

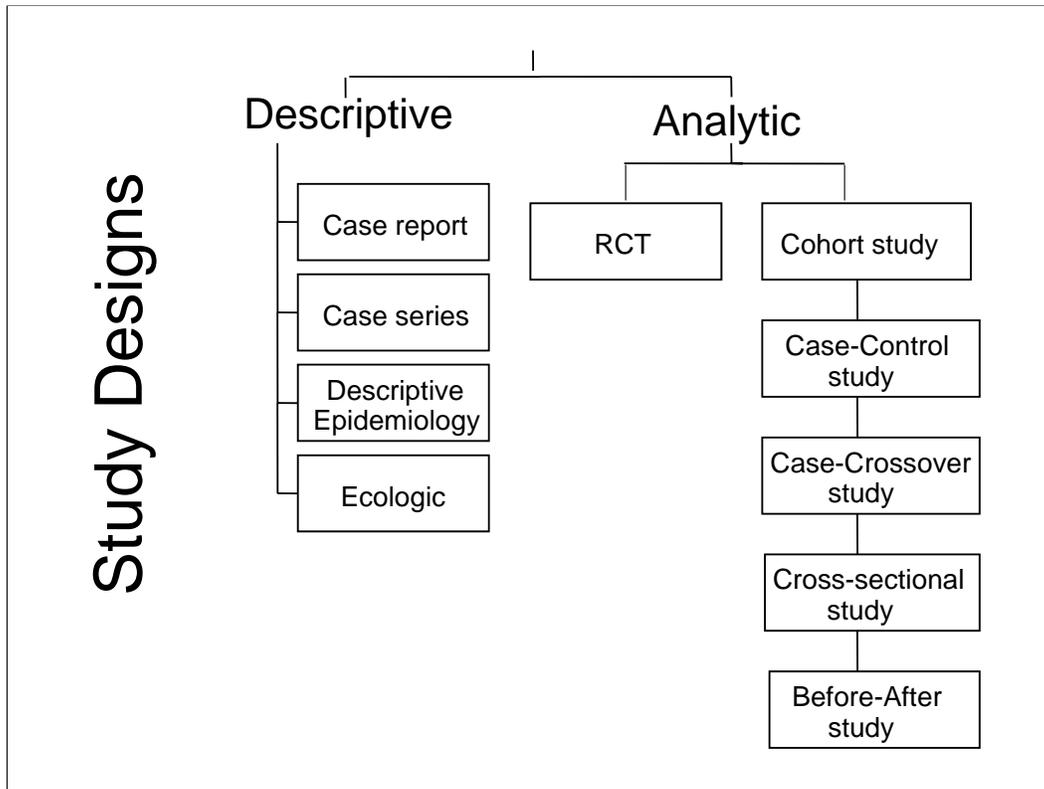


Methods in Injury Research

Study Design Modules

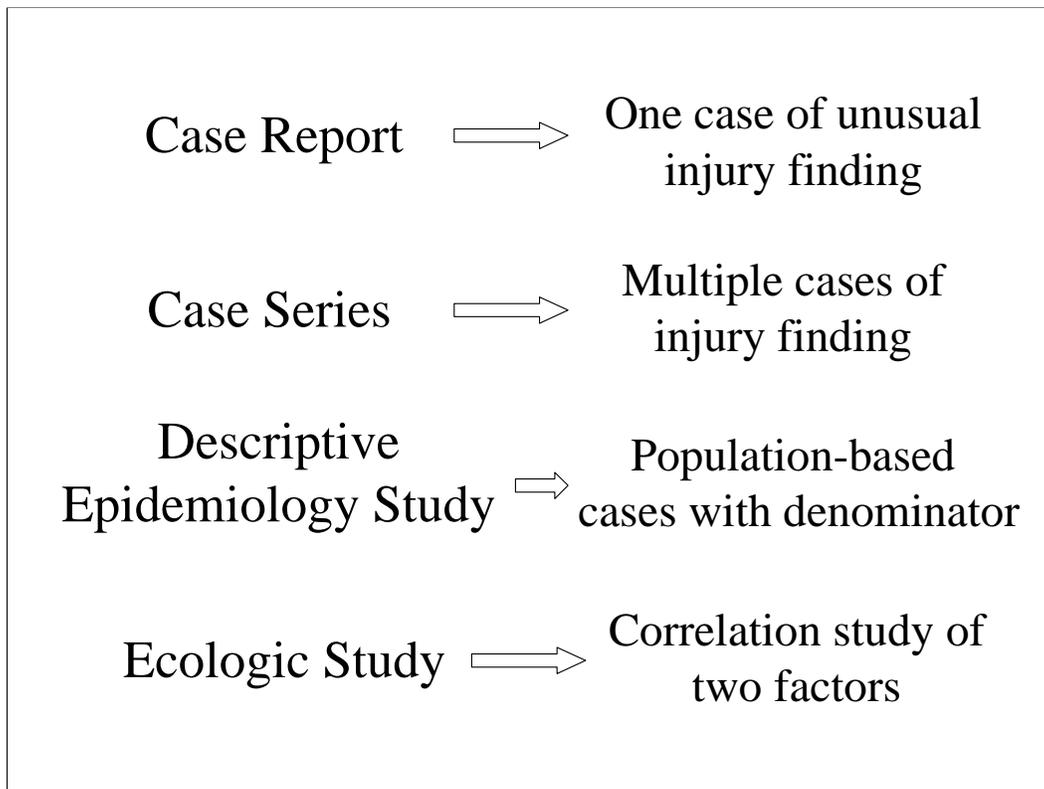
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Several different types of injury studies can be found in the literature. The purpose of this lecture is to illustrate the various forms of study designs used in injury research, and to highlight their strengths and weaknesses, using current studies.



