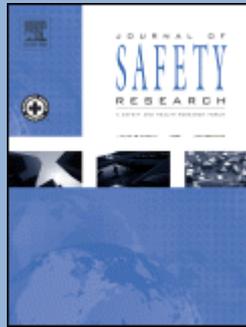


Journal of Safety Research – rok 2020, Volume 79

December 2021



Ma'en Mohammad Ali Al-Omari, Mohamed Abdel-Aty, Qing Cai. *Crash analysis and development of safety performance functions for Florida roads in the framework of the context classification system. Pages 1-13.*

Introduction: Safety performance functions (SPF) are employed to predict crash counts at the different roadway elements. Several SPFs were developed for the various roadway elements based on different classifications such as functional classification and area type. Since a more detailed classification of roadway elements leads to more accurate crash predictions, multiple states have developed new classification systems to classify roads based on a comprehensive classification. In Florida, the new roadway context classification system incorporates geographic, demographic, and road characteristics information. **Method:** In this study, SPFs were developed in the framework of the FDOT roadway context classification system at three levels of modeling, context classification (CC-SPFs), area type (AT-SPFs), and statewide (SW-SPF) levels. Crash and traffic data from 2015-2019 were obtained. Road characteristics and road environment information have also been gathered along Florida roads for the SPF development. **Results:** The developed SPFs showed that there are several variables that influence the frequency of crashes, such as annual average daily traffic (AADT), signalized intersections and access point densities, speed limit, and shoulder width. However, there are other variables that did not have an influence in crash occurrence such as concrete surface and the presence of bicycle slots. CC-SPFs had the best performance among others. Moreover, network screening to determine the most problematic road segments has been accomplished. The results of the network screening indicated that the most problematic roads in Florida are the suburban commercial and the urban general roads. **Practical Applications:** This research provides a solid reference for decision-makers regarding crash prediction and safety improvement along Florida roads.

- **Keywords:** Safety performance functions; FDOT context classification system; Network screening

Nicholas N. Ferenchak, Masoud Ghodrati Abadi. *Nighttime pedestrian fatalities: A comprehensive examination of infrastructure, user, vehicle, and situational factors. Pages 14-25.*

Introduction: Pedestrian fatalities in the United States increased 45.5% between 2009 and 2017. More than 85% of those additional pedestrian fatalities occurred at night. **Method:** We examine Fatality Analysis Reporting System (FARS) data for fatal pedestrian crashes that occurred in the dark between 2002 and 2017. Within-variable

and before/after examinations of crashes in terms of infrastructure, user, vehicle, and situational characteristics are performed with one-way analysis of variance (ANOVA) and two-sample t-tests. We model changes in crash characteristic proportions between 2002–2009 and 2010–2017 using linear regressions and test for autocorrelation with Breusch-Godfrey tests. **Results:** The increase in fatal nighttime pedestrian crashes is most strongly correlated with infrastructure factors: non-intersection unmarked locations (saw 80.8% of additional fatalities); 40–45 mph roads (54.6%); five-lane roads (40.7%); urban (99.7%); and arterials (81.1%). In addition, SUVs were involved in 39.7% of additional fatalities, overrepresenting their share of the fleet. Increased pedestrian alcohol and drug involvement warrant further investigation. The age of pedestrians killed increased more (18.1%) than the national average (3.2%). **Conclusions:** By identifying factors related to the increase in nighttime pedestrian fatalities, this work constitutes a vital first step in making our streets safer for pedestrians. **Practical Applications:** More research is needed to understand the efficacy of different solutions, but this paper provides guidance for such future research. Engineering solutions such as road diets or traffic calming may be used to improve identified infrastructure issues by reducing vehicle speeds and road widths. Rethinking vehicle design, especially high front profiles, may improve vehicle issues. However, the problems giving rise to these pedestrian fatalities are likely a result of not only engineering issues but also interrelated social and political factors. Solutions may be correspondingly comprehensive, employing non-linear, systems-based approaches such as Safe Systems.

- **Keywords:** Pedestrian; Fatality; Injury; Safety; Night; Dark; Infrastructure; Arterial; Drug; Alcohol; SUV

Anh Vu Ngo, Julian Becker, Dinesh Thirunavukkarasu, Peter Urban, Saiprasit Koetniyom, Julaluk Carmai. *Investigation of occupant kinematics and injury risk in a reclined and rearward-facing seat under various frontal crash velocities. Pages 26-37.*

Introduction: The availability of highly automated driving functions will vastly change the seating configuration in future vehicles. A reclined and rearward-facing seating position could become one of the popular seating positions. The occupant safety needs to be addressed in these novel seating configurations, as novel occupant loading conditions occur and the current standards as well as regulations are not fully applicable. **Method:** Twelve finite element simulations using a series production seat model and a state of the art 50th percentile male human body model were conducted to investigate the influences of various parameters on the occupant kinematics and injury risk. The varied parameters included the seatback angle, impact speed, and seatback rotational stiffness. **Results:** The seat model shows a large seatback rotation angle during the frontal crash scenario with high impact speed. A reclining of the seatback angle leads to no significant increase of the injury risk for the assessed injury values. However, the reclining does affect the interaction among the occupant, seatbelt, and seatback. An increase of the seatback rotational stiffness helps reduce brain and chest injury metrics, while neck injury values are higher for the stiffer seatback.

- **Keywords:** Rearward facing; Highly automated vehicle; Reclined seating; Occupant kinematics; Injury risk

Ramakrishna S. Kakara, Briana L. Moreland, Yara K. Haddad, Iju Shakya, Gwen Bergen. *Seasonal variation in fall-related emergency department visits by location of fall – United States, 2015. Pages 38-44.*

Introduction: In the United States, fall-related emergency department (ED) visits among older adults (age 65 and older) have increased over the past decade. Studies document seasonal variation in fall injuries in other countries, while research in the

United States is inconclusive. The objectives of this study were to examine seasonal variation in older adult fall-related ED visits and explore if seasonal variation differs by the location of the fall (indoors vs. outdoors), age group, and sex of the faller. **Methods:** Fall-related ED visit data from the National Electronic Injury Surveillance System-All Injury Program were analyzed by season of the ED visit, location of the fall, and demographics for adults aged 65 years and older. **Results:** Total fall-related ED visits were higher during winter compared with other seasons. This seasonal variation was found only for falls occurring outdoors. Among outdoor falls, the variation was found among males and adults aged 65 to 74 years. The percentages of visits for weather-related outdoor falls were also higher among males and the 65–74 year age group. **Conclusions:** In 2015, there was a seasonal variation in fall-related ED visits in the United States. Weather-related slips and trips in winter may partially account for the seasonal variation. Practical Implications: These results can inform healthcare providers about the importance of screening all older adults for fall risk and help to identify specific patients at increased risk during winter. They may encourage community-based organizations serving older adults to increase fall prevention messaging during winter.

- **Keywords:** Older adults; Elderly; Falls; Winter; Indoor; Outdoor

Ou Stella Liang, Christopher C. Yang. *Determining the risk of driver-at-fault events associated with common distraction types using naturalistic driving data.* Pages 45-50.

