

Epidemiologic methods improve assessment of fatal injuries

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Epidemiological methods used during the investigation of fatal injuries makes the results more accurate, and allows for greater legal certainty of conclusions. Michael Freeman will address this as he defends his thesis at Umeå University, Sweden, on November 6.

Experts in [forensic investigation](#), the investigation of injuries and death, are often asked if they can predict the likelihood that a particular event caused an [injury](#) or death. In other cases, experts are asked to examine hypothetical situations that assess the probability of various scenarios, such as the likelihood that a casualty would have survived a car crash with the use of a seat belt. In forensic medicine, the answers to such questions are often based on the prior experience of the investigator, and as a result the answers can vary greatly.

The aim of Freeman's thesis is to describe how epidemiological concepts and data can improve the reliability of conclusions in the field of forensic medicine.

In one of the studies in the thesis, Dr. Freeman describes a case study of a fatal traffic crash in which a survivor's position in the vehicle was uncertain. Investigators suspected that the survivor had been driving the vehicle, but could not determine the likelihood this was true. By matching the injuries for both the deceased and the surviving persons with damage to the vehicle and other data from the accident, Dr. Freeman was able to show that it was 19 times more likely that the survivor was the driver than the passenger during the accident.

In a further study, he examines the likelihood that a person was wearing a seat belt during an crash when the individual was thrown out of the vehicle. Several publications have proposed the theory that non-functioning safety belts cause damage to the arm closest to the side window when the person is thrown out of the car because the belt tightens on the arm. However, Dr. Freeman rejects this theory based on an analysis of data from a large U.S. crash injury database.

"The hypothesis that a non-functioning seat belt will reliably cause arm injuries is incorrect. Although such injuries occur more often in an occupant who is ejected from a car because the seat belt failed, you cannot conclude that this is always the case. There are no specific injury patterns that make it possible to establish whether a passenger has used a seatbelt or not, outside of classic seat belt abrasions" says Freeman.

In another paper, Dr. Freeman studied the relationship between roof crush to a car in a rollover crash and the likelihood that an occupant would sustain a serious head or neck injury.

The analysis of the data showed that, as suspected, there is a very strong relationship between roof crush and head and neck injury. The analysis was used to construct a practical method for the investigation of fatal rollover crashes, in which the injuries of occupants can be quantified, and then matched to the amount of the roof crush as a means of reliably identifying the occupant who was driving the vehicle at the time of the crash.

In his thesis, Dr. Freeman also examined data collected during autopsies performed in Sweden to see if specific injuries occur to the head and neck during certain types of fatal falls.

The population described in the thesis were those people who died of a fall and a subsequent injury to the spinal cord or brain. Fractures in the

base of the skull and in the spine were found to occur most often when the victim landed head first on the ground, with their body weight above their head. Such injuries occur when when people fall down a staircase, or fall from a low height. In contrast, fractures that occurred in the top of the skull (above the ears) were more likely at ground level.

A unique finding in the study was that dislocations of the skull from the spine occurred almost exclusively when the person had fallen from more than three meters. Previously, the perception was that this type of injury only occurred when the skull has been subjected to tension force away from the spine, for example from a hanging. Instead, says Michael Freeman, it is more likely that these injuries are caused by excessive shear force to the side of the skull.

"My hope is that this thesis will bring attention and awareness of the usefulness of epidemiological analysis to [forensic medicine](#). Such analysis can enhance the reliability and validity of forensic assessments, and have important implications in the courtroom," says Dr. Freeman.

More information: The thesis is published at urn.kb.se/resolve?urn=urn:nbn:se:umu:diva-81434

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