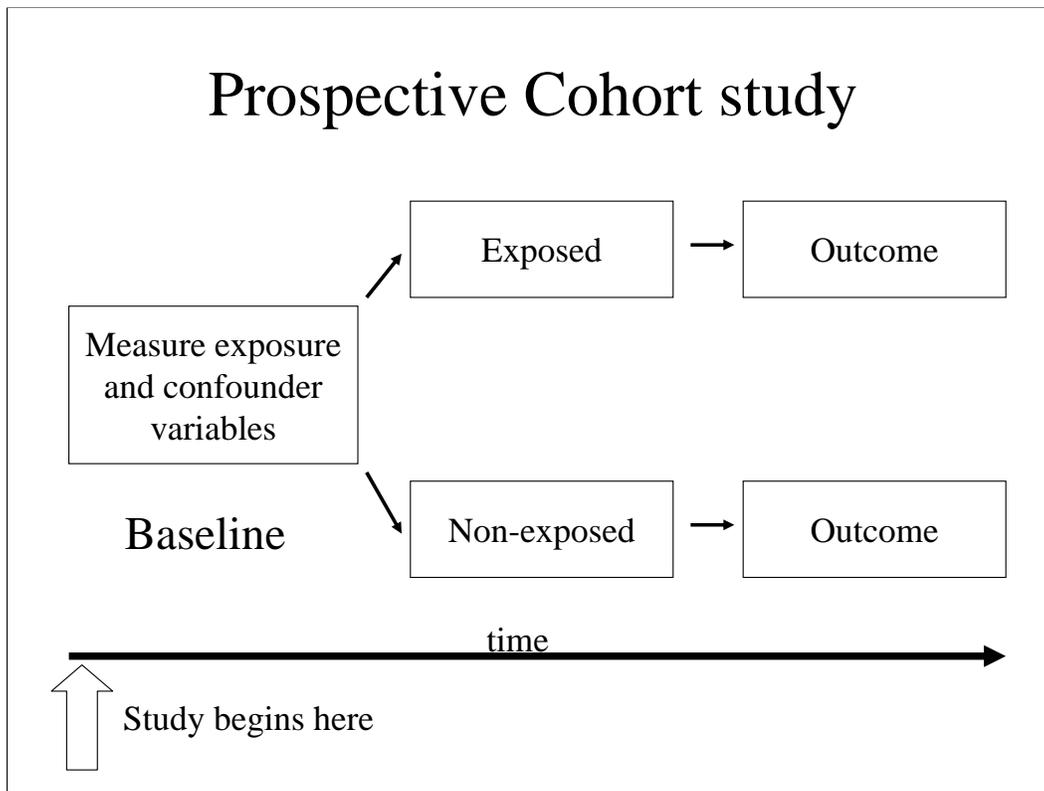
As Koepsell has illustrated in the book, “Injury Control”, injury studies may be descriptive in nature (describing the frequency or characteristics of injury events) or analytic (testing relationships between common traits and injury). Differing forms of descriptive studies exist. These designs are outlined in the next slide.

