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The Chronicle for Driver Education Professionals

Allen Robinson, Ph.D.
Chief Executive, ADTSEA
(724) 801-8246 (Office)
(724) 349-5042 (Fax)
arrobin@adtsea.org
www.adtsea.org

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Publishing Information
Send article submissions to:
John Palmer, Ph.D., Editor
832 Halliday Road
St. Cloud, MN 56301
palmertss@cloudnet.com

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Greetings to ADTSEA Members

Fred Nagao, ADTSEA President

As 2011 begins I would like to reflect on a few of ADTSEA's challenges for this year.

ADTSEA currently has members from public schools, privately owned driver education schools, and commercial schools. At one time all of our members were public school teachers. This new membership demographic reflects how driver education is changing. Continued membership growth is essential to strengthen our organization. Membership recruitment and retention is a top priority. The Executive Board will be exploring ways to accomplish this goal.

The conference of 2010 (St. Louis) helped us to open communication between the Headquarters, Board of Directors, State Presidents and the members. Some of us may be electronically challenged but this should not stop us in keeping a list of your current email address. This can provide you with instant information at the sender's fingertips.

Newsletters and mailings can be expensive so if we can get everyone to click on to the website: www.adtsea.org information can be retrieved instantly. You are also provided with links to other websites and provided an opportunity for online ordering at the ADTSEA store.

The Conference Committee is at work to provide attendees a very meaningful and worthwhile experience: Hawaii 2011. The Host Committee is working at providing a memorable experience for everyone.

With these few items in mind let us give the leadership your support to provide a topnotch organization.

News from the CEO

Allen Robinson, Ph.D., CEO

We have turned the corner and the date is 2011. ADTSEA has been in our new office for one year. Budgets are stable and the outlook for 2011 is positive.

Driver education programs throughout the nation are continually challenged by budget problems. While the economy is improving the change has not yet benefitted driver education.

At the end of 2010 the ADTSEA office received verbal approval of a cooperative agreement with National Highway Traffic Safety Association (NHTSA). This agreement will allow us to begin working on the new ADTSEA 3.0 Curriculum and a Strategic Plan for Driver Education. Other projects will follow throughout the four year agreement.

Another significant project is the NHTSA Driver Education Assessment Project. This project is managed by NHTSA staff and the purpose is to assess how well a state measures up to the National Driver Education Standards. To date, Maryland and Oregon have completed this assessment. If your state is interested in a Driver Education Assessment please contact Jim Wright at NHTSA.

Plans are on target for the National Student Safety Program Conference and the ADTSEA Conference to be held in Honolulu, Hawaii. The NSSP Conference is July 15 – 18, 2011 and the ADTSEA Conference is July 16 – 20, 2011.

Information on both conferences can be found at www.adtsea.org.

On the website you will also find a list of candidates for regional and national offices. Ballots for these offices will be mailed prior to March 1, 2011.

As you read this issue of The Chronicle for Driver Education Professionals online please consider submitting your own article for the next issue. Your article can be sent either to Dr. John Palmer palmertss@cloudnet.com or Dr. Dale Ritzel at dritzel@siu.edu. Help us make this your Chronicle for Driver Education.

Development of a Second-stage Novice Driver Education and Training Program

M. Jensen, J. Wagner, Ph.D., P.E., F. Switzer, Ph. D., K. Alexander, Ed.D., and P. Pidgeon, Ed. D., D. Min. - Department of Mechanical Engineering, Psychology Department, and Automotive Safety Research Institute, College of Engineering and Science, and College of Business and Behavioral Science, Clemson University, K. Rogich, Richard Petty Driving Experience

ABSTRACT: Novice drivers are overrepresented in traffic crashes and fatalities. Traffic crashes are the leading cause of death for 16 to 20 year olds and account for one in three deaths in this age group (NHTSA, 2008; CDC, 2010). Significant research has been conducted developing and analyzing driver education and training and education programs. Effective programs identify their target audiences and tailor the program paradigm and methods to their developmental needs. This paper develops a second-stage safe driver program for novice drivers focusing on classroom and behind-the-wheel instruction for four common driving skills and situations: braking, avoiding obstacles, losing control, and tailgating. Based on a review of the available research, four modules are outlined which integrate best practices and training tools aimed to improve not only driver knowledge but behavior, awareness, and driving skills as well.

