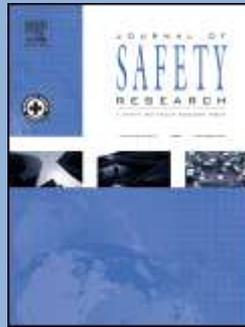


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Jack Short, Brian Caulfield. *Record linkage for road traffic injuries in Ireland using police hospital and injury claims data. Pages 1-14.*

Introduction: The study of non-fatal road traffic injuries is growing in importance. Since there are rarely comprehensive injury datasets, it is necessary to combine different sources to obtain better estimates on the extent and nature of the problem. Record linkage is one such technique. **Method:** In this study, anonymized datasets from three separate sources of injury data in Ireland: hospitals, police, and injury claims are linked using probabilistic and deterministic linkage techniques. A method is proposed that creates a 'best' set of linked records for analysis, useful when clerical review of undecided cases is not feasible. **Results:** The linkage of police and hospital datasets shows results that are similar to those found in other countries, with significant police understatement especially of cyclist and motorcyclist injuries. The addition of the third dataset identifies a large number of additional injuries and demonstrates the error of using only the two main sources for injury data. **Practical application:** The study also underlines the risk in relying on the Lincoln–Petersen capture–recapture estimator to provide an estimate of the total population concerned. **Conclusion:** The data show that road traffic injuries are significantly more numerous than either police or hospital sources indicate. It is also argued that no single measure can fully capture the range of impacts that a serious injury entails.

- **Keywords:** Road safety; Accident records; Data linkage

Kaigang Li, Bruce Simons-Morton, Benjamin Gee, Ralph Hingson. *Marijuana-, alcohol-, and drug-impaired driving among emerging adults: Changes from high school to one-year post-high school. Pages 15-20.*

Introduction: Driving while impaired (DWI) increases the risk of a motor vehicle crash by impairing performance. Few studies have examined the prevalence and predictors of marijuana, alcohol, and drug-specific DWI among emerging adults. **Methods:** The data from wave 3 (W3, high school seniors, 2012, N = 2407) and wave 4 (W4, one year after high school, N = 2178) of the NEXT Generation Health Study with a nationally representative cohort. W4 DWI (≥ 1 day of past 30 days) was specified for alcohol-specific, marijuana-specific, alcohol/marijuana-combined, illicit drug-related DWI. Multinomial logistic regression models estimated the association of W4 DWI with W3 covariates (perceived peer/parent influence, drinking/binge drinking, marijuana/illicit drug use), and W4 environmental status variables (work/school/residence) adjusting for W3 overall DWI, demographic, and complex survey variables. **Results:** Overall DWI

prevalence from W3 to W4 changed slightly (14% to 15%). W4 DWI consisted of 4.34% drinking-specific, 5.02% marijuana-specific, 2.41% drinking/marijuana combined, and 3.37% illicit drug-related DWI. W3 DWI was significantly associated with W4 alcohol-related and alcohol/marijuana-combined DWI, but not other DWI. W3 marijuana use, binge drinking, and illicit drug use were positively associated with W4 marijuana-specific, alcohol/marijuana-combined, and illicit drug-related DWI, respectively. W3 friend drunkenness and marijuana use were positively associated with W4 alcohol-specific and marijuana-related DWI, respectively. W3 peer marijuana use was negatively associated with W4 alcohol-specific DWI. **Conclusions:** Driving under the influence of alcohol, marijuana, and illicit drugs is a persistent, threatening public health concern among emerging U.S. adults. High school seniors' binge drinking as well as regular alcohol drinking and marijuana/illicit drug use were independently associated with respective DWI one year after high school. Peer drunkenness and marijuana use in high school may be related to subsequent DWI of emerging adults. **Practical applications:** The results support the use of injunctive peer norms about getting drunk and smoking marijuana in guiding the development of prevention programs to reduce youth DWI.

- **Keywords:** Adolescents; Impaired driving; Alcohol drinking; Marijuana use; Illicit drug use

Ja K. Gu, Luenda E. Charles, Michael E. Andrew, Claudia C. Ma, Tara A. Hartley, John M. Violanti, Cecil M. Burchfiel. *Prevalence of work-site injuries and relationship between obesity and injury among U.S. workers: NHIS 2004–2012. Pages 21-30.*