Analytic studies include experimental designs (the randomized controlled trial) and observational designs (case-control studies, cohort studies, etc.). The case-crossover study design has received a lot of attention in the injury field in the last five years.



Descriptive study designs include case reports, case series, incidence studies, and ecologic studies. The case report is the most elementary study design in the literature. It generally describes an injury or injuries to one or two individuals that have been identified in a medical setting. There is also usually a unique feature to the noted injury (by cause, by nature of injury, etc.). The case series design is an extension of the case report. In a case series, a number of events are described. These events usually have been observed over a set period of time (such as one year) and are identified from one reporting source (e.g. a hospital).

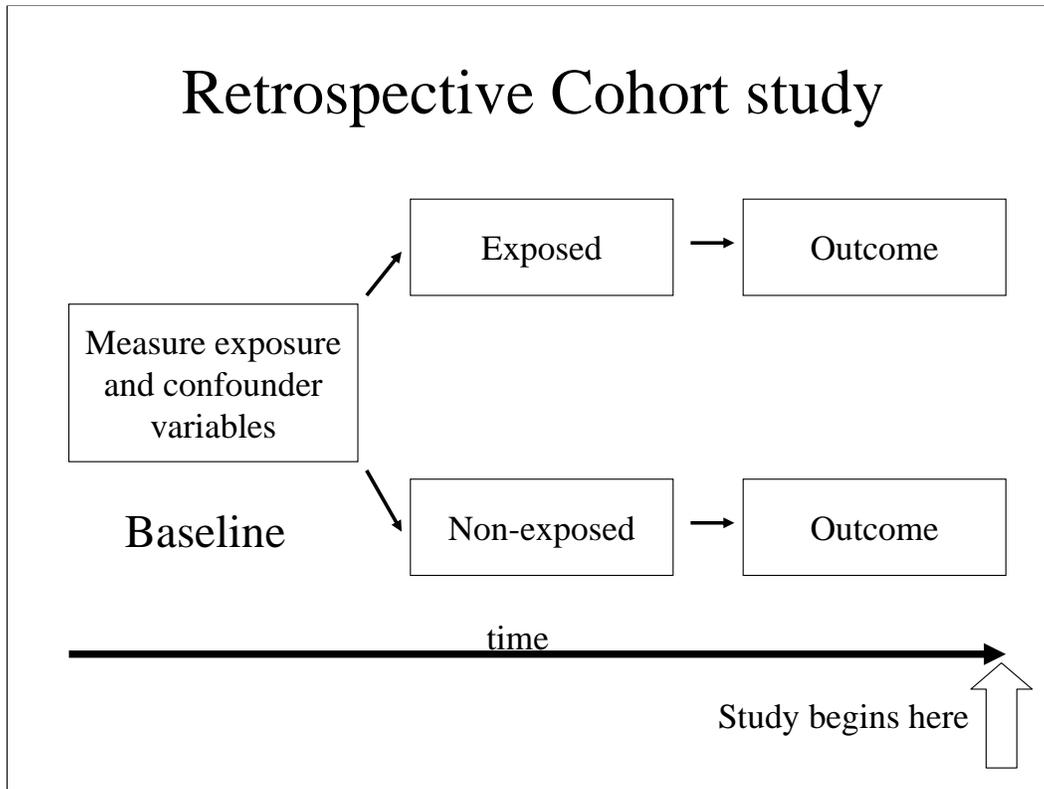
The descriptive epidemiology study is noted by the collection of injuries over a defined population base and by the use of denominator data to determine rates. The most frequent information generated from these designs are incidence rates for injuries. The ecologic study is a hypothesis generating study. Usually using group-level data, it examines if two factors are correlated with each other.