1. INTRODUCTION

Driver education and training is a necessary and important aspect of vehicle operation and general mobility. During 2006, the 12.7 million 16-20 year old drivers represented 6 percent of the nation's licensed drivers; about 2 million new drivers, mostly teens begin driving each year (NHTSA, 2008a). While nearly all eligible US students received driver education coursework during the 1970s, by 2008 driver education was offered in only 30 states and the District of Columbia as a requirement of the Graduated Licensing program (NHTSA, 2008b). All 50 states and the District of Columbia implement some form of a GDL program; all have a minimum age to start licensure and most include night and passenger restrictions, along with specified supervised driving documentation and learner permit holding periods. Requirements vary state by state, but generally a minimum of thirty (30) classroom hours and six (6) behind-the-wheel hours of instruction are required before a beginner driver is eligible to attempt licensure for vehicle operation (Bishop *et al.*, 2005). More recently, many states have removed mandatory driver education for young drivers. States that have eliminated these local and/or state government-funded driver education programs rely more heavily on parental involvement and graduated driver licensing (GDL) programs for driver development. Further, they use driving examinations for driver competency testing (Senserrick, 2007). As of 2005, all 50 states and the District of Columbia have implemented some form of a GDL program (Williams & Mayhew, 2008). GDL programs focus on restricting young drivers (under 18 years of age) from certain high-risk situations for a specified amount of time, providing young drivers with real-world driving experience, and allowing them to practice under safer conditions. For instance, GDL-imposed driving restrictions include nighttime driving, driving with multiple passengers, and unsupervised driving during certain hours (Insurance Institute for Highway Safety, 2010). Over time, and assuming violation free status, the GDL restrictions are reduced and/or eliminated.

Recent developments in driver education and training have focused on a multistage instructional design (Mayhew, 2007). In 1994, the National Highway Traffic Safety Administration (NHTSA) suggested the merits of a multistage novice driver education and training to take advantage of the time delay for driving privileges in GDL. The proposed multistage education and training should offer classroom and behind-the-wheel training progressively at different points during licensure. The first stage of driver education and training should occur early in the driver licensing program when students have obtained the learner's permit. During this stage the novice driver education and training would involve formal driver education with instruction in general knowledge, rules of road, and basic vehicle handling conducted during learner phase of GDL. The second-stage of education and training should

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ideally occur after the students have had at least 6 months of driving experience with an intermediate/provisional license. Thus, second-stage driver education and training is designed to complement the supervised driving with parents in order to provide instruction in safe driving procedures including risk perception and decision-making skills.

The theoretical basis for a multistage driver education and training program is consistent with research in adolescent development which has demonstrated that the learning goals for the driving task should be spread out over time due to both the student's inadequate cognitive abilities as well as their lack of readiness to learn (Mynttinen, 2010; Gregersen et al. 2000; Gregersen, 1994; McKnight, 1985). According to Mayhew and Simpson (2002), it is important for novice drivers to have experience in real world driving in order for instruction in safe driving to be more meaningful. The authors further suggest that a second-stage of driver training should address the following key areas: (a) psychomotor, cognitive, and perceptual skills; (b) safe driving practices; (c) personal limitations and skill deficiencies; (d) overconfidence in training skills; and (e) lifestyle and psychosocial factors.

Beyond formal driver education, supplemental or second -stage training programs ranging from brief internet courses to intensive multi-day in-vehicle programs have been developed (Mayhew, 2007). According to Foss (2007), programs focused on increasing students' driving safety level should address human behaviors equally or to a greater extent than driving skills and knowledge. These courses should moreover include targeted content appropriate for the given demographic. For novice or inexperienced drivers, content related to visual searching, attention errors, and overall vehicle speed should be included (McKnight, 2006). Additionally, training in both risk assessment and risk management should be considered necessary components of any second-stage training program (Mynttinen, 2010; Rosenbloom et al., 2008; Fisher et. al., 2006).

It should be noted that some studies have suggested that programs attempting to increase driver safety by means of increasing driver skill levels may at best be ineffective and can increase the student's crash risk (Senserrick, 2007). This higher crash risk is thought to be due to the fact that advanced driving skills courses may unintentionally encourage overconfidence and increased risk taking on the part of participants (Katila *et al.,* 1996). However, more recent studies have offered a favorable view of designing a driver skills education and training program which avoids increasing overconfidence in its participants (Rosenbloom *et al.,* 2008). Such a course should give priority to instruction in anticipatory driving strategies while at the same time teaching maneuvering skills (Katila *et al.,* 2004).

This paper discusses the development of a second-stage safe driving program that includes both classroom and behind-the-wheel curriculum. First, we present a brief review of the literature on curriculum development in driver skills and education training programs. Second, we discuss the development of the novice driver education and training program curriculum. And, finally, we present conclusions.