Introduction: Studies have reported associations between obesity and injury in a single occupation or industry. Our study estimated the prevalence of work-site injuries and investigated the association between obesity and work-site injury in a nationally representative sample of U.S. workers. Methods: Self-reported weight, height, and injuries within the previous three months were collected annually for U.S. workers in the National Health Interview Survey (NHIS) from 2004–2012. Participants were categorized as normal weight (BMI: 18.5–24.9 kg/m²), overweight (BMI: 25.0–29.9), obese I (BMI: 30.0–34.9), and obese II (BMI: 35 +). The prevalence of injury and prevalence ratios from fitted logistic regression models was used to assess relationships between obesity and injury after adjusting for covariates. Sampling weights were incorporated using SUDAAN software. Results: During the 9-year study period from 2004 to 2012, 1120 workers (78 workers per 10,000) experienced a work-related injury during the previous three months. The anatomical sites with the highest prevalence of injury were the back (14.3/10,000 ± 1.2), fingers (11.5 ± 1.3), and knees (7.1 ± 0.8). The most common types of injuries were sprains/strains/twists (41.5% of all injuries), cuts (20.0%), and fractures (11.8%). Compared to normal weight workers, overweight and obese workers were more likely to experience work-site injuries [overweight: PR = 1.25 (95% CI = 1.04–1.52); obese I: 1.41 (1.14–1.74); obese II: 1.68 (1.32–2.14)]. These injuries were more likely to affect the lower extremities [overweight: PR = 1.48, (95% CI = 1.03–2.13); obese I: 1.70 (1.13–2.55); obese II: 2.91 (1.91–4.41)] and were more likely to be due to sprains/strains/twists [overweight: PR = 1.73 (95% CI = 1.29–2.31); obese I: PR = 2.24 (1.64–3.06); obese II: PR = 2.95 (2.04–4.26)]. Conclusions: Among NHIS participants, overweight and obese workers were 25% to 68% more likely to experience injuries than normal weight workers. Practical applications: Weight reduction policies and management programs may be effectively targeted towards overweight and obese groups to prevent or reduce work-site injuries.

- **Keywords:** Occupational incident; Overweight; Obese; Body mass index; United States

Juneyoung Park, Mohamed Abdel-Aty, Jaeyoung Lee. *Use of empirical and full Bayes before–after approaches to estimate the safety effects of roadside barriers with different crash conditions.* Pages 31-40.

Introduction: Although many researchers have estimated the crash modification factors (CMFs) for specific treatments (or countermeasures), there is a lack of prior studies that have explored the variation of CMFs. Thus, the main objectives of this study are: (a) to estimate CMFs for the installation of different types of roadside barriers, and (b) to determine the changes of safety effects for different crash types, severities, and conditions. **Method:** Two observational before–after analyses (i.e. empirical Bayes (EB) and full Bayes (FB) approaches) were utilized in this study to estimate CMFs. To consider the variation of safety effects based on different vehicle, driver, weather, and time of day information, the crashes were categorized based on vehicle size (passenger and heavy), driver age (young, middle, and old), weather condition (normal and rain), and time difference (day time and night time). **Results:** The results show that the addition of roadside barriers is safety effective in reducing severe crashes for all types and run-off roadway (ROR) crashes. On the other hand, it was found that roadside barriers tend to increase all types of crashes for all severities. The results indicate that the treatment might increase the total number of crashes but it might be helpful in reducing injury and severe crashes. In this study, the variation of CMFs was determined for ROR crashes based on the different vehicle, driver, weather, and time information. **Practical applications:** Based on the findings from this study, the variation of CMFs can enhance the reliability of CMFs for different roadway conditions in decision making process. Also, it can be recommended to identify the safety effects of specific treatments for different crash types and severity levels with consideration of the different vehicle, driver, weather, and time of day information.

- **Keywords:** Safety effectiveness; Crash modification factors; Highway safety manual; Roadside barriers; Empirical and Full Bayes

Angela H. Eichelberger, Anne T. McCartt. *Impaired driving enforcement practices among state and local law enforcement agencies in the United States.* Pages 41-47.

Introduction: Alcohol-impaired driving (DUI) persists as a substantial problem, yet detailed data on DUI enforcement practices are rarely collected. The present study surveyed state and local law enforcement agencies about their DUI enforcement activities. **Method:** Telephone interviews were conducted with law enforcement liaisons in state highway safety offices. Officers from a nationally representative sample of municipal, county, and state law enforcement agencies were also interviewed about their agency's DUI enforcement activities, including the types of enforcement, frequency of use, and whether activities were publicized. Response rates were 100% among law enforcement liaisons, 86% among county agencies, 93% among municipal agencies, and 98% among state agencies. **Results:** Based on the highway safety office survey, 38 states conducted sobriety checkpoints in 2011. Nationally, 58% of law enforcement agencies reported that they conducted or helped conduct sobriety checkpoints during 2011–12, with 14% of all agencies conducting them monthly or more frequently. The vast majority (87%) of agencies reported conducting dedicated DUI patrols. However, dedicated DUI patrols were less likely to be publicized than checkpoints. Less than a quarter of agencies reported using passive alcohol sensors to improve detection of alcohol-impaired drivers. **Conclusions:** Results show that 38 states conducted sobriety checkpoints in 2011, little changed from a previous survey in 2000. Despite evidence of effectiveness, many agencies do not conduct frequent, publicized DUI enforcement or use passive alcohol sensors. **Practical applications:** The survey suggests that there are several areas in which impaired driving enforcement could be improved: increasing the frequency of special enforcement, such as sobriety checkpoints and/or dedicated patrols;