Introduction: Studies thus far have focused on automobile accidents that involve driver distraction. However, it is hard to discern whether distraction played a role if fault designation is missing because an accident could be caused by an unexpected external event over which the driver has no control. This study seeks to determine the effect of distraction in driver-at-fault events. **Method:** Two generalized linear mixed models, one with at-fault safety critical events (SCE) and the other with all-cause SCEs as the outcomes, were developed to compare the odds associated with common distraction types using data from the SHRP2 naturalistic driving study. **Results:** Adjusting for environment and driver variation, 6 of 10 common distraction types significantly increased the risk of at-fault SCEs by 20-1330%. The three most hazardous sources of distraction were handling in-cabin objects (OR = 14.3), mobile device use (OR = 2.4), and external distraction (OR = 1.8). Mobile device use and external distraction were also among the most commonly occurring distraction types (10.1% and 11.0%, respectively). **Conclusions:** Focusing on at-fault events improves our understanding of the role of distraction in potentially avoidable automobile accidents. The in-cabin distraction that requires eye-hand coordination presents the most danger to drivers' ability in maintaining fault-free, safe driving. **Practical Applications:** The high risk of at-fault SCEs associated with in-cabin distraction should motivate the smart design of the interior and in-vehicle information system that requires less visual attention and manual effort.

- **Keywords:** Distracted driving; Driver-at-fault event; Road safety; Naturalistic driving study; Generalized linear mixed model

Jin Lee, Yueng-Hsiang Huang, Marvin J. Dainoff, Yimin He. *Where to focus? Insights from safety personnel and external safety consultants on lessons learned about safety climate interventions – A qualitative approach.* Pages 51-67.

Introduction: Safety climate is important for promoting workplace safety and health. However, there is a dearth of empirical research on the effective ways of planning, designing, and implementing safety climate interventions, especially regarding what is going to be changed and improved. To address this gap, the present study sought to extract a comprehensive pool of compiled suggestions for safety climate intervention

based on qualitative interviews with professionals in occupational safety and health management from potentially hazardous industries. **Method:** A series of systematic semi-structured interviews, guided by a comprehensive sociotechnical systems framework, were conducted with company safety personnel (n = 26) and external safety consultants (n = 15) of 21 companies from various industries. The taxonomy of five work system components of the sociotechnical systems approach served as overarching themes, representing different areas of improvement in an organization for occupational safety and health promotion, with an aim of enhancing safety climate. **Results:** Of the 36 codes identified, seven codes were based on the theme of external environment work system, four were based on the theme of internal environment work system, five were based on the theme of organizational and managerial structure work system, 14 codes were based on the theme of personnel subsystem, and six were based on the theme of technical subsystem. **Conclusions:** Safety climate intervention strategies might be most commonly based upon the principles of human resource management (i.e., codes based on the personnel subsystem theme and organizational and managerial structure work system theme). Meanwhile, numerous attributes of external/internal environment work system and technical subsystem can be jointly improved to bolster safety climate in a holistic way. **Practical Applications:** More systematic and organized management of safety climate would be available when various interrelated codes pertinent to a given context are carefully considered for a safety climate intervention.

- **Keywords:** Safety climate; Intervention; Qualitative analysis; Sociotechnical systems approach

Laura Mills, James Freeman, Verity Truelove, Jeremy Davey, Patricia Delhomme. *Comparative judgements of crash risk and driving ability for speeding behaviours.* Pages 68-75.

Introduction: Preliminary research has indicated that numerous drivers perceive their risk of traffic crash to be less than other drivers, while perceiving their driving ability to be better. This phenomenon is referred to as 'comparative optimism' (CO) and may prove to inhibit the safe adoption of driving behaviors and/or dilute perceptions of negative outcomes. The objective of this study was to investigate comparative judgments regarding crash risk and driving ability, and how these judgments relate to self-reported speeding. **Method:** There were 760 Queensland motorists comprised of 51.6% males and 48.2% females, aged 16–85 (M = 39.60). Participants completed either a paper or online version of a survey. Judgments of crash risk and driving ability were compared to two referents: the average same-age, same-sex driver, and the average same-age, same-sex V8 supercar champion. **Results:** Drivers displayed greater optimism when comparing their crash risk and driving ability to the average same-age, same-sex driver (respectively, 72%, 72.4%), than when comparing to a V8 supercar champion (respectively, 60%, 32.9%). When comparing judgements of crash risk and driving ability to a similar driver, it appears that participants in the present study are just about as optimistic about their risk of crash (i.e. 72%) as they are optimistic about their driving ability (i.e. 74.2%).

- **Keywords:** Comparative optimism; Comparative pessimism; Risk of offending; Self-reported speeding; Perceptions

Aaron J. Benson, Brian C. Tefft, Lindsay S. Arnold, William J. Horrey. *Fatal hit-and-run crashes: Factors associated with leaving the scene.* Pages 76-82.

Introduction: Hit-and-run crashes are a criminal offense that leave the victim without prompt medical care or the ability to receive financial compensation. **Method:** The purpose of the current study was to quantify the factors associated with the probability that a driver leaves the scene of a fatal crash, using multiple imputation to incorporate

information from drivers who were never apprehended and thus whose characteristics were unknown. **Results:** The results of this study show that in addition to driver, vehicle, and environmental factors having significant impacts on the likelihood of a driver fleeing the scene, economic and demographic factors are important as well. **Practical Applications:** This analysis allows for a more holistic understanding of hit-and-run crashes and informs potential countermeasures and future research.

- **Keywords:** Hit-and-run; Criminal driving behavior; Fatal crashes; Pedestrian; Crash analysis

Denny Meyer, Samuel Muir, Sampathawaduge Sandun Malpriya Silva, Reneta Slikboer, Allison McIntyre, Kelly Imberger, Victoria Pyta. *Modelling the relationship of driver license and offense history with fatal and serious injury (FSI) crash involvement. Pages 83-93.*

Introduction: Previous research has indicated that increases in traffic offenses are linked to increased crash involvement rates, making reductions in offending an appropriate measure for evaluating road safety interventions in the short-term. However, the extent to which traffic offending predicts fatal and serious injury (FSI) crash involvement risk is not well established, prompting this new Victorian (Australia) study.

Method: A preliminary cluster analysis was performed to describe the offense data and assess FSI crash involvement risk for each cluster. While controlling demographic and licensing variables, the key traffic offenses that predict future FSI crash involvement were then identified. The large sample size allowed the use of machine learning methods such as random forests, gradient boosting, and Least Absolute Shrinkage and Selection Operator (LASSO) regression. This was done for the 'all driver' sample and five sometimes overlapping groups of drivers; the young, the elderly, and those with a motorcycle license, a heavy vehicle license endorsement and/or a history of license bans.

Results: With the exception of the group of drivers who had a history of bans, offense history significantly improved the accuracy of models predicting future FSI crash involvement using demographic and licensing data, suggesting that traffic offenses may be an important factor to consider when analyzing FSI crash involvement risk and the effects of road safety countermeasures. **Conclusions:** The results are helpful for identifying driver groups to target with further road safety countermeasures, and for showing that machine learning methods have an important role to play in research of this nature. **Practical Application:** This research indicates with whom road safety interventions should particularly be applied. Changes to driver demerit policies to better target offenses related to FSI crash involvement and repeat traffic offenders, who are at greater risk of FSI crash involvement, are recommended.