2. LITERATURE REVIEW

Historically, driver education was considered to be the best method for teaching basic driving skills to novice drivers (Warner, 1972). In the United States, driver education has traditionally been administered through the public school system and taught by instructors with varying qualifications. The driver education programs in the 1940s and 50s were designed to teach basic driving skills and knowledge required to pass the state-regulated driver examinations (written and behind-the-wheel). Driver education and training programs increasingly began to address other critical objectives as a more systematic examination of the driving task occurred in the early 1960s. Curricular areas focusing on motivation, hazard perception, risk evaluation, and risk acceptance were added in the 60s and became normative by the 1970s. The total amount of instructional time scheduled in driver education programs has not varied much since the first national conference on Safety Education recommended 30 (classroom) and 6 (behind the wheel). (Palmer, 1981). An expectation that students were practicing driving

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skills with their parents/guardians outside of formal training environment has been common among driver education instructors and many driver education instructors have made guided practice and assignment between behind the wheel driving lessons. Current estimates for the total amount of supervised teen driving needed to prepare a novice driver range from 40 to 75 hours (Simons -Morton & Ouimet, 2006).

Recently, many countries have seen an increased demand for programs offering specialized instruction and improved driving skills training for novice drivers. This increase has led the European Commission to publish the "Summary and Publication of Best Practices in Road Safety" in the EU Member States (SUPREME, 2007). The SUPREME report found that then current formal pre-license driving schools had a limited safety benefit while advanced post-license skills training trended to have a negative safety impact.

The DeKalb County (Georgia, USA) driver education study (NHTSA, 1983) found no statistically significant positive safety impacts for driver education. Several evaluations of the original DeKalb dataset have been conducted since the early 1980's (Lund *et al.,* 1986; Smith & Blatt, 1987; de Wolf and Smith, 1988; and Davis, 1990) and each concluded that formal driver education was not associated with any reduction of crash involvement by young drivers within two (2) years of training. Jones and McCormac (1989) examined crash rates in Oregon for trained and untrained drivers, finding no significant difference in crash involvement within one (1) year after licensure. Gregersen (1994) evaluated a Swedish driver training program and found that crash rates were higher for trained drivers in the first year post-licensure, but were slightly reduced in the second year. The net effect of the program after two years was negligible. Mayhew *et al.* (1998) note that other similar studies have reached the same conclusion.

One study conducted in Denmark by Carstensen (1994) analyzed a newly adopted mandatory driver education program for young drivers. Unlike previous studies, Carstensen concluded the program yielded a positive reduction in crash rates. However, the study was completed under less than ideal conditions utilizing a quasi-experimental design that examined before and after groups. Regardless of the research design, the Denmark study has remained the best evidence of a positive effect on novice driver safety by a driver education and training program. A follow up study (Carstensen, 2002) used a different subject group and longer driving history to confirm the earlier results of the Denmark training program.

The American Driver and Traffic Safety Education Association (ADTSEA) has developed a formal driver education program used by many USA school districts. The program provides suggestions for in-class and behind-the-wheel programming using a best-practices approach to novice driver training. Williams *et al.* (NHTSA, 2009a) examined the feasibility of evaluating the ADTSEA program using a complete and randomly assigned study (similar to the DeKalb project). The paper concluded that such a study would be prohibitive due to cost, necessary group size, and difficulty of obtaining participating schools and students. Moreover, ADTSEA through the National Driver Education Standards Project released *Novice Teen Driver Education and Training Standards* in 2009. This effort has resulted in a tool which is intended to assist driver education and training professionals in advancing best practices (NHTSA, 2009b).

New research on development of driver education and training has focused on motivation, or insight training, where a driver's knowledge of their limitations and behaviors allow them to change their driving style to suit a given scenario (MacNeil, 2007). Insight training seeks to impart in participants a greater appreciation for personal driving skill sets or lack thereof. For young drivers especially, this self-awareness is underdeveloped and should be incorporated into any driver education and training program, most notably second-stage driver education programs aimed at improving driver safety during the intermediate stage of the licensing process.

Similarly, recent research in teen driving safety from the perspective of adolescent development has suggested promising avenues for enhancing the acquisition of safe driving skills. While it remains true that expertise in safely maneuvering a motor vehicle is developed over time,

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research also indicates that initial training in correctly acquiring these skills is extremely important to embedding the desired patterns of behavior (Keating, 2007). Furthermore, it is clear that instruction in maneuvering skills for novice drivers must be secondary to stronger emphasis on the acquisition of anticipatory safe driving strategies (Rosenbloom *et al.,* 2008). Additionally, pedagogy must be aimed at helping participants avoid overconfidence and risk-taking behaviors in the driving task (Hatakka *et al.,* 2002).