publicizing these efforts to maximize deterrent effects; and using passive alcohol sensors to improve detection of alcohol-impaired drivers.

- **Keywords:** Alcohol-impaired driving; Law enforcement; Sobriety checkpoints; Dedicated patrols; DUI

Carl Bonander, Linda Beckman, Staffan Janson, Carolina Jernbro. *Injury risks in schoolchildren with attention-deficit/hyperactivity or autism spectrum disorder: Results from two school-based health surveys of 6- to 17-year-old children in Sweden.* Pages 49-56.

Introduction: Injuries are one of the leading causes of death and disability among children in Sweden and attention-deficit/hyperactivity disorder (ADHD) has previously been associated with an increased risk of injury in pediatric populations elsewhere in the world. Current evidence regarding the possible link between autism spectrum disorder (ASD) and injury risk appears limited, even though some potentially risk-increasing symptoms overlap. The purpose of this study was thus to study the association between both ADHD and ASD concerning the risk of injury among Swedish schoolchildren.

Methods: Two samples were used: a population-based register study containing data from 18,416 children ranging from the ages of 6–17 years collected by school nurses during 2012/2014 (Survey A), and a national cross-sectional study of 3202 ninth-grade children (~ 15 years old) collected from 92 schools in 2011 (Survey B). The data were analyzed using χ^2 -tests and log-binomial generalized linear models to obtain risk ratios (RR), comparing cases reportedly affected by ADHD or ASD to unaffected controls.

Results: After adjusting for confounders, ADHD was associated with a 65% increased risk of injury (RR 1.65 [95% CI: 1.32–2.05] in Survey A, and a 57% increased risk of injury (RR 1.57 [95% CI: 1.27–1.95]) in Survey B. ASD was not significantly associated with any differences in injury risk (RR 0.81 [95% CI: 0.57–1.14]). **Conclusions:** The results indicate that there is an elevated injury risk among Swedish schoolchildren with ADHD but not for children with ASD. Future studies should focus on causal mechanisms mediating the association between ADHD and injuries in order to facilitate injury prevention strategies. **Practical applications:** Parents and teachers of schoolchildren with ADHD should be made aware of the elevated injury risks associated with the diagnosis. Safety experts and injury control professionals should consider the development of specialized prevention strategies in order to reduce these risks.

- **Keywords:** ADHD; Accidents; ASD; Injuries; Pediatric

Bhaven Naik, Li-Wei Tung, Shanshan Zhao, Aemal J. Khattak. *Weather impacts on single-vehicle truck crash injury severity.* Pages 57-65.

Introduction: The focus of this paper is on illustrating the feasibility of aggregating data from disparate sources to investigate the relationship between single-vehicle truck crash injury severity and detailed weather conditions. Specifically, this paper presents: (a) a methodology that combines detailed 15-min weather station data with crash and roadway data, and (b) an empirical investigation of the effects of weather on crash-related injury severities of single-vehicle truck crashes. **Method:** Random parameters ordinal and multinomial regression models were used to investigate crash injury severity under different weather conditions, taking into account the individual unobserved heterogeneity. The adopted methodology allowed consideration of environmental, roadway, and climate-related variables in single-vehicle truck crash injury severity.

Results and conclusions: Results showed that wind speed, rain, humidity, and air temperature were linked with single-vehicle truck crash injury severity. Greater recorded wind speed added to the severity of injuries in single-vehicle truck crashes in general. Rain and warmer air temperatures were linked to more severe crash injuries in single-vehicle truck crashes while higher levels of humidity were linked to less severe injuries. Random parameters ordered logit and multinomial logit, respectively, revealed some

individual heterogeneity in the data and showed that integrating comprehensive weather data with crash data provided useful insights into factors associated with single-vehicle truck crash injury severity. **Practical applications:** The research provided a practical method that combined comprehensive 15-min weather station data with crash and roadway data, thereby providing useful insights into crash injury severity of single-vehicle trucks. Those insights are useful for future truck driver educational programs and for truck safety in different weather conditions.