- **Keywords:** Fatal and serious injury (FSI) crash involvement; Traffic offending; Machine learning; Cluster analysis; LASSO regression, random forests and gradient boosting

Kerry A. Howard, Sarah F. Griffin, Laura J. Rolke, Kerry K. Sease. *Factors related to youth self-efficacy for injury prevention bicycle skills. Pages 94-99.*

Introduction: Bicycle riding is a common activity for children, but they are prone to bicycle-related injuries. It is well-established that injury prevention measures such as wearing a helmet and correctly riding a bicycle can reduce the severity of an injury and the likelihood of having an accident. However, how to increase bicycle injury prevention behaviors among children, who collectively fail to engage in injury prevention behaviors, is less well understood. Self-efficacy is consistently predictive of injury prevention behavior, making it an important approach to understanding injury prevention skills among this key population. The objective of this study was to explore and identify factors

internal to the child as well as factors about his or her environment that predict a child's self-efficacy for injury prevention skills. **Method:** Two generalized linear mixed effects models were created from survey data collected from elementary school students ($n = 2,255$) as part of a school-based bicycle education program. Models focused on self-efficacy for riding a bicycle and self-efficacy for wearing a helmet correctly. **Results:** In both models, road safety knowledge, opportunity for skill building through owning appropriate equipment (a bicycle or helmet), and situation through perception of neighborhood safety were predictive. The analyses reveal these variables as key factors for greater confidence, with feeling safe riding in the neighborhood, in particular, emerging as highly predictive of self-efficacy for injury prevention skills. **Conclusions:** These findings highlight the interplay of individual and environmental factors within confidence for injury prevention behavior. Given self-efficacy's strong relationship to prevention behavior, these findings indicate actionable strategies. **Practical Applications:** The key factors highlighted in this study can be used by policymakers to target specific areas (e.g., neighborhood safety) to promote self-efficacy and thus improve injury prevention. These factors can also inform strategies for establishing safety skills in bicycle-safety education programs.

- **Keywords:** Bicycle safety; Helmet use; Self-efficacy; Injury prevention; Child safety

Dawei Wang, Zhaobiao Zong, Wenxu Mao, Li Wang, Phil Maguire, Yixin Hu. *Investigating the relationship between person–environment fit and safety behavior: A social cognition perspective.* Pages 100-109.

Introduction: This study explored the relationship between person–job fit and safety behavior, as well as the mediating role played by psychological safety, from the perspective of social cognitive theory and person–environment fit theory. **Method:** A total of 800 employees from petroleum enterprises were recruited, with cluster random sampling used to collect data in two stages. **Results:** The results showed that employees' safety behavior is higher under the condition of "high person–job fit—high person–organization fit" than under that of "low person–job fit—low person–organization fit." In other words, the more congruent the level of person–job fit and person–organization fit for a given employee, the higher their level of safety behavior. **Practical Applications:** Psychological safety plays a mediating role between the congruence of both person–job fit and person–organization fit and employees' safety behavior.

- **Keywords:** Person–job fit; Person–organization fit; Safety behavior; Psychological safety; Polynomial regression

Bethany A. West, Merissa A. Yellman, Rose A. Rudd. *Use of child safety seats and booster seats in the United States: A comparison of parent/caregiver-reported and observed use estimates.* Pages 110-116.

Background: Motor-vehicles crashes are a leading cause of death among children. Age- and size-appropriate restraint use can prevent crash injuries and deaths among children. Strategies to increase child restraint use should be informed by reliable estimates of restraint use practices. Objective: Compare parent/caregiver-reported and observed child restraint use estimates from the FallStyles and Estilos surveys with the National Survey of the Use of Booster Seats (NSUBS). **Methods:** Estimates of child restraint use from two online, cross-sectional surveys—FallStyles, a survey of U.S. adults, and Estilos, a survey of U.S. Hispanic adults—were compared with observed data collected in NSUBS. Parents/caregivers of children aged ≤ 12 years were asked about the child's restraint use behaviors in FallStyles and Estilos, while restraint use was observed in NSUBS. Age-appropriate restraint use was defined as rear-facing child safety seat (CSS) use for children aged 0–4 years, forward-facing CSS use for children aged 2–7 years, booster seat use for children aged 5–12 years, and seat belt use for children aged 9–12 years.

Age-appropriate restraint users are described by demographic characteristics and seat row, with weighted prevalence and corresponding 95% confidence intervals (CI) calculated. **Results:** Overall, child restraint use as reported by parents/caregivers was 90.8% (CI: 87.5–94.1) (FallStyles) and 89.4% (CI: 85.5–93.4) for observed use (NSUBS). Among Hispanic children, reported restraint use was 82.6% (CI: 73.9–91.3) (Estilos) and 84.4% (CI: 79.0–88.6) for observed use (NSUBS, Hispanic children only). For age-appropriate restraint use, estimates ranged from 74.3% (CI: 69.7–79.0) (FallStyles) to 59.7% (CI: 55.0–64.4) (NSUBS), and for Hispanic children, from 71.5% (CI: 62.1–81.0) (Estilos) to 57.2% (CI: 51.2–63.2) (NSUBS, Hispanic children only). Conclusion and **Practical Application:** Overall estimates of parent/caregiver-reported and observed child restraint use were similar. However, for age-appropriate restraint use, reported use was higher than observed use for most age groups.

- **Keywords:** Child restraint; Car seats; Motor vehicles; Hispanic

Olga A. Bredikhina, Sanaa Rafique, Justin W. Fisher, Praveena Penmetsa, Laurel M. Wheeler, Xiaobing Li, Steven M. Polunsky. *Ride-hailing with kids: Who's got their back?* Pages 117-124.

Introduction: As transportation network companies (TNC) are on the rise, assessing the safety of children traveling in these vehicles is imperative. For this reason, this study developed and adopted a scoring system to assess states' safety standards for children traveling in TNC vehicles. **Methods:** The scoring was based on two parameters pertaining to child car seat laws for TNCs: clarity and stringency. For each parameter, three criteria that could impact child safety in TNC vehicles were formulated. If a state met a certain criterion it got 1 point and 0 otherwise. The authors gathered all the necessary information by reviewing state statutes in Nexus Uni, a legal research database. These reviews took place between December 2019 and October 2020, and this study evaluated state laws in effect on October 28, 2020. **Results:** During this assessment, the authors observed a lack of clarity in state child car seat laws, which could compromise safety of children traveling in TNC vehicles. For clarity of laws, Georgia and Indiana received the highest scores (3 out of 3 points), while 16 states scored only 1 point, which was the lowest score in this category. In terms of stringency of laws, Pennsylvania received the highest score (3 out of 3 points), while Indiana scored the least (0 points). **Conclusions:** Besides one state (Oregon), all other states defined TNCs in their state laws. All states except for Indiana and Washington required child car seats in TNC vehicles. The responsibility for child car seat use was clearly defined in 35 states. The fine for child car seat violation was \$50 or more in 28 states. **Practical Application:** This study will help TNCs, policymakers, and stakeholders identify states that need to improve their standards for child safety in TNC vehicles, and comprehensively address the issue.