Recent studies have only begun to show a renewed interest in evaluating the effectiveness of novice driver education and training programs (Lonero & Mayhew, 2010). The questions as to what skills and knowledge should be taught, how best to teach those skills and knowledge, and how much practice is necessary in driver education and training have yet to be definitively answered. In order to increase driver/occupant safety, a successful education and training program will have to be developed using a research- and theory-based approach that utilizes previous research, best-practices, and new (or new to the field) technologies and emphasizes content and teaching methods, with possible inclusion of student assessment (both short-term and long-term) (Lonero & Mayhew, 2010).

3. SAFE DRIVING PROGRAM (SDP)

During development of the Petty Safe Driving Program (SDP), a second-stage novice driver education and training program, teen drivers were targeted due to their driving inexperience and underdeveloped skill set. This pilot program was designed to improve driver safety through improved classroom and behind-the-wheel training with emphasis on program delivery and content. One of the underlying assumptions was that students learned fundamental vehicle operation skills and safety guidelines prior to enrollment in the SDP. The SDP course offered supplemental education and training in anticipatory safe driving strategies regarding the leading causes of automotive crashes through classroom and in-vehicle training. In addition, meaningful feedback was provided to students through written and performance evaluation. Section 3.1 of this paper discusses the paradigm used for the program delivery while section 3.2 introduces the content for the driving and classroom modules.

3.1 Paradigm

Effective delivery was critical for the program to be successful, while efficient use of time and space was equally important. The developed SDP totals six (6) hours and consists of a 30 minute opening, four (4) 75 minute long modules, and a 30 minute conclusion. Equal time was given to classroom and behind-the-wheel curriculum with the presented materials reinforcing each other. The 50/50 ratio of classroom and behind-the-wheel time departed from a formal driver education course; however, the SDP was designed to provide supplemental instruction/practice rather than fundamental instruction. The classroom time was used to emphasize important knowledge and behaviors for safe driving while the behind-the-wheel instruction focused on skill development.

Each of the four modules included goals and objectives, introduction, demonstration, driving instruction and guided-practice, classroom activities, and assessment. During the driving portion, students practiced skills with in-vehicle instructors who provided one-on-one instruction to each student. In order to promote best practices (Lonero & Mayhew, 2010; NHTSA, 2009b; SUPREME, 2007; Williams *et al.,* 2009), instructors acted as coaches, providing verbal feedback and corrections throughout the training rather than basic instructions. The skills training and classroom curriculum reinforced each other without being dependent on one another. A single classroom instructor was used to focus discussions and introduce driving strategies and methodologies normally undertaken by more experienced drivers. A more detailed discussion of the materials is presented in section 3.2.

All classroom and in-vehicle instructors had completed a training course directly related to novice driver training. This course included methodologies for educating teenagers, an overview of all SDP materials, and step-by-step discussion of each driving module.

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In order to provide a safe and controlled environment for the driving portions of the program, a closed course of at least 450 meters (m) (1500 ft) by 610 m (2000 ft) was suggested. Ideally the location should be relatively flat without any obstacles such as concrete barriers or light poles present. Typically large open parking lots were considered suitable.

3.2 Modules

Four modules were developed for the SDP including: braking skills, reaction time / obstacle avoidance, loss of control, and tailgating. These modules were identified in order to address major contributing factors for teen crashes both in the southeastern states (primary locations for the program) and nationwide. The contributing factors for teen crashes were determined using the Fatality Analysis Reporting System (FARS) which contained data on all fatal crashes within the 50 states, District of Columbia, and Puerto Rico. Each module was designed as a 75 minute stand-alone course with a 10 minute introduction/ demonstration, 30 minutes of behind-the-wheel activities, 30 minutes of classroom material, and a 5 minute conclusion.

Braking Skills: The primary driving skill for safe driving was the use of proper braking techniques. The inclusion of anti-lock braking systems (ABS) in modern vehicles has reduced the difficulty associated with repeatable, maximum (emergency) stopping; however, not all vehicles (including brand new vehicles) are equipped with ABS. Additionally, vehicles equipped with ABS do not stop in as short a distance as possible (Alleyne, 1997). These conditions, along with novice drivers' lack of experience with emergency braking, had lead to the inclusion of a braking skills module in the SDP.

Rationale: The braking skills module addressed several contributing fatal crash factors for teen drivers including: driving too fast for conditions, running off the road, and following improperly.

The purpose of this module was to help novice drivers gain insight into factors that affect braking performance and provide experience and skill development in maximum or threshold braking (i.e., stopping without skidding). In addition, instruction was provided to help participants better understand the limitations of their vehicle's brakes and motivate them to avoid situations in which they were unable to stop their vehicle in time to avoid a crash. Both ABS and non-ABS equipped vehicles were utilized in wet and dry pavement conditions. Participants began by accelerating to a constant speed. At a set point on the track, a stop light was triggered by the vehicle signaling the participant to bring the vehicle to a sudden and complete stop using the vehicle's maximum stopping ability.

