand column lists the driver conditions and driver actions that appear on police accident reports. The next three columns show the percent of crashes in which these driver conditions or actions were identified by police as a contributory factor. The first column presents data on single-vehicle fatal collisions involving a heavy truck; the next two columns present data from multiple vehicle collisions.

Police seldom identify fatigue and falling asleep at the wheel as a driver condition in fatal and injury collisions involving heavy trucks or those involving passenger vehicles. This is not surprising because it is difficult to determine sometime after the crash occurred if a driver was fatigued or falling asleep at the time of the crash. Among heavy truck drivers, 3% of those involved in single-vehicle fatal collisions were reported as being fatigued or falling asleep, compared to only 1% of those involved in multiple-vehicle collisions. In these multiple-vehicle heavy truck collisions, fatigue was reported more often for drivers of passenger vehicles than for those of heavy trucks – 4% compared to 1%.

In injury collisions (see Table 2), 6% of the heavy truck drivers involved in single-vehicle collisions were reported as being fatigued or falling asleep, compared to less than 1% of those involved in multiple-vehicle collisions. In these multiple-vehicle heavy truck collisions, fatigue was identified for only 1% of drivers of passenger vehicles.

Inattention/Distraction

Heavy truck drivers in single-vehicle fatal collisions were more likely than those in multiple-vehicle collisions to be identified as inattentive or distracted (8% compared to 3%). However, in multiple-vehicle heavy truck fatal collisions, only 3% of heavy truck drivers were reported as being inattentive or distracted, compared to 13% of passenger vehicle drivers.



Table 1
Percent of Heavy Truck Fatal Crashes* Involving
Various Driver Conditions and Actions**

	Single-Vehicle	Multiple-Vehicle	
		Heavy Trucks	Drivers of: Passenger Vehicles
Driver Condition			
Fatigue/falling asleep	3	1	4
Inattention/distraction	8	3	13
Driver Action			
Following Too Closely	0	2	3
Turning Improperly	0	<1	2
Driving Too Fast For Conditions	17	3	9
Exceeding the Speed Limit	5	0	1
Changing Lanes Improperly	0	2	7
Failing to Yield Right of Way	2	2	9
Disobeying Traffic Control Devices	3	3	8
Driving Wrong Direction	0	2	9
Backing Unsafely	0	0	0
Loss of Control	2	<1	6
Failing to Signal	0	0	0
No Lights Used	0	0	0

*Percentages should not be totaled because more than one driver condition or action can be identified for a driver

**Excludes Quebec because data on driver conditions and actions are not reported.

Table 2
Percent of Heavy Truck Injury Crashes* Involving
Various Driver Conditions and Actions**

	Single-Vehicle	Multiple-Vehicle	
		Heavy Trucks	Drivers of: Passenger Vehicles
Driver Condition			
Fatigue/falling asleep	6	<1	1
Inattention/distraction	13	9	8
Driver Action			
Following Too Closely	<1	11	4
Turning Improperly	1	2	2
Driving Too Fast For Conditions	16	4	7
Exceeding the Speed Limit	1	<1	1
Changing Lanes Improperly	1	6	5
Failing to Yield Right of Way	2	5	5
Disobeying Traffic Control Devices	1	4	5
Driving Wrong Direction	1	1	1
Backing Unsafely	1	1	<1
Loss of Control	8	1	3
Failing to Signal	0	0	<1
No Lights Used	0	0	0

*Percentages should not be totaled because more than one driver condition or action can be identified for a driver

**Excludes Quebec because data on driver conditions and actions are not reported.



Heavy truck drivers in single-vehicle injury collisions were more likely than those in multiple-vehicle injury collisions to be identified as inattentive or distracted (13% compared to 9%). In multiple-vehicle heavy truck injury collisions, 9% of heavy truck drivers and a similar 8% of passenger vehicle drivers were reported as being inattentive or distracted.

Improper Driver Actions

Although police officers investigating fatal and injury collisions can identify driver actions that in their judgment contributed to the crash (e.g., following too closely, turning improperly, and driving too fast for conditions), these actions are often not reported. Given that police reporting practices would be similar for different types of vehicles, an examination of driver actions can still provide some insight into those improper driving behaviours characteristic of collisions involving heavy trucks.

No consistent pattern is evident in the data but a few actions are notable. The contributory factor most often cited in single-vehicle truck collisions was “driving too fast for conditions” (reported in 17% and 16% of the fatal and injury collisions, respectively).

Also of some interest, in multiple-vehicle injury collisions, the driver of the passenger vehicle was reported to be “following too closely” in only 4% of the cases while the driver of the heavy truck was following too closely in 11% of the collisions.



References —●

1. Transport Canada. (2003). *Canadian Motor Vehicle Traffic Collision Statistics*. Ottawa, Ontario: Transport Canada.
2. Statistics Canada. (2002). *Canadian Vehicle Survey*. Ottawa, Ontario: Statistics Canada, Transportation Division.
3. Insurance Institute for Highway Safety. (2002). *Fatality Facts: Large Trucks*. Arlington, Virginia: Insurance Institute for Highway Safety.
4. National Highway Traffic Safety Administration. (2002). *Traffic Safety Facts 2001*. Washington, D.C.: National Center for Statistics and Analysis, National Highway Traffic Safety Administration.
5. Mayhew, D.R., Brown, S.W. and Simpson, H.M. (2003). *The Alcohol-Crash Problem in Canada 2001*. Ottawa, Ontario: Transport Canada.