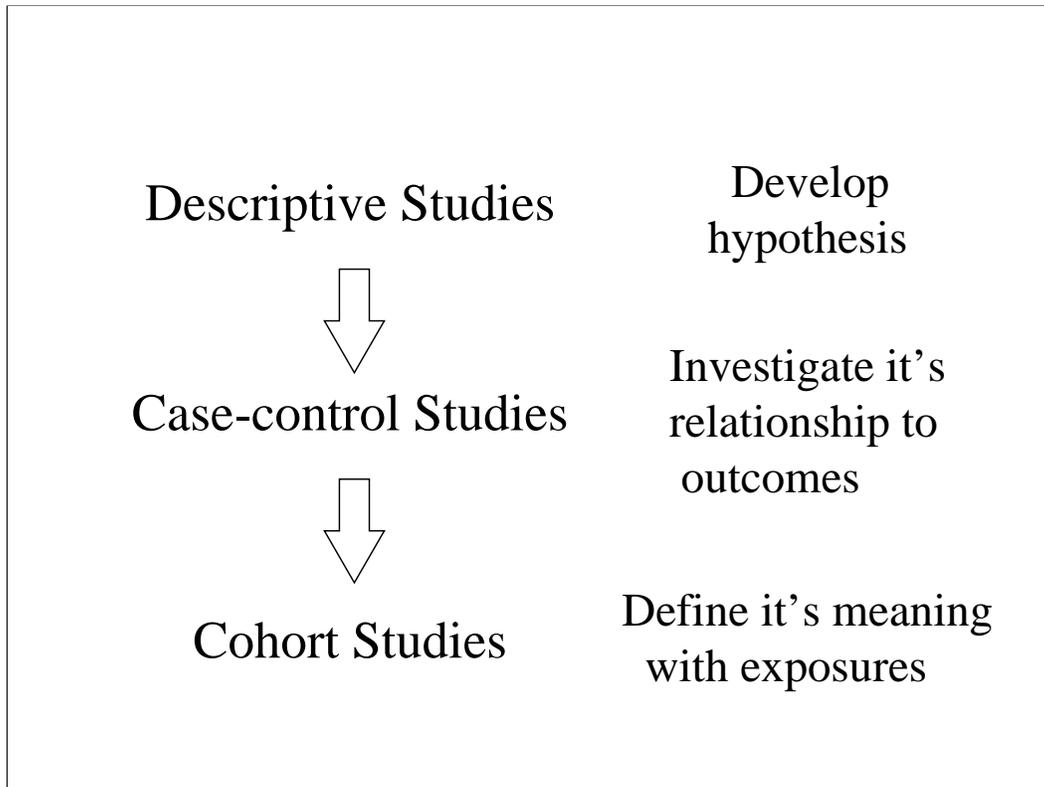
Case-control studies are perhaps the most frequent form of analytic study designs used in the injury field. These designs are very good for events that are rare in occurrence, and one could argue that severe injuries are relatively rare.

Still, there are some situations where cohort study designs would be appropriate in the injury field. Most notably for less severe forms of injury. The classic design in a cohort study is shown here. The study begins by assessing baseline levels of the exposure and other variables. Study subjects are then followed on a regular basis to identify the outcome. The frequency of outcomes are tested between persons who had exposure to the possible risk factor at baseline and persons with no exposure.

Retrospective Cohort study



An alternative form of the cohort study is something termed the retrospective cohort study. Other researchers may also call this a historical prospective study. This design is nearly identical to the prospective cohort study. The sequence of baseline exposure determination and longitudinal follow-up for outcomes is similar. The difference lies in the time in which the study begins. In this retrospective design, the researcher constructs the cohort study by looking back in time and placing data in the appropriate order and sequence. These studies are possible to do with large medical databases, such as the membership files of the Health Maintenance Organizations, or the medical files in the Scandinavian countries.



This slide is presented as a matter of review to illustrate the following points.

1. Descriptive studies are useful for identifying hypotheses to test in analytic studies.
2. Case-control studies are then usually applied to evaluate if the hypothesized factor is related to the outcome of interest. Case-control studies generally illustrate if a factor is associated with an injury. It does not assign causation to the role of the risk factor.
3. Subsequently, cohort or longitudinal studies are applied to further define the importance of exposure to the causal agent for the development of the outcome. Cohort designs allow for investigators to make causal inferences for injuries.