Classroom instruction included exercises focused on safe driving judgment and decision making and an overview of vehicle maintenance as a safe driving strategy. Three role-play situations were used to teach awareness of risky driving situations and promote driving strategies for anticipating hazards. Vehicle maintenance was reinforced through presentation displays about vehicle fluids and brake pad wear along with demonstrations on how to check tire pressure and tire tread depth.

Reaction Time / Obstacle Avoidance: The ability to react quickly in an emergency driving situation can often mean the difference between a near miss or a crash and sometimes even life and death. Personal perception or reaction time can be defined as the time it takes a person to visually recognize a stimulus and respond properly (e.g., see the red light, lift foot off gas pedal, and depress the brake pedal). During an obstacle avoidance situation, reaction time and situation awareness (the ability to perceive and think ahead) were the most critical elements for safe maneuvering.

Rationale: The module addressed several contributing crash factors including: driving too fast for conditions, inattentive, failure to obey traffic signals and following improperly.

The driving portion of the module utilized a similar layout to the braking skills module. Wet and dry roadway conditions were used for practicing vehicle maneuvering and braking for the purpose of obstacle avoidance. Three (3) lanes are simulated using traffic cones with the participants beginning the module in the center lane. Participants were instructed to bring the vehicle to a constant speed until a traffic light above each lane illuminated at a

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pre-defined location. The signal light was used to convey the safety level of each lane with green/unlit signifying safe and red identifying potential danger. The participants were asked to maneuver the vehicle as quickly as possible into the correct (safe) lane while either maintaining the vehicle's speed or bringing the vehicle to a complete stop. Exploration of each driver's personal reaction and decision-making skills allowed for participants to better identify the limitations of the vehicle and their own limited driving abilities.

In the classroom, participants applied a four component safe driving strategy - *scan, anticipate, decide, move-countermove* - to several case studies. These case studies used typical traffic conditions and driver behaviors to initiate discussions about the importance of reaction time and situation awareness and how to avoid overconfidence. The importance for all vehicle occupants to use seat belts correctly was also emphasized.

Loss of Control: This module focused on improving participants' skills in loss of control situations, including recognition of loss of traction and use of countermeasures for loss of control in cornering and braking situations.

Rationale: The module addressed contributing crash factors including driving too fast for conditions and inattention, while also focusing on failure to keep in proper lane, over-correction and improper turn.

This module was designed to improve participants' chances of avoiding loss of control situations by providing anticipatory driving strategies such as recognizing advisory curve speed (ACS) signs, scanning farther down the road for obstructions and blind curves, and looking in the direction they want to travel. The module included both a circular skid pad and simulated roadway environment. During the skid pad exercise, participants experienced both front and rear-wheel skids. The roadway portion included three (3) turns (two right-hand, one left-hand) of various radii and traction levels. Several runs performed at different speeds were suggested, providing participants with different simulated scenarios.

In addition to the driving instruction, classroom activities included the hands-on demonstration of how to jump-start a vehicle with a dead battery and a discussion about supplies needed in a vehicle emergency kit. A review of vehicle maintenance tasks and safe driving strategies was conducted in a game format. These activities were all used to reinforce situational awareness in the driving task and underscore drivers' responsibilities.

Tailgating: The tailgating module was designed to complement the braking module, as tailgating may lead to necessary emergency braking and was one of the more common driving errors made by drivers. Additionally, tailgating was a common situation where drivers typically experience no repercussions from dangerous behavior. The lack of consequences can very easily create overconfidence and foster inattention.

Rationale: The module was a more specialized driving module; however, several contributing crash factors were addressed including driving too fast for conditions, inattention, and following improperly.

A custom training tool was developed in conjunction with the driving curriculum in order to better simulate a tailgating scenario (Jensen *et. al.,* 2011). During the in-vehicle instruction, two participant-driven vehicles followed the tailgating apparatus at various distances while maintaining a constant speed. The instructor in the lead vehicle (to which the apparatus is attached) performed sudden emergency braking maneuvers triggering the participants to react and attempt to bring their vehicle to a stop prior to colliding with the apparatus (refer to Figure 1).

Figure 1: Demonstration of the tailgate apparatus during the tailgating module.

In the event of a collision, the apparatus had been designed to absorb low speed impacts without causing damage to either vehicle or the apparatus itself. By allowing

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collisions, participants were able to experience the consequence of poor following techniques without personal injury or vehicle damage. This training experience was designed to directly address overconfidence with respect to actual skills in crash avoidance.