- **Keywords:** Transportation network companies; Child car seat laws; Child safety; Car seat

Pernille T. Goodbrand, Connie Deng, Nick Turner, Krista L. Uggerslev, Jeff Gordon, Kasey Martin, Charlotte R. McClelland. *Exploring safety knowledge sharing among experienced and novice workers.* Pages 125-134.

Introduction: This paper investigates how members of a culinary and hospitality arts program generate, share, and learn safety knowledge via social and identity mechanisms. **Method:** We conducted semi-structured interviews with 20 participants of varying roles and experience (i.e., students, culinary instructors, and restaurant chefs) in the culinary and hospitality arts program at a large polytechnic in western Canada. **Results:** The emergent themes from these interviews indicated that the circulation of

safety knowledge relied on the interaction among individuals with various levels of experience, such that those who were more experienced in the culinary arts were able to share safety knowledge with novices, who had less experience. Comparing safety knowledge gleaned from within the school against that gleaned from within the industry highlighted differences between the construction of safety in the two contexts. Notably, many aspects of safety knowledge are not learned in school and those that are may not apply in the industry context. We found that safety knowledge was shared through informal means such as storytelling, a process that allowed members to come to a deep, collective understanding of what safety meant, which they often labeled "common sense." Conclusion: We found that safety knowledge was a currency through which participants achieved legitimacy, generated through continual practical accomplishment of the work in interaction with others. **Practical Applications:** Our findings provide novel insights into how safety knowledge is shared, and we discuss the implications of these findings for classroom, work-based learning, and other forms of curricula.

- **Keywords:** Culinary; Injuries; Safety; Safety knowledge sharing

Lei Kang, Akshay Vij, Alan Hubbard, David Shaw. *The unintended impact of helmet use on bicyclists' risk-taking behaviors.* Pages 135-147.

Introduction: Safety is a critical factor in promoting sustainable urban non-motorized travel modes like bicycles. Helmets have shown to be effective in reducing injury severity in bicycle crashes, however, their effects on bicyclists' behaviors still requires deeper understanding, especially amid the emerging trend of using shared bicycles. Risk compensation effects suggest that bicyclists may offset perceived gains in safety from wearing a helmet by increasing risk-taking behaviors. A better understanding of these compensation effects can be useful in assessing various bicycle safety related programs. **Method:** Using a sample of 131 bicyclists from the San Francisco Bay area, this research studies how bicyclists respond with respect to risk-taking behaviors under various urban-street conditions, as a function of helmet use. Study participants were each shown 12 videos, shot in Berkeley, California, from the perspective of a bicyclist riding behind another bicyclist. A fractional factorial experiment design was used to systematically vary contextual attributes (e.g., speed, bike lane facilities, on-street parking, passing vehicles) across the videos. After each video, participants were asked to indicate if they would overtake the bicyclist in the video. With the help of data adaptive estimation techniques, targeted maximum likelihood estimation (TMLE) was applied to estimate the average risk difference between helmeted users and non-users, controlling for self-selection effects. Individual-based nonparametric bootstrap was performed to assess the uncertainty associated with the estimator. **Results:** Our findings suggest, on average, individuals more likely to wear a helmet are 15.6% more likely to undertake a risky overtaking maneuver. **Practical Applications:** This study doesn't try to oppose mandatory helmet laws, but rather serves as a cautionary warning that road safety programs may need to consider strategies in which unintended impact of bicycle helmet use can be mitigated. Moreover, our findings also provide additional evaluation component when it comes to the cost-benefit assessment of helmet-related laws.

- **Keywords:** Risk compensation effects; Bicycle helmet; Risk-taking behavior; Targeted maximum likelihood estimation; Data adaptive estimation

Steven J. Wurzelbacher, Alysha R. Meyers, Michael P. Lampl, P. Timothy Bushnell, Stephen J. Bertke, David C. Robins, Chih-Yu Tseng, Steven J. Naber. *Workers' compensation claim counts and rates by injury event/exposure among state-insured private employers in Ohio, 2007–2017. Pages 148-167.*

Introduction: This study analyzed workers' compensation (WC) claims among private employers insured by the Ohio state-based WC carrier to identify high-risk industries by detailed cause of injury. **Methods:** A machine learning algorithm was used to code each claim by U.S. Bureau of Labor Statistics (BLS) event/exposure. The codes assigned to lost-time (LT) claims with lower algorithm probabilities of accurate classification or those LT claims with high costs were manually reviewed. WC data were linked with the state's unemployment insurance (UI) data to identify the employer's industry and number of employees. BLS data on hours worked per employee were used to estimate full-time equivalents (FTE) and calculate rates of WC claims per 100 FTE. **Results:** 140,780 LT claims and 633,373 medical-only claims were analyzed. Although counts and rates of LT WC claims declined from 2007 to 2017, the shares of leading LT injury event/exposures remained largely unchanged. LT claims due to Overexertion and Bodily Reaction (33.0%) were most common, followed by Falls, Slips, and Trips (31.4%), Contact with Objects and Equipment (22.5%), Transportation Incidents (7.0%), Exposure to Harmful Substances or Environments (2.8%), Violence and Other Injuries by Persons or Animals (2.5%), and Fires and Explosions (0.4%). These findings are consistent with other reported data. The proportions of injury event/exposures varied by industry, and high-risk industries were identified. **Conclusions:** Injuries have been reduced, but prevention challenges remain in certain industries. Available evidence on intervention effectiveness was summarized and mapped to the analysis results to demonstrate how the results can guide prevention efforts. **Practical Applications:** Employers, safety/health practitioners, researchers, WC insurers, and bureaus can use these data and machine learning methods to understand industry differences in the level and mix of risks, as well as industry trends, and to tailor safety, health, and disability prevention services and research.

- **Keywords:** Surveillance; Prevention; Injury cause; Insurance; Machine learning

Celestin Missikpode, Cara J. Hamann, Corinne Peek-Asa. *Association between driver and child passenger restraint: Analysis of community-based observational survey data from 2005 to 2019. Pages 168-172.*

Introduction: Crash data suggest an association between driver seatbelt use and child passenger restraint. However, community-based restraint use is largely unknown. We examined the association between driver seatbelt use and child restraint using data from a state-wide observational study. **Methods:** Data from Iowa Child Passenger Restraint Survey, a representative state-wide survey of adult seat belt use and child passenger safety, were analyzed. A total of 44,996 child passengers age 0–17 years were observed from 2005 to 2019. Information about driver seatbelt use and child restraint was directly observed by surveyors and driver age was reported. Logistic regression was used to examine the association between driver seatbelt use and child restraint adjusting for vehicle type, community size, child seating position, child passenger age, and year. **Results:** Over the 15-year study period, 4,114 (9.1%) drivers were unbelted, 3,692 (8.2%) children were completely unrestrained, and another 1,601 (3.6%) children were improperly restrained (analyzed as unrestrained). About half of unbelted drivers had their child passengers unrestrained (51.8%), while nearly all belted drivers had their child passengers properly restrained (92.3%). Compared with belted drivers, unbelted drivers had an 11-fold increased odds of driving an unrestrained child passenger (OR = 11.19, 95%CI = 10.36, 12.09). The association between driver seatbelt use and child restraint was much stronger among teenage drivers. Unbelted teenage drivers were 33-fold more

likely (OR = 33.34, 95%CI = 21.11, 52.64) to have an unrestrained child passenger. Conclusion: These data suggest that efforts to increase driver seatbelt use may also have the added benefit of increasing child restraint use. **Practical applications:** Enforcement of child passenger laws and existing education programs for new drivers could be leveraged to increase awareness of the benefits of seatbelt use for both drivers themselves and their occupants. Interventions aimed at rural parents could emphasize the importance of child safety restraints.