Elements of each study

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings

The elements outlined here will be examined in each of the following papers. Several items warrant attention if you are reading an injury paper to assist you in assessing the value of the research work. These include the study design reported, the definition of injury used, what sources were used to identify the injuries from and what these sources may reflect regarding the severity of injury being studied. Nearly every study has one type of bias or another. The presence of bias is also discussed in each study.

Houseboat Carbon Monoxide Poisonings on Lake Powell

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Case series
- CO poisoning
- NPS EMS transport records
- medical attn or death
- Lake Powell events
- missing cases
- outdoor exposures

The first paper to examine is the MMWR paper on carbon monoxide poisonings noted at Lake Powell. This paper attempts to identify all CO poisoning events identified from the EMS records of the National Park Service from 1994-2000. It is thus a case series study design. The study was initiated because of case reports of CO poisoning death related to houseboats on the lake. The definition of injury used was based upon information in the transport records. Cases were defined as events with either (a) symptoms of CO poisoning and laboratory elevated carboxyhemoglobin values or (b) exposure to exhaust and symptoms. By design, only injuries receiving medical attention are included in this study.

The study is unique in that it found several cases of outdoor exposure to CO poisoning. CO poisoning is most often found in indoor settings. The report suggests that the placement of generators on houseboats creates a poisoning hazard. It implies causality related to these generators, but the design cannot prove it in the strict methodologic sense. Potential bias in the report may be the underascertainment of CO poisoning cases. It is not clear how accurate the NPS transport records may be.

Source: Houseboat associated carbon monoxide poisonings on Lake Powell. MMWR 49(49):1105-1108, December 15, 2000.

Electrical Injury from Subway Third Rails

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Case series
- electrical burn injury
- two hospitals
- hospitalized injury
- not applicable
- may miss fatal events
- 16 cases
- new classification needed

The infamous third rail! This paper seeks to identify the consequences of exposure to intermediate range electrical currents by examining the circumstances and outcomes surrounding 16 cases of persons injured by coming into contact with the third rail in the Boston subway. This study represents a case series study design. It identified electrical injuries (by E-codes) from the medical records of persons attending two medical facilities in Boston over the period 1970-1995. Both fatal and non-fatal events were noted and the authors sought to distinguish occupational for non-occupational events.

Due to the study design and other factors, the results and their interpretation are limited in scope. The authors found varying reasons for exposure to the third rail, some work-related, some suicide attempts. The design, though, does not allow for assessment of the impact of contact with intermediate ranges of electrical current. The focus on two institutions and the lack of review of medical examiner records also raise questions about how representative the results might be.

Source: Rabban J, Adler J, Rosen C, Blair J, Sheridan R. Electrical injury from subway third rails: serious injury associated with intermediate voltage contact. *Burns* 23:515-518, 1997.

Scooter Injuries

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Descriptive study
- ED visits
- CPSC-NEISS, IPII (fatal)
- medical attention
- United States
- reporting of scooters
- scooter related injuries have increased over the last 2 yrs

Scooters are one in a series of fads in the United States. What injury risks do they carry? This paper examines scooter-related injuries from 1998-2000 to highlight this issue. It provides an estimate of all injuries in the United States. The study design is of a descriptive epidemiology format. However, no population estimates are gathered. In other words, the authors have gathered numerator data, but not denominator data. No measures of exposure have been gathered. Thus, an assessment of injury is not possible.

The study examines data in the NEISS and IPII files of the Consumer Product Safety Commission. This allows for the determination of whether a scooter was involved or not. All of the other injury surveillance systems do not gather this type of information. It would be very difficult to obtain from a medical records system. The definition of injury used in the study is not stated. In NEISS methods, though, injury visits to emergency departments are abstracted. As NEISS is based upon ED visits, the severity of injury assigned is moderate to severe. Scrapes and cuts from scooter crashes are not going to be included here. The NEISS methods also sample hospitals throughout the U.S. to allow for population estimates.

The study reports that scooter related injuries increased from a few hundred in 1998 and 1999 to 27,600 in 2000. Potential bias might exist in the form of under-reporting of scooter events in the medical system.

Source: Anonymous. Unpowered Scooter-Related Injuries-United States, 1998-2000. MMWR 49(49):1108-1110, 2000.