Classroom instruction reinforced the driving materials through a hands-on activity about the blind areas surrounding large vehicles. With a participant seated in the cab of a semi-truck providing direction, other participants used chalk and traffic cones to outline the "No-Zone" in order to gain an appreciation of correct following distances when sharing the road with trucks and busses. In a second exercise, participants referred to vehicle manuals as a tool for discussion regarding safe vehicle operation and maintenance.

4. CONCLUSION

Traffic crashes kill a large number of Americans every year and is the leading cause of death for adolescents. Significant research has been conducted on the impact of driver education and training courses, but few positive results have been found to date. Other studies have been conducted to identify possible best practices for safety focused driver training programs.

This paper has outlined four training modules that constitute the Petty SDP, a second-stage safe driving program focused on improving novice driver safety. Future research efforts should include a pilot test of the new curriculum in order to determine its effectiveness. Assessment of the program's impact should examine the change in participants' knowledge, attitude, and driving behaviors, as well as provide an evaluation of driving performance, perceptual strategies and decision making.

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Traffic Citations According to Selected Demographics, Behaviors, and Injury Severity Factors among Drivers Involved in Crashes in Utah

Steven M. Thygerson, PhD, MSPH, Ray M. Merrill, PhD, MPH, Department of Health Science, College of Life Sciences, Brigham Young University

ABSTRACT

Introduction: When determining the cause of a motor vehicle crash (MVC) from archival data, culpability in the crash was a variable of interest. Estimating culpability helps identify exposure and risk factors for road users. The objective of this study was to assess associations between specific traffic citations and selected factors involved in MVCs.

Methods: Data were obtained from the Utah Department of Transportation, Division of Traffic and Safety, from 1999 through 2005, and linked to statewide emergency department (ED) and hospital admission (inpatient) records.

Results: Drivers involved in crashes who received a citation were more likely to be aged 16-17, male, not wearing a safety belt, intoxicated, fatigued, injured as a result of the crash and to be driving a truck or flatbed truck. Drivers who visited the emergency department following a crash were more likely to be issued a citation for specific types of violations. Specific types of violations issued were associated with increased risk of emergency department visits and hospitalization.

Conclusions: Using information about citations as they relate to driver culpability is important for understanding causal factors in MVCs.

Keywords: Motor vehicle crash, citations, culpability, probabilistic linkage.

INTRODUCTION

Motor vehicle crash (MVC) fatalities in the United States are estimated to be at their lowest rates since 1949 (NHTSA, 2006). Engineering controls, enforcement, and education are factors that have contributed to the lower rates. However, MVCs are still the leading cause of unintentional injury-related deaths (Centers for Disease Control, 2009). There continues to be a primary need to identify and understand factors contributing to crashes through police reports, emergency medical services data, and emergency department and hospital information.

Identifying those who were at fault for the crash and the specific factors involved has been the subject of many crash-related studies. One study determined that female drivers' odds of culpability in a crash with high blood alcohol content was 30.81 compared to males with an odds ratio of 7.47. The same study found that the odds of culpability for drivers with a high blood alcohol content was 17.20 for unbelted drivers and 5.70 for belted drivers (Kufera, Soderstrom, Dischinger, Ho, & Shepard, 2006). In another study, 83% of motorcycle drivers with positive blood alcohol were significantly more likely to cause a crash with injuries involved than motorcyclists without alcohol in their blood (83% vs. 46%) (Soderstrom, Dischinger, Ho, & Soderstrom, 1993). Two additional studies showed the importance of culpability when estimating exposure and risk for road users (af Wahlberg & Dorn, 2007; Cooper, Meckle, & Andersen, 2010).

Receiving a citation is typically an indication of culpability in MVCs (Cydulka, Harmody, Barnoski, Fallon, & Emerman, 1998; Haselkorn, Mueller, & Rivara, 1998). Citations are more commonly given to younger and older drivers (Dulisse, 1997; McCartt, Shabanova, & Leaf, 2003). Is the nature of the citation different according to age? The current study will examine the association between receiving a traffic citation and involvement in crashes when selected demographic, behavior, and injury severity factors are considered. To our knowledge, previous studies have not specifically linked the type of citation given with selected demographic, behavior, and injury severity factors.