- **Keywords:** Child safety restraint; Driver seatbelt; Rural areas, urban areas

Milad Haghani, Ali Behnood, Oscar Oviedo-Trespalacios, Michiel C. J. Bliemer. *Structural anatomy and temporal trends of road accident research: Full-scope analyses of the field. Pages 173-198.*

Introduction: Scholarly research on road accidents over the past 50 years has generated substantial literature. We propose a robust search strategy to retrieve and analyze this literature. **Method:** Analyses was focused on estimating the size of this literature and examining its intellectual anatomy and temporal trends using bibliometric indicators of its articles. **Results:** The size of the literature is estimated to have exceeded N = 25,000 items as of 2020. At the highest level of aggregation, patterns of term co-occurrence in road accident articles point to the presence of six major divisions: (i) law, legislation & road trauma statistics; (ii) vehicular safety technology; (iii) statistical modelling; (iv) driving simulator experiments of driving behavior; (v) driver style and personality (social psychology); and (vi) vehicle crashworthiness and occupant protection division. Analyses identify the emergence of various research clusters and their progress over time along with their respective influential entities. For example, driver injury severity " and crash frequency show distinct characteristics of trending topics, with research activities in those areas notably intensified since 2015 Also, two developing clusters labelled autonomous vehicle and automated vehicle show distinct signs of becoming emerging streams of road accident literature. **Conclusions:** By objectively documenting temporal patterns in the development of the field, these analyses could offer new levels of insight into the intellectual composition of this field, its future directions, and knowledge gaps. **Practical Applications:** The proposed search strategy can be modified to generate specific subsets of this literature and assist future conventional reviews. The findings of temporal analyses could also be instrumental in informing and enriching literature review sections of original research articles. Analyses of authorships can facilitate collaborations, particularly across various divisions of accident research field.

- **Keywords:** Road trauma; Road crashes; Traffic safety; Road safety; Scientometrics

Peijie Wu, Li Song, Xianghai Meng. *Influence of built environment and roadway characteristics on the frequency of vehicle crashes caused by driver inattention: A comparison between rural roads and urban roads. Pages 199-210.*

Introduction: With prevalent and increased attention to driver inattention (DI) behavior, this research provides a comprehensive investigation of the influence of built environment and roadway characteristics on the DI-related vehicle crash frequency per year. Specifically, a comparative analysis between DI-related crash frequency in rural road segments and urban road segments is conducted. **Method:** Utilizing DI-related crash data collected from North Carolina for the period 2013–2017, three types of models: (1) Poisson/negative binomial (NB) model, (2) Poisson hurdle (HP) model/negative binomial hurdle (HNB) model, and (3) random intercepts Poisson hurdle (RIHP) model/random intercepts negative binomial hurdle (RIHNB) model, are applied to

handle excessive zeros and unobserved heterogeneity in the dataset. **Results:** The results show that RIHP and RIHNB models distinctly outperform other models in terms of goodness-of-fit. The presence of commercial areas is found to increase the probability and frequency of DI-related crashes in both rural and urban regions. Roadway characteristics (such as non-freeways, segments with multiple lanes, and traffic signals) are positively associated with increased DI-related crash counts, whereas state-secondary routes and speed limits (higher than 35 mph) are associated with decreased DI-related crash counts in rural and urban regions. Besides, horizontal curved and longitudinal bottomed segments and segments with double yellow lines/no passing zones are likely to have fewer DI-related crashes in urban areas. Medians in rural road segments are found to be effective to reduce DI-related crashes. **Practical Applications:** These findings provide a valuable understanding of the DI-related crash frequency for transportation agencies to propose effective countermeasures and safety treatments (e.g., dispatching more police enforcement or surveillance cameras in commercial areas, and setting more medians in rural roads) to mitigate the negative consequences of DI behavior.

- **Keywords:** Driver inattention; Crash frequency analysis; Built environment; Hurdle models

Jacob Mathew, Rahim F. Benekohal. *Highway-rail grade crossings accident prediction using Zero Inflated Negative Binomial and Empirical Bayes method. Pages 211-236.*

Introduction: Recently the Federal Railroad Administration (FRA) released a new model for accident prediction at railroad grade crossings using a Zero Inflated Negative Binomial (ZINB) model with Empirical Bayes (EB) adjustments for accident history (2). This new model is adopted from the work that was conducted by the authors (3–6). The unique feature of the new FRA model is that it has a single equation for all three warning devices (crossbuck, flashing light, and gates) and uses the same variables regardless of the warning devices at the crossing. Since the New FRA model incorporates the warning device category as one of the variables in its model equation, the predicted accident frequency is higher when a crossing has crossbucks than flashing lights, and higher when it has flashing lights than gates. While this model is significantly better than the old USDOT model (7), its shortcoming is that the single equation does not accurately represent the field condition. **Method:** This paper presents the ZINEBS model (Zero Inflated Negative binomial with Empirical Bayes adjustment System). The ZINEBS model gives three different equations depending on the type of warning device used at the crossings (gates, flashing lights, and crossbucks). The three equations use variables, some of which are common across all warning devices, while other variables are specific to a warning device. The predicted values for the ZINEBS model show a closer agreement with the field data than the new FRA model. This observation was true for all three warning device types analyzed. **Practical Applications:** Based on the results of this study, the ZINEBS compliments the new FRA model and should be used when the single equation is not adequately representing the role of traffic control device types and relevant variables associated with that device type.

- **Keywords:** Accident prediction; Highway rail grade crossings; Empirical Bayes; Zero-inflated negative binomial

Austin Valentine Angulo, Brian L. Smith. *Evaluation of driver performance with a prototype cyber physical mid-block crossing advanced warning system. Pages 237-245.*

Introduction: Using connected vehicle technologies, pedestrian to vehicle (P2V) communication applications can be installed on smart devices allowing pedestrians to communicate with drivers by broadcasting discrete safety messages, received by drivers

in-vehicle, as an alternative to expensive fixed-location physical safety infrastructure. **Method:** This study consists of designing, developing, and deploying an entirely cyber-physical P2V communication system within the cellular vehicle to everything (C-V2X) environment at a mid-block crosswalk to analyze drivers' reactions to in-vehicle advanced warning messages, the impacts of the advanced warning messages on driver awareness, and drivers' acceptance of this technology. **Results:** In testing human subjects with, and without, advanced warning messages upon approaching a mid-block crosswalk, driver reaction, acceptance, speed, eye tracking data, and demographic data were collected. Through an odds ratio comparison, it was found that drivers were at least 2.44 times more likely to stop for the pedestrian with the warning than without during the day, and at least 1.79 times more likely during the night. Furthermore, through binary logistic regression analysis, it was found that driver age, time of the day, and the presence of the advanced warning message all had strong, significant impacts with a confidence value of at least 98% ($p < 0.02$) on the rate at which drivers stopped for the pedestrian. **Conclusions:** The results from this study indicate that the advanced warning message sent within the C-V2X had a strong, positive impact on driver behavior and understanding of pedestrian intent. **Practical Applications:** Pedestrian crashes and fatality rates at mid-block crossings continue to increase over the years. Connected vehicle technology utilizing smart devices can be used as a means for communications between pedestrians and drivers to deliver safety messages. State and local city planners should consider geofencing designated mid-block crossings at which this technology operates to increase pedestrian safety and driver awareness.