- **Keywords:** Weather data; Truck safety; Crash severity; Random parameters ordered logit model; Mixed logit model

Ward Vanlaar, Marisela Mainegra Hing, Steve Brown, Heather McAteer, Jennifer Crain, Steven McFaull. *Fatal and serious injuries related to vulnerable road users in Canada. Pages 67-77.*

Introduction: The goals of this study were to analyze possible trends of fatal and serious injuries related to vulnerable road users in Canada (pedestrians, cyclists and motorcyclists) from 1990 to 2012 and the role of alcohol and drugs in these cases. Drugs have rarely been documented with respect to vulnerable road users. **Method:** The Traffic Injury Research Foundation's National Fatality and Serious Injury Databases and the Public Health Agency of Canada's Canadian Hospitals Injury Reporting and Prevention Program databases were used. Numbers and rates of fatalities and serious injuries among vulnerable road users were analyzed and regression models were used to assess changes over time. **Results:** The analyses show that while the absolute number of fatalities and the rate per 100,000 population among vulnerable road users may be decreasing, no such trends are apparent when looking at the proportions of these road user fatalities out of all motor-vehicle fatalities. The trend for the proportion of motorcyclist fatalities is significantly increasing (coef. = 0.16, $p < 0.001$). The elderly (76 years or older) are overrepresented among pedestrian fatalities, and serious injuries (they represent 18.5% of all pedestrian fatalities but only 5.8% of the population), while those 15 years or younger are overrepresented among cyclists (they represent 23.3% of cyclist fatalities but 19.5% of the population), and those 16 to 25 years old are overrepresented among motorcyclists (27.2% of motorcyclists fatalities and 13.6% of population). Alcohol and drug use among fatally injured vulnerable road users were significant problems, especially among pedestrians. Among fatally injured pedestrians tested for alcohol and drugs, 39.7% and 43.4% tested positive, respectively. **Conclusions:** With the promotion of walking and cycling as forms of exercise and the popularity of motorcycling, the safety of vulnerable road users is an important issue. The results corroborate previous research and extend our understanding about the influence of alcohol and drugs in vulnerable road user injuries. **Practical applications:** These findings can help better inform prevention and mitigation initiatives for vulnerable road users.

- **Keywords:** Pedestrians; Bicyclists; Motorcyclists; Alcohol; Drugs

Saeid R. Dindarloo, Jonisha P. Pollard, Elnaz Siami-Irdemoosa. *Off-road truck-related accidents in U.S. mines. Pages 79-87.*

Introduction: Off-road trucks are one of the major sources of equipment-related accidents in the U.S. mining industries. A systematic analysis of all off-road truck-related accidents, injuries, and illnesses, which are reported and published by the Mine Safety and Health Administration (MSHA), is expected to provide practical insights for identifying the accident patterns and trends in the available raw database. Therefore, appropriate safety management measures can be administered and implemented based on these accident patterns/trends. **Methods:** A hybrid clustering-classification methodology using K-means clustering and gene expression programming (GEP) is proposed for the analysis of severe and non-severe off-road truck-related injuries at U.S. mines. Using the GEP

sub-model, a small subset of the 36 recorded attributes was found to be correlated to the severity level. **Results:** Given the set of specified attributes, the clustering sub-model was able to cluster the accident records into 5 distinct groups. For instance, the first cluster contained accidents related to minerals processing mills and coal preparation plants (91%). More than two-thirds of the victims in this cluster had less than 5 years of job experience. This cluster was associated with the highest percentage of severe injuries (22 severe accidents, 3.4%). Almost 50% of all accidents in this cluster occurred at stone operations. Similarly, the other four clusters were characterized to highlight important patterns that can be used to determine areas of focus for safety initiatives. **Conclusions:** The identified clusters of accidents may play a vital role in the prevention of severe injuries in mining. Further research into the cluster attributes and identified patterns will be necessary to determine how these factors can be mitigated to reduce the risk of severe injuries. **Practical application:** Analyzing injury data using data mining techniques provides some insight into attributes that are associated with high accuracies for predicting injury severity.

- **Keywords:** Off-road mining trucks; Fatalities and injuries; K-means clustering; Genetic programming; Classification

Jingyan Wan, Changxu Wu, Yiqi Zhang. *Effects of lead time of verbal collision warning messages on driving behavior in connected vehicle settings.* Pages 89-98.

