

Summary:

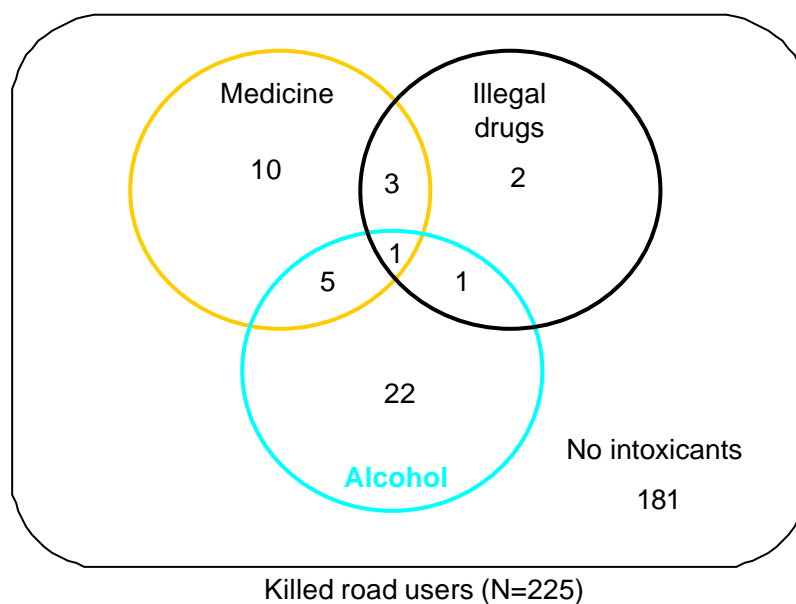
In-depth road accident investigations Aggregated results from 196 fatal accidents in Mälardalen, Sweden, 1997-99

Since 1997, all fatal road traffic accidents in Sweden are investigated by teams from the National Roads Administration. The teams collect data about the accident site and the vehicles and road users involved. The data base is supplemented by information from police, rescue teams, and hospitals (post mortem examinations).

This report presents aggregated results based on investigations of all fatal accidents in the Mälardalen region in the years 1997, 1998 and 1999. The research was commissioned by the Swedish National Roads Administration, Region Mälardalen.

A total of 196 fatal accidents occurred during the three-year period, including 225 killed persons. The purpose of the project is to identify factors that may have contributed to the fatal outcome of accidents. A particular focus has been put on road users' failure to use safety equipment, and on the influence of alcohol and drugs.

Alcohol, drugs and medicines



For 20 per cent of the fatalities post mortem examination revealed alcohol, illegal drugs, or medicines, which might have influenced the road users' behaviour before the

accident. The real number is probably somewhat higher, because such substances were not necessarily detected in persons who died some days after the accident.

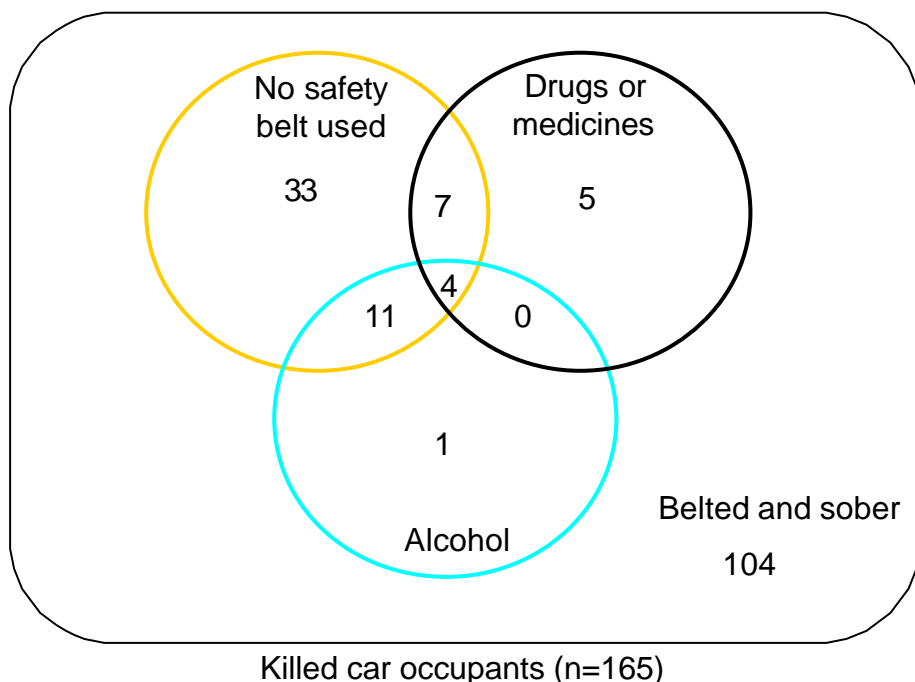
Unprotected road users

The in-depth study material included 60 killed unprotected road users, including 17 motorcycle riders or passengers, 22 bicyclists, and 21 pedestrians. The following results should be noted:

- More than half of the pedestrian fatalities occurred during darkness.
- Ten of the 21 pedestrians and eight of the 22 bicyclists were killed in or close to crossing facilities.
- Head injuries is the single most frequent cause of death for bicyclists, comprising at least 13 of the 22 fatalities.
- Twenty-one percent of the killed unprotected road users were influenced by alcohol.

Car occupants – intoxication and non-use of safety belts

Among the 225 fatalities in the investigated accidents 165 were car occupants (116 drivers and 49 passengers).