- **Keywords:** Pedestrian; Connected vehicle; Safety; Cellular; Message; Cyber physical system

Seyed Alireza Samerei, Kayvan Aghabayk, Nirajan Shiwakoti, Amin Mohammadi. *Using latent class clustering and binary logistic regression to model Australian cyclist injury severity in motor vehicle–bicycle crashes. Pages 246-256.*

Introduction: In recent years, Australia is seeing an increase in the total number of cyclists. However, the rise of serious injuries and fatalities to cyclists has been a major concern. Understanding the factors affecting the fatalities and injuries of bicyclists in crashes with motor vehicles is important to develop effective policy measures aimed at improving the safety of bicyclists. This study aims to identify the factors affecting motor vehicle-bicycle (MVB) crashes in Victoria, Australia and introducing effective countermeasures for the identified risk factors. **Method:** A data set of 14,759 MVB crash records from Victoria, Australia between 2006 and 2019 was analyzed using the binary logit model and latent class clustering. **Results:** It was observed that the factors that increase the risk of fatalities and serious injuries of bicyclists (FSI) in all clusters are: elderly bicyclist, not using a helmet, and darkness condition. Likewise, in areas with no traffic control, clear weather, and dry surface condition (cluster 1), high speed limits increase the risk of FSI, but the occurrence of MVB crashes in cross intersection and T-intersection has been significantly associated with a reduction in the risk of FSI. In areas with traffic control and unfavorable weather conditions (cluster 2), wet road surface increases the risk of FSI, but the areas with give way sign and pedestrian crossing signs reduce the risk of FSI. **Practical Applications:** Recommendations to reduce the risk of fatalities or serious injury to bicyclists are: improvement of road lighting and more exposure of bicyclists using reflective clothing and reflectors, separation of the bicycle and vehicle path in mid blocks especially in high-speed areas, using a more stable bicycle for the older people, monitoring helmet use, improving autonomous emergency braking, and using bicyclist detection technology for vehicles.

- **Keywords:** Motor vehicle-bicycle crashes; Bicyclist injury severity; Cycling safety; Latent class clustering and binary logit model

Adheesh Kumar Vivek, Tathagatha Khan, Smruti Sourava Mohapatra. *Safety and associated parameters influencing performance of rail road grade crossings: A critical review of state of the art. Pages 257-272.*

Introduction: Railroad grade crossings (RRGCs) have emerged as critical transportation infrastructures from the point of safety and operational aspects because two modes of transportation intermingle at the intersecting zone; the understanding of safety and traffic operation at RRGC is of prime concern while planning and designing this transportation facility. **Method:** In this context, this work tries to comprehend RRGC performance-related parameters from published literature and figure out critical gaps. An international synthesis on the identified potential parameters influencing the RRGC performance (i.e., safety, driver behavior, and operational impact) was carried out by critically reviewing the articles published worldwide. Furthermore, key findings, used variables, analysis methods, research gaps, and recommendations were studied. **Results:** The review revealed that many researchers had explored the driver behavior and safety aspect based on past crash data and violations prevailing at RRGC. However, little research has been done to evaluate the effect of highways' operational characteristics on the performance of RRGC. Moreover, limited investigation has been carried out to understand the dilemma of drivers and the proactive safety evaluation of pedestrians and non-motorized vehicles at RRGC. A total of seven critical research gaps concerning parameters are recognized, facilitating a clear agenda for further research pertaining to RRGC performance.

- **Keywords:** Railroad grade crossing; Driver behavior; Safety; Operational impact; Performance evaluation

Kay Fitzpatrick, Eun Sug Park. *Nighttime effectiveness of the pedestrian hybrid beacon, rectangular rapid flashing beacon, and LED-embedded crossing sign. Pages 273-286.*

Introduction: A large majority of pedestrian fatal crashes occurred during the nighttime. The focus of this research was to identify if the following pedestrian crossing treatments were more or less effective at night: pedestrian hybrid beacon (PHB), rectangular rapid flashing beacon (RRFB), or LED-embedded crossing warning sign (LED-Em). **Method:** For each treatment, two statistical evaluations were used on the staged pedestrian data: ANCOVA models that considered per site mean yield rates and logistic regression that considered the individual driver response to the crossing pedestrian. **Results:** For the PHB, essentially no difference was found between the very high daytime and nighttime driver yielding values. The research found RRFBs to be more effective at night, and the LED-Em to be more effective during the day. Using the results from the logistic regression evaluation, higher driver yielding was observed at LED-Em sites in the lower speed limit group (30 or 35 mph (48.3 or 56.3 kph), with 2 lanes (rather than 4 lanes), with narrow lanes of 10.5 or 11 ft (3.2 or 3.4 m) widths (rather than 11.5 or 12 ft (3.5 or 3.7 m) widths), and lower hourly volumes. The results from the ANCOVA model for LED-Ems also showed a statistically significant difference for yield lines (higher yielding when present). **Conclusions:** This analysis represents the only known study to date on the effectiveness of pedestrian crossing treatments at night. **Practical Applications:** This study provides additional support for the PHB as a treatment because the PHB was found to be highly effective during the nighttime as well as the daytime. The value of using advance yield lines was also demonstrated. The findings offer a caution regarding the use of the LED-Em treatment on higher speed, higher volume, or wider roads.

- **Keywords:** Pedestrian crossings; Driver yielding; Uncontrolled pedestrian crosswalk; Pedestrian traffic control devices

Mathias B. Forrester. *Beach and patio umbrella injuries treated at emergency departments.* Pages 287-291.

Introduction: Beach and patio umbrellas may cause injury. There is limited published information on injuries due to beach and patio umbrellas. This study sought to describe beach and patio umbrella injuries reported to United States emergency departments (EDs). **Method:** An analysis was performed of beach and patio umbrella injuries using data from the National Electronic Injury Surveillance System during 2000–2019. **Results:** An estimated 5,512 beach umbrella injuries and 7,379 patio umbrella injuries were identified. The patient was age 40 years or older in 62.1% of the beach umbrella and 65.1% of the patio umbrella injuries. The patient was female in 68.0% of the beach umbrella and 66.9% of the patio umbrella injuries. Wind was reported involved in 50.6% of the beach umbrella and 27.5% of the patio umbrella injuries. The most frequently reported injuries with beach and patio umbrella injuries, respectively, were laceration (44.0% vs 33.0%), contusions or abrasions (19.8% vs 19.0%), and internal organ injury (16.6% vs 17.0%) and most often affected the head/neck (60.2% vs 44.0%) and upper extremity (16.3% vs 30.1%). **Conclusions:** The majority of patients with beach and patio umbrella injuries treated at EDs were age 40 years or older and most patients were female. For both types of umbrella injury, the most frequently reported injury was laceration followed by contusions or abrasions and internal organ injury, and the body part with the highest proportion of injuries was the head/neck followed by the upper extremity. **Practical Applications:** Persons should use sturdier models of beach or patio umbrella, use a rocking motion to dig into the sand and secure the beach umbrella with a metal anchor and screws, add weight to the bottom of the umbrella, and tilt the umbrella into the wind. Policy-makers should educate the public about the potential dangers of beach and patio umbrellas.