Introduction: Under the connected vehicle environment, vehicles will be able to exchange traffic information with roadway infrastructure and other vehicles. With such information, collision warning systems (CWSs) will be able to warn drivers with potentially hazardous situations within or out of sight and reduce collision accidents. The lead time of warning messages is a crucial factor in determining the effectiveness of CWSs in the prevention of traffic accidents. Accordingly, it is necessary to understand the effects of lead time on driving behaviors and explore the optimal lead time in various collision scenarios. **Methods:** The present driving simulator experiment studied the effects of controlled lead time at 16 levels (predetermined time headway from the subject vehicle to the collision location when the warning message broadcasted to a driver) on driving behaviors in various collision scenarios. **Results:** Maximum effectiveness of warning messages was achieved when the controlled lead time was within the range of 5 s to 8 s. Specifically, the controlled lead time ranging from 4 s to 8 s led to the optimal safety benefit; and the controlled lead time ranging from 5 s to 8 s led to more gradual braking and shorter reaction time. Furthermore, a trapezoidal distribution of warning effectiveness was found by building a statistic model using curve estimation considering lead time, lifetime driving experience, and driving speed. **Conclusions:** The results indicated that the controlled lead time significantly affected driver performance. **Practical applications:** The findings have implications for the design of collision warning systems.

- **Keywords:** Collision warning message; Lead time; Driving behavior; Driving performance; Connected vehicles

Elizabeth R. Burns, Judy A. Stevens, Robin Lee. *The direct costs of fatal and non-fatal falls among older adults – United States.* Pages 99-103.

Introduction: This study sought to estimate the incidence, average cost, and total direct medical costs for fatal and non-fatal fall injuries in hospital, ED, and out-patient settings among U.S. adults aged 65 or older in 2012, by sex and age group and to report total direct medical costs for falls inflated to 2015 dollars. **Method:** Incidence data came from the 2012 National Vital Statistics System, 2012 Healthcare Cost and Utilization Project-Nationwide Inpatient Sample, 2012 Health Care Utilization Program National Emergency Department Sample, and 2007 Medical Expenditure Panel Survey. Costs for fatal falls

were derived from the Centers for Disease Control and Prevention's Web-based Injury Statistics Query and Reporting System; costs for non-fatal falls were based on claims from the 1998/1999 Medicare fee-for-service 5% Standard Analytical Files. Costs were inflated to 2015 estimates using the health care component of the Personal Consumption Expenditure index. **Results:** In 2012, there were 24,190 fatal and 3.2 million medically treated non-fatal fall related injuries. Direct medical costs totaled \$616.5 million for fatal and \$30.3 billion for non-fatal injuries in 2012 and rose to \$637.5 million and \$31.3 billion, respectively, in 2015. Fall incidence as well as total cost increased with age and were higher among women. **Conclusion:** Medically treated falls among older adults, especially among older women, are associated with substantial economic costs. **Practical application:** Widely implementing evidence-based interventions for fall prevention is essential to decrease the incidence and healthcare costs associated with these injuries.

- **Keywords:** Fall; Older people; Costs; Hospital care; STEADI

Keith W. Easterling, Karin A. Mack, Christopher M. Jones. *Location of fatal prescription opioid-related deaths in 12 states, 2008–2010: Implications for prevention programs. Pages 105-109.*

Introduction: Prescription opioid pain reliever overdose is a major public health issue in the United States. To characterize the location of drug-related deaths, we examined fatal prescription opioid and illicit drug-related deaths reported in 12 states. **Methods:** Data are from the Substance Abuse and Mental Health Services Administration's Drug Abuse Warning Network (DAWN). Medical examiners or coroners in 12 states (MA, MD, ME, NH, NM, OK, OR, RI, UT, VA, VT, WV) reported details of state-wide drug-related mortality during 2008–2010. DAWN data included location and manner of death, age, race, and drugs involved. Deaths were coded into three categories: prescription opioid-related, illicit drug-related, and cases that involved both a prescription opioid and an illicit drug. **Results:** During a 3-year period, there were 14,091 opioid or illicit drug-related deaths in 12 states. More than half of the prescription opioid-related deaths in all states, except Maryland, occurred at home, rather than in public or in a health care facility. Although it was still the predominant category, lower percentages of illicit drug-related deaths occurred at home. **Conclusion:** Prescription opioid overdoses have increased substantially, and the location of the person at the time of death can have important public health implications for interventions. **Practical applications:** This paper highlights that bystander support can be a critical lifesaving factor in drug related deaths but may be more likely for illicit drug-related deaths than for prescription opioid-related deaths.

- **Keywords:** Drug Abuse Warning Network (DAWN); Mortality; Overdose; Opioid; Heroin