- Seventeen percent (28 persons) were influenced by alcohol, illegal drugs, or medicines.

- Thirty percent (55 persons) of the killed car occupants did not wear a safety belt. There was a notable interaction between intoxication and non-use of safety belts.
- In collisions between cars (where one or both drivers were killed), nine per cent of the killed drivers sat in a car with airbag, compared to 25 per cent of the surviving drivers.

Single-car accidents

- Fifty-three (32 per cent) of the 165 car occupants were killed in single accidents.
- More than one third of the fatalities in single car accidents were collisions with trees (including three collisions with poles), a total of 18 killed persons, amounting to 12 per cent of all killed car occupants.

Injury mechanisms

- Almost one half of the fatal injuries occur as a consequence of the vehicle being compressed or penetrated by a colliding vehicle or some other object.
- Ten persons died because the roof of the vehicle was pressed down. Concerning occupant protection, the roof appears to be a particularly weak point of many car makes.
- About one fourth died as consequence of hitting the steering-wheel or some other part of the car interior.
- Eight of the fatally injured persons were ejected from the car during the crash. Some of them would most likely have survived if they had been belted.

Accidents involving heavy vehicles

- Heavy vehicles were involved in 45 of the 196 accidents, i.e., 23 percent.
- Fifty-eight persons were killed in these accidents, i.e., 26 % of all fatalities.
- The 58 killed persons comprised 45 car occupants, 8 bicyclists, 3 pedestrians, and two heavy vehicle occupants.
- Among the 58 road users killed in heavy vehicle accidents 17 percent were intoxicated, and 29 percent of the car occupants did not use a safety belt.

Why are car occupants killed on roads with 70 or 50 km/h speed limit?

According to the assumed tolerance levels of road users, on which Vision Zero has based its recommended speed limits, a person sitting in a modern car with the safety belt

fastened is supposed to survive a frontal collision with another car (not heavy vehicles) or certain barriers with a speed up to 70 km/h. The tolerance for side collisions is somewhat lower, for such collisions the limit for survival is assumed to be 50 km/h.

- A total of 52 car occupants were killed on roads with 50 or 70 km/h speed limit.
- For 48 of these 52 persons one or more of the Vision Zero conditions were not satisfied. Deviations included speeding, driving without safety belt, old car (or new car without airbag), collision with heavy vehicle and/side collision on roads with 70 km/h speed limit.
- The remaining 4 persons were killed in spite of satisfying all the mentioned preconditions for survival. Three of them were more than 70 years old, and the fourth one had a heart disease. This indicates that the Vision Zero speed limits may not in a sufficient extent consider the limitations of older persons and/or those with a health problem.

Illness and suicide in traffic

Twenty-three of the investigated accidents were caused by illness; in 16 of these cases post mortem examinations indicated that the illness itself rather than the accident was the cause of death.

Suicide was suspected for 13 car drivers and for 4 unprotected road users. These cases represent 8.7 percent of all fatal accidents and 7.6 percent of killed persons.

The reasons for suspecting suicide were not evident in all cases. Considering the difficulty in establishing whether a traffic accident is a suicide, it is important to establish clear criteria, lest an overestimation of suicide cases result in neglect of other causes that may be more amenable to countermeasures.

Suicide in traffic as well as drivers who die behind the wheel are an important concern for the road authorities primarily to the extent that these incidents represent a threat to other road users. In addition to the road users who died from illness or suspected suicide, six additional road users were injured in these accidents.

Countermeasures

The in-depth studies may provide a basis for proposing accident countermeasures. One cannot, however, predict the total safety effects of the measures from these studies, since measures that reduces the risk of one accident type, may increase another. In addition, some measures result in behavioural adaptation counteracting the safety increase. With these precautions, the following measures seem relevant as judged from the in-depth studies.

- Guard fences along the roadside and/or median, since 80 percent of the single accidents occurred on road sections without guard fences.
- Removing trees and other obstacles within a certain distance from the road.

- Lower speed limits on undivided roads.
- Ignition interlock or other technical devices to prevent driving without fastened safety belts and driving while intoxicated.
- Crash absorption zones on heavy vehicles.
- Improved crossing facilities for pedestrians.
- Improved visibility of pedestrians.
- Mandatory use of helmets for cyclists.
- Increased surveillance of alcohol and drug intoxication among motorcyclists.

Methodological improvement potential and future research tasks

The following improvements of the in-depth studies are suggested:

- A clearer definition of the purpose of the studies.
- Improved procedures for data quality assurance
- Include estimations of vehicle pre-crash and crash speeds.
- Develop a coding system for registration of all data in electronic form, for the purpose of subsequent aggregated analyses.

The available in-depth study data of the National Roads Administration may be further exploited in research projects, such as:

- Repeating the reported analyses on a national level, with increased possibilities of finding statistically significant relationships.
- Studies relating the in-depth results to other data sources, primarily exposure data regarding the prevalence of various potential risk factors in ordinary traffic.
- Analyses of safety equipment like safety belts and airbags, by comparing accident type distributions between vehicles/road users with and without such equipment.
- If better information could be obtained regarding cyclists' use of helmets, the relationship between head injuries and helmet use should be further studied.
- More knowledge is needed about pedestrian accidents in darkness, and how the design of crossing facilities may influence the accident pattern.

With reference to Vision Zero, further studies should be carried out regarding accident and injury mechanisms for car occupants on roads with speed limits 70 and 50 km/h.