- **Keywords:** Umbrella; Injury; Emergency department; Epidemiology; National Electronic Injury Surveillance System

Jie Yang, Xiaoyu Guo, Minchuan Xu, Lusheng Wang, Dominique Lord. *Alcohol-impaired motorcyclists versus car drivers: A comparison of crash involvement and legal consequence from adjudication data.* Pages 292-303.

Introduction: Driving under the influence (DUI) increases the probability of motor-vehicle collisions, especially for motorcycles with less protections. This study aimed to identify commonalities and differences between criminally DUI offenses (i.e., with a blood alcohol concentration (BAC) of 80 mg/dL or higher) committed by motorcyclists and car drivers. **Methods:** A total of 10,457 motorcycle DUIs and 8,402 car DUIs were compared using a series of logistic regression models, using data extracted from the documents of adjudication decisions by the courts of Jiangsu, China. **Results:** The results revealed that offenders from the high-BAC group (i.e., 200 mg/dL or higher) accounted for more than 20% of the total DUI offenses, and were more likely to be involved in a crash and punished with a longer detention. Motorcyclists had a higher likelihood of crash involvement, and were also more likely to be responsible for single-vehicle crashes associated with higher odds of injury sustained, compared to alcohol-impaired car drivers. In the verdict, motorcycle offenders were more likely to receive a less severe penalty. **Conclusions:** Interventions are clearly required to focus on reducing in the high-BAC group of offenders. For alcohol-impaired motorcyclists, their risks of crash and injury against BAC climb more steeply than the risks for car drivers. The factors including frequent occurrences, uncertainty of detection, and short-term sentences may weaken the deterrence effect of the criminalization of motorcycle DUI. **Practical Applications:** The traffic-related adjudication data support traffic safety analysis. Strategies such as combating motorcycle violations (e.g., unlicensed operators or driving unsafe vehicles), undertaking education and awareness campaigns, are expected for DUI prevention.

- **Keywords:** Driving under the influence; Crash involvement; Adjudication outcomes; Motorcycle; Deterrent effect

Annika Hinze, Jemma L König, Judy Bowen. *Worker-fatigue contributing to workplace incidents in New Zealand Forestry. Pages 304-320.*

Problem: Reports of incidents in dangerous work environments can be analysed to identify common hazards, in turn aiding in the prevention of future accidents. Whilst studies exist that do this, most focus on causes that involve physical risks. In this paper we propose an alternative approach, and illustrate causes of forestry incidents from the perspective of worker-failure and fatigue. **Method:** This paper outlines the analysis of eight years' worth of New Zealand forestry incident data, with a focus on the cause of, and time that, incidents occur. **Results:** This has resulted in two main findings. First, 70% of incidents can be attributed, at least in part, to worker-failures. Second, 78% of worker-failure based causes show indications of fatigue. This indicates that a significant number of forestry incidents are caused by worker-fatigue. Finally, this dataset showed inconsistencies in data quality, similar to those that exist in other datasets. This did not affect our analysis. However, these types of errors have the potential to affect the data quality in the national reporting system. **Impact on industry:** The results from this study will be used in a larger project on detecting fatigue in forestry workers for injury and incident prevention. It is also our hope that other researchers may find these results of interest for further fatigue prevention research in hazardous industries.

- **Keywords:** Data analysis; Worker-failure; Worker-fatigue; Incident reporting; Injury prevention; New Zealand forestry

Xiaoyu Guo, Lingtao Wu, Xiaoqiang Kong, Yunlong Zhang. *Inclusion of phone use while driving data in predicting distraction-affected crashes. Pages 321-328.*

Introduction: Given the tremendous number of lives lost or injured, distracted driving is an important safety area to study. With the widespread use of cellphones, phone use while driving has become the most common distracted driving behavior. Although researchers have developed safety performance functions (SPFs) for various crash types, SPFs for distraction-affected crashes are rarely studied in the literature. One possible reason is the lack of critical distracted behavior information in the commonly used safety data (i.e., roadway inventory, traffic, and crash counts). Recently, the frequency of phone use while driving (referred to as phone use data) is recorded by mobile application companies and has become available to safety researchers. The primary objective of this study is to examine if phone use data can potentially predict distracted-affected crashes. **Method:** The authors first integrated phone use data with roadway inventory, traffic, and crash data in Texas. Then, the Random Forest (RF) algorithm was applied to assess the significance of the feature - phone use while driving - for predicting the number of distraction-affected crashes on a road segment. Further, this study developed two SPFs for distraction-affected crashes with and without the phone use data, separately. Both SPFs were assessed in terms of model fitting and prediction performances. **Results:** RF results rank the frequency of phone use as an important factor contributing to the number of distraction-affected crashes. Performance evaluations indicated that the inclusion of phone use data in the SPFs consistently improved both fitting and prediction abilities to predict distracted-affected crashes. **Practical Applications:** The phone use data provide new insights into the safety analyses of distraction-affected crashes, which cannot be achieved by only using the conventional roadway inventory and crash data. Therefore, safety researchers and practitioners are encouraged to incorporate the emerging data sources in reducing distraction-affected crashes.

- **Keywords:** Distraction-affected crash; Distracted driving; Phone use while driving; Safety performance function

Siu Shing Man, Saad Alabdulkarim, Alan Hoi Shou Chan, Tingru Zhang. *The acceptance of personal protective equipment among Hong Kong construction workers: An integration of technology acceptance model and theory of planned behavior with risk perception and safety climate.* Pages 329-340.

Introduction: The phenomenon that construction workers do not use personal protective equipment (PPE) is a major reason for the high occurrence frequency of accidents in the construction industry. However, little efforts have been made to quantitatively examine the factors influencing construction workers' acceptance of PPE. **Method:** In the current study, a PPE acceptance model for construction workers (PAMCW) was proposed to address the noted need. The PAMCW incorporates the technology acceptance model, theory of planned behavior, risk perception, and safety climate for explaining construction worker acceptance of PPE. 413 construction workers participated in this study to fill out a structured questionnaire. The PAMCW was analyzed using structural equation modeling. **Results:** Results provide evidence of the applicability of the technology acceptance model and theory of planned behavior to the PPE acceptance among construction workers. The positive influence of safety climate and risk perception-severity on attitude toward using PPE was significant. Safety climate positively influences perceived usefulness. Risk perception-worry and unsafe was found to positively affect intention to use PPE. **Practical Applications:** Practical suggestions for increasing construction workers' use of PPE are also discussed.