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METHODS

Population

This study was based on all reported motor vehicle crashes (MVC) occurring on Utah roads during the years 1999 through 2005. Data were obtained from the Utah Department of Transportation, Division of Traffic and Safety. Data reflected information collected by local law enforcement officers at the scene of the crash using a standard form. In addition to basic demographic information, recorded information included whether a citation was given to the driver, the nature of the citation (if any), specifically whether a safety belt was worn, whether the driver was intoxicated and/or fatigued, whether injuries were sustained, and the vehicle type. The police crash database made several changes in 2006 thereby restricting the years of assessment for the current study to the years prior to this time. Additional information included in the police report described road and weather conditions, road conditions, and vehicle damage descriptions.

MVC data were linked to statewide hospital discharge (inpatient and ED) records, which were obtained from the Utah Health Data Committee/Office of Healthcare Statistics and the Utah Department of Health, to which all licensed EDs in Utah are mandated to submit data. These databases contain billing information for all admissions and discharges, including patient demographics, external cause of injury codes, up to nine International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes, and billed charges.

Drivers who were probabilistically linked with a hospital discharge record were categorized as hospitalized. Safety belt use, driving while intoxicated, and fatigue were dichotomous variables that were defined by police officer reports at the crash scene. Driving while intoxicated included both alcohol and drug intoxication. The use of these databases received approval from the Internal Review Board at Brigham Young University.

Probabilistic linkage

The linked database was constructed by probabilistically linking the MVC database to the ED and hospital inpatient databases for the seven year study period. The probabilistic record linkage is a method that uses variables common to two or more databases to determine the probability that two records refer to the same person and/or event. The ability to link specific crash events to hospital outcome data allows for a more complete analysis of the event. More detailed descriptions of probabilistic linkage have been published previously (Cook, Olson, & Dean, 2001; Jaro, 1995).

Statistical analysis

During the years 1999 through 2005 there were 649,679 reported drivers in crashes in Utah. We excluded 5,610 motorcycle crashes, 198 farm tractors, and 424 crashes with unknown vehicle information, leaving 643,647 for the study. An additional 7,570 drivers in crashes were deleted because they were younger than age 16. This left 636,077 drivers in crashes for analyses. Frequency distributions were calculated for selected variables. Differences in proportions between drivers in crashes who were cited compared with not cited were evaluated using the chi-square test. Rates were obtained by dividing the number of drivers in crashes by the Utah population. Adjusted risk ratios were calculated using Poisson regression. Ninety-five percent confidence intervals for the risk ratios were used to assess the precision of the estimates. Risk ratios were adjusted for age, sex, and calendar year. Analyses were performed using the Statistical Analysis System (SAS) software, version 9.2 (SAS Institute Inc., 2003).

RESULTS

The average age of all drivers in crashes was 34.3 (SD = 16.1), with 231,452 (36.4%) receiving a citation. The frequency distribution of crashes and the risk of receiving a citation according to selected variables are presented in Table 1. The risk of a citation was significantly greatest in the calendar years 2000-2001; among those aged 16-17; among males; among those not wearing a safety belt; among those intoxicated; among those fatigued; among those experiencing an injury; or among those driving a passenger car, single unit enclosed box, truck and trailer, or flatbed. Those visiting the emergency room were significantly less likely to receive a citation and there was no significant association between receiving a citation in general and being hospitalized.

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Table 1. Bivariate analyses of citations by selected variables among drivers in Utah crashes, aged 16 years and older, 1999-2005

			Citation Charged				
			Yes	No	Chi-square		
	No.	Column %	Row%*	Row %*	P value	Risk Ratio*	95% CI*
Calendar Year							
1999	92,188	14.5	37.0	63.0	< 0.001	Referent	
2000	92,446	14.5	37.9	62.1		1.02	1.01-1.04
2001	90,541	14.2	37.7	62.3		1.02	1.01-1.03
2002	90,285	14.2	34.9	65.1		0.95	0.94-0.96
2003	86,126	13.6	36.4	63.6		1.00	0.98-1.01
2004	92,453	14.5	35.5	64.5		0.98	0.96-0.99
2005	92,038	14.5	35.3	64.7		0.07	0.96-0.99
Age							
16-17	59,547	9.4	48.6	51.4	< 0.001	Referent	
18-20	83,961	13.2	45.7	54.3		0.94	0.93-0.95
21-24	94,147	14.8	40.2	59.8		0.83	0.81-0.83
25-29	79,260	12.4	35.3	64.7		0.72	0.71-0.73
30-49	205,188	32.3	31.2	68.8		0.64	0.63-0.65
50-69	88,210	13.9	27.6	72.4		0.56	0.55-0.57
≥ 70	25,764	4.0	38.6	61.4		0.79	0.78-0.80
Gender							
Male	370,003	58.2	37.2	62.8	< 0.001	Referent	
Female	266,074	41.8	35.3	64.7		0.92	0.91-0.93
Safety Belt Use							
Yes	540,248	84.9	35.9	64.1	< 0.001	Referent	
No	40,913	6.4	44.7	55.3		1.18	1.17-1.19
Missing	54,916	8.7	35.2	64.8		0.97	0.96-0.98
Alcohol							
No	598,927	94.2	36.7	63.3	< 0.001	Referent	
Yes	13,833	2.2	85.2	14.8		2.04	2.02-2.05
Missing	23,317	3.7	0	100		--	--
Fatigue							
No	603,768	94.9	37.6	62.4	< 0.001	Referent	
Yes	8,992	1.4	48.9	51.1		1.22	1.19-1.24
Missing	23,317	3.7	0	100		--	--