Firearms in 3 cities

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Descriptive epidemiology
- powdered gun injury
- police/ME/EMS/ED/hosp
- moderate to fatal
- city residents
- miss cases shot outside of city
- Memphis had highest incidence rate of firearm injury

Guns are a rallying call for several individuals in the polarized debate over gun control. This manuscript is a descriptive epidemiology study of firearm injuries in Memphis, Seattle, and Galveston. The authors examined records from several data sources (police, medical examiners, EMS, EDs and hospitals) to identify all firearm injuries in these areas. Population data were then applied to identify the incidence rate of these mishaps. Firearm injury was defined as an injury resulting from the discharge of a powder firearm. Both fatal and non-fatal events were examined.

This study is an excellent example of the descriptive epidemiology study design. The authors were very thorough in identifying cases and restricted eligible events to city residents to allow for more appropriate determination of incidence. This report found variation in firearm injury incidence rates between the cities. Memphis had rates that were 4-5 times higher than those in Seattle and 50% higher than in Galveston. The standardized nature of data collection and injury definition allow for comparisons between the areas. This comparison suggests that there is something in Seattle that may contribute to lower rates or conversely something in Memphis that contributes to higher rates. The results can generate hypothesis in these areas for further investigation.

Source: Kellermann AL, Rivara FP, Lee RK, Banton JG, Cummings P, Hackman BB, et. al. Injuries due to firearms in three cities. NEJM 335:1438-1444, 1996.

Injuries in Hispanic/Non-Hispanic Youth

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Ecologic study
- hospital injury by ICD code
- hospital records
- severe
- orange county residents
- multiple admissions
- acculturation related to injuries in Hispanics

A fishing expedition or an ecologic study? Ecologic study designs are often derided in the literature but they serve a good purpose in putting forth hypothesis for future studies. This report examines the relationship between poverty, acculturation, and injury. The study took place in Orange County, California and identified injury cases among young residents (0-14) which were hospitalized (by E-codes) or fatal (from medical examiner records and E-codes). Addresses of the injured were gathered and analyses were focused at the census block level. Measures of poverty, acculturation and crowding were also gathered by census block from the census bureau. Crowding was associated with injuries in white children. Acculturation was related to injury in Hispanic children. This study examined group level data and cannot make individual-based inferences regarding causality.

Source: Anderson CL, Agran PF, Winn DG, Tran C. Hispanic and non-Hispanic white children: an ecologic analysis. *Injury Prevention* 4:33-38, 1998.

Medical Conditions and Crashes in Older Adults

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Case-control study
- injury requiring medical care by ICD code
- police reports, HMO database
- moderate to severe
- HMO members
- small samples with disease
- higher risks in diabetic drivers

Many believe that the health status of older drivers places them at greater risk for motor vehicle accidents. This study examines the association between several medical conditions and motor vehicle accidents resulting in injury. It uses the case-control study design as the method of study as crashes are rare events and several disease conditions are relatively rare in their occurrence. The study was based upon members in the Group Health Cooperative HMO. Cases were individuals who received medical care for injuries sustained in a crash where they were the driver. Accidents were identified from police reports. Controls were a random selection of HMO members who had not been injured in a crash. Collision injuries were identified from a review of the HMO database. Information on existing health conditions were also gathered from the database. All subjects were mailed a questionnaire to ascertain driving patterns, driving exposure, and health habits.

Overall, the study found higher crash rates in subjects with diabetes, but not in subjects with several other medical conditions, including cardiovascular disease, neurological disease, arthritis, and depression. This study was based upon police accident reports, so events with injuries that were not reported are not included. Also, the sample sizes of subjects with several of the conditions were small (less than 10) indicating limited ability to detect small to moderate associations.

Source: Koepsell TD, Wolf ME, McCloskey L, Buchner DM, Louie D, Wagner EH, Thompson RS. Medical conditions and motor vehicle collision injuries in older adults.

Traffic Accidents and Benzodiazepine Use

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Case-crossover
- police reported accident
- police, Rx records
- crashes
- tayside residents
- exposure data is sketchy
- benzo association found overall and with a dose-response effect as well

Drugs and crashes. Several studies suggest that psychoactive drugs can impair driving skills. This report examines the association between the use of psychoactive drugs and car crashes with a case-crossover study design. Crashes were identified from police accident reports over a three-year period and linked to a database of medicines and dispensing to chart psychoactive drug use or non-use. Cases were the drivers who crashed and their recorded drug use on the day of the crash. Comparisons were made with the same drivers and their drug use at the same time from 1-18 weeks earlier.