- **Keywords:** Personal protective equipment; Risk perception; Safety climate; Theory of planned behavior; Technology acceptance model

Patricia Delhomme, Alexandra Gheorghiu. *Perceived stress, mental health, organizational factors, and self-reported risky driving behaviors among truck drivers circulating in France.* Pages 341-351.

Introduction: The growth of the European market for road-freight transport has recently led to important changes. The growing number of foreign pavilion drivers transiting in France, which plays a bridging role among European countries, has influenced the lives of truck drivers by increasing competition, pressure on day-to-day activities, and constraints related to delivery deadlines. Adding this new pressure to those inherent in the road-freight transport sector has raised concerns, especially ones linked to levels of perceived stress by truck drivers. **Method:** With safety concerns in mind, we devised a questionnaire aimed at understanding how French truck drivers and non-French truck drivers, passing through four highway rest areas in France perceive stress, organizational factors, mental health, and risky driving behaviors. A sample of 515 truck drivers took part in the survey (260 French nationals), 97.9% of whom were male. **Results:** The results of a structural equation model indicated that perceived stress can increase self-reported risky driving behaviors among truck drivers. Furthermore, organizational factors and mental health were closely linked to perceived stress. Finally, some differences were found between French and non-French truck drivers with respect to mind-wandering and mental health, and to perceive driving difficulties to overcome and driving skills. **Practical Applications:** Several recommendations based on the findings are provided to policymakers and organizations.

- **Keywords:** European truck drivers in France; Perceived stress; Mental health; Organizational factors; Self-reported risky behaviors

Sherrie-Anne Kaye, Klaire Somoray, David Rodwell, Ioni Lewis. *Users' acceptance of private automated vehicles: A systematic review and meta-analysis. Pages 352-367.*

Introduction: This research systematically reviewed relevant studies on users' acceptance of conditional (Level 3) to full (Level 5) automated vehicles when such vehicles are to be used privately (herein referred to as 'private automated vehicles or private AVs). **Method:** The search followed the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines, and was undertaken in three databases: APA PsycINFO, Transport Research International Documentation, and Web of Science. Articles were required to focus on individuals' acceptance of private SAE Level 3–5 AVs. Acceptance was defined as individuals' attitudes towards or intentions and/or willingness to use AVs in the future. A total of 2,354 articles were identified in the database search. Thirty-five articles were included in the review, six of which included multiple studies and/or comparison groups. **Results:** Most studies (n=31) applied self-reported measures to assess user acceptance together with a range of psychosocial factors predicting such acceptance. The meta-analytic correlations revealed that perceived behavioral control, perceived benefits/usefulness, perceived ease of use, and subjective/social norms had significant positive pooled relationships with attitudes and intentions. Trust and sensation seeking also had significant positive pooled correlations with intentions, while knowledge of AVs had a significant and negative pooled correlation with intentions. Age did not show any significant pooled relationship with attitudes, intentions, or willingness. **Conclusions:** The findings obtained from the systematic review and meta-analysis provide support for psychosocial models to aid understanding of users' acceptance of private AVs. **Practical applications:** Examining acceptance of AVs after participants have experienced these vehicles on closed tracks or open roads would advance contemporary knowledge of users' intentions to use these vehicles in the future. Further, experiencing these vehicles firsthand may also help with addressing any perceived barriers reducing acceptance of future use of private AVs.

- **Keywords:** Autonomous vehicles; Psychosocial factors; Attitudes; Intentions; Willingness

Bonnie Huang, Verity Truelove, Jeremy Davey. *Crash proneness? Predictors of repeat crashes in older drivers. Pages 368-375.*

Introduction: Older drivers are believed to be prone to crashes due to age-related deterioration of their driving abilities. Currently, little is known about the characteristics of repeat crashers and the factors that predict subsequent crashes among these older drivers. **Method:** A dataset containing the records of crash events that occurred between January 2014 and November 2019 was provided by the Department of Transport and Main Roads (DTMR) in Queensland, Australia. This dataset included 16,973 records of older drivers involved in a single crash and 222 cases in multiple crashes, comprising a total of 17,195 cases. Descriptive and inferential analyses were performed to understand the characteristics of repeat crashers. Survival analysis techniques were used to determine risk factors predictive of subsequent crashes. **Results:** Nearly half (46%) of the repeat crashers were culpable for both of their crashes. Their average age was significantly older than those who were culpable for none or one of their crashes. For older male drivers, riding a motorcycle or driving a heavy vehicle were significant risk factors for having a subsequent crash. The risk for female at-fault drivers being involved in a subsequent crash was 4.53 times greater than those not at-fault. Older female drivers involved in crashes caused by slowing or stopping also presented a higher risk of being involved in subsequent crashes. **Conclusions:** This study identified risk factors for older drivers being involved in repeat crashes; distinctive gender differences in the risk for involvement in repeat crashes were found. **Practical Applications:** To reduce the likelihood of older drivers being involved in subsequent crashes, attention should be

directed towards elders living in major cities, male motorcycle riders and heavy vehicle drivers, and at-fault female drivers.

- **Keywords:** Repeat crashers; Crash culpability; Gender; Risk factors; Survival analysis

Eduardo Romano, James Fell, Kaigang Li, Bruce G. Simons-Morton, Federico E. Vaca. *Alcohol-related deaths among young passengers: An analysis of national alcohol-related fatal crashes. Pages 376-382.*

Introduction: There is consensus that riding with an impaired driver (RWI) constitutes a major threat to public health. The aim of this study was to characterize the factors contributing to the motor-vehicle deaths of 15–20 year-old (y/o) passengers that RWI with a peer. **Method:** Secondary analyses of the 2010–2018 Fatality Analysis Reporting System. 5,673 passengers aged 15–20 y/o killed while riding in passenger cars with a driver aged 21 or older, 3,542 of these drivers also aged 15–20 y/o. Analyses were conducted between October 2019 and December 2020. **Results:** Sixty-three percent of the young passengers were killed while riding with a driver 15–20 y/o. Of these drivers, 26.8% had a blood alcohol concentration (BAC) >0.00 g/dL and 77.1% had a BAC \geq 0.08 g/dL. Compared with those occurring during the day on weekdays, fatalities of young passengers who RWI with a peer driver with a BAC \geq 0.08 g/dL often occurred on weekend nights (OR = 8.2) and weekday nights (OR = 5.2), and when the passenger and driver were both male (OR = 1.8). Race/ethnicity was not a significant contributor to RWI fatalities. **Conclusions:** Most 15–20 y/o RWI fatalities occurred on weekends, at night, when the driver was a young peer with a high BAC, and the passenger and driver were male. The high prevalence of fatalities in these high-risk situations suggests that young driver-passenger dynamics may contribute to alcohol-related fatalities. **Practical Applications:** To curb RWI fatalities among underage passengers, countermeasures should focus not only on underage drinking drivers and riders, but also on drinking drivers of all ages. Prevention should increase focus on situations in which both the young passenger and young driver are males.

- **Keywords:** Alcohol-related crashes; Riding with an impaired driver; Adolescents; Passengers 5–20 years old