No associations with tricyclic anti-depressants and serotonin inhibitors and crashes were observed. Users of Benzodiazepines, though, had higher crash rates. A dose-response relationship was also found with benzos: It was not clear, though, if the crashes were related to the drug use or the underlying disease for which they were prescribed.

Source: Barbone F, McMahon AD, Davey PG, Morris AD, Reid IC, McDevitt DG, et al. Association of road traffic accidents with benzodiazepine use. *Lancet* 352:1331-1336, 1998.

Cell phones and crashes

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Case-crossover study
- property damage crash
- phone records, survey
- moderate, no severe injury
- ontario
- volunteers, control time frame
- 4 times higher risk for crash when using the phone

Are you distracted when using a cellular telephone in a car to the extent that you crash more often? That is the basic question that this study seeks to address. This work was one of the first examples of the case-crossover study design in the injury literature. It examined a population of drivers in Toronto who brought their vehicles into a collision damage assessment center following a crash. They obtained informed consent from the drivers and got copies of their phone records. The cases served as their own controls. Case events included phone use at the time of the crash. Control events included phone use at the same time on the day before the crash. Alternative evaluation days were also considered. The data examines moderate crashes producing property damage to the cars. No serious or fatal injury crashes are included.

The authors found a higher risk for crash (4 times higher) at the time of phone use. This was a fairly well done study for its time. The study subjects, though, were all volunteers and may not be representative. The driving patterns in the control period may also have been different than in the case period.

Source: Redelmeier DA, Tibshirani RJ. Association between cellular telephone calls and motor vehicle collisions. *NEJM* 336:453-458, 1997.

Marijuana Use and Injuries

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- Retrospective cohort
- ICD codes
- medical database
- medical attended injury
- KP members
- high SES group
- no association between marijuana use and injuries

This paper seeks to evaluate the association between marijuana use and injuries. It adopts a retrospective cohort study design. This design is applied by using the medical databases of the Kaiser Permanente health system and linking them to a health survey given from 1979-1986. In this survey, information on marijuana use was obtained and classified as current users, past users or never users. This baseline data was linked to subsequent injury related hospital visits. These events were identified in the database through N-codes and E-codes. The type of injuries examined included both ED and hospital admissions and represent moderate to severe events.

The authors found no significant association between marijuana use and the risk for injury. This is a unique study approach, but several bias' may influence the results. One, the study population are members of an HMO, and may have a higher SES than the general population. Two, the assessment of marijuana exposure was crude and was by self-report. Three, no measures of marijuana use are available at the time of the injury.

Source: Braun BL, Tekawa IS, Gerberich SG, Sidney S. Marijuana use and medically attended injury events. *Annals of Emergency Medicine* 32:353-360, 1998.

Prevention of Falls in the Elderly

- Study design
- Definition of injury
- Data Sources
- Severity of Injury
- Population
- Bias
- Findings
- RCT
- falls
- quarterly surveys
- minor to severe
- community dwelling
- self reported falls
- lower fall rates in intervention group

Falls are a leading cause of injuries in the elderly. This study examines the benefits of a structured assessment of older persons who fall and if it can reduce subsequent falls. The study design used was a randomized controlled trial. Older persons coming into an ED with a primary diagnosis of a fall were randomized into two groups; one group received a comprehensive medical and occupational therapy assessment, the control group received regular care. The study endpoint was the number of subsequent falls over a twelve-month period. Falls were defined as “inadvertently coming to rest on the ground.” Data on falls were gathered from a quarterly survey filled out by the participants. Monthly diaries were also given to the subjects to aid in recall of falls.

The authors found that the medical and occupational therapy assessment lowered the risk for subsequent falls. The risk of falling was 0.40 in this group compared to the controls. About 20% of each study group were lost-to-follow-up in this study.

Source: Close J, Ellis M, Hooper R, Glucksman E, Jackson S, Swift C. Prevention of falls in the elderly trial (PROFET): a randomized controlled trial. *Lancet* 353:93-97, 1999.