(continued on page 19)

Table 1. Bivariate analyses of citations by selected variables among drivers in Utah crashes, aged 16 years and older, 1999-2005 continued

			Citation Charged				
			Yes	No	Chi-square		
	No.	Column %	Row%*	Row %*	P value	Risk Ratio*	95% CI*
Severity							
No injury	393,643	61.9	35.5	64.5	< 0.001	Referent	
Possible injury	147,194	23.1	37.7	62.3		1.07	1.07-1.08
Bruises and abrasions	57,687	9.1	39.1	60.9		1.10	1.08-1.11
Broken bones or	34,830	5.5	38.0	62.0		1.06	1.05-1.08
Fatal	2,723	0.4	9.2	90.8		0.26	0.23-0.30
Vehicle Type							
Passenger Car	357,044	56.1	37.9	62.1	< 0.001	Referent	
Pickup Truck	253,942	39.9	35.1	64.9		0.96	0.95-0.97
Tractor Trailer	11,508	1.8	26.8	73.2		0.80	0.78-0.83
Truck†/Flatbed	5,941	0.9	38.4	61.6		1.08	1.05-1.12
Bus	2,333	0.4	18.3	81.7		0.58	0.53-0.63
Mobile Home	778	0.1	23.4	76.6		0.70	0.62-0.80
ATV	495	0.1	15.2	84.8		0.39	0.32-0.48
Other	4,036	0.6	24.9	75.1		0.71	0.68-0.75
Emergency Room Visit							
No	563,116	88.5	12.3	87.7	< 0.001	Referent	
Yes	72,961	11.5	10.0	90.0		0.81	0.80-0.82
Hospitalized							
No	631,137	99.2	0.8	99.2	0.779	1.05	0.99-1.11
Yes	3,133	0.8	0.8	99.2			

*Adjusted for age, gender, and calendar year
†Single unit enclosed box, truck and trailer.

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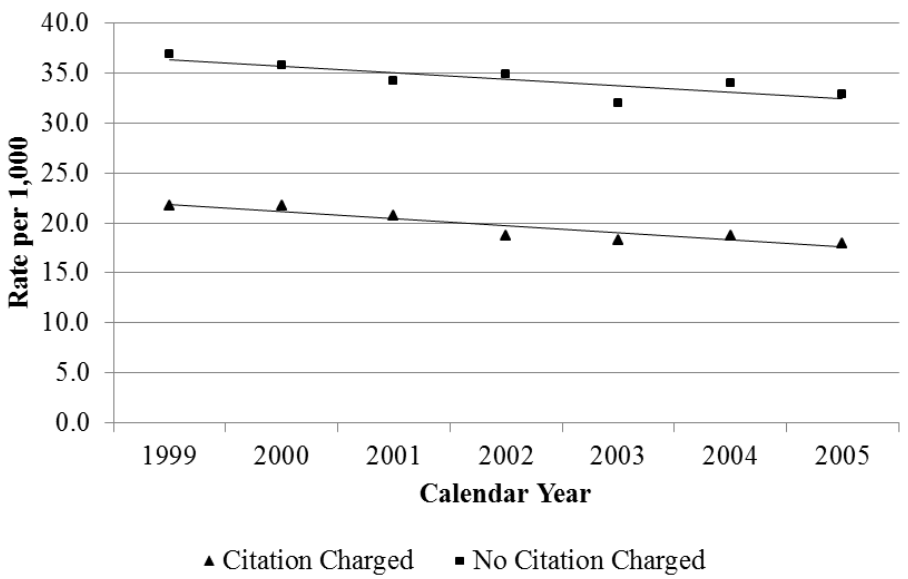
Although Table 1 shows that the number of vehicle crashes remained constant over the study period, the actual crash rates decreased because of the increasing state population (Figure 1). Rates decreased for both crashes involving a citation and crashes not involving a citation. The percent decrease for drivers in crashes that received a citation charge was 17.3%. The percent decrease for drivers in crashes on receiving a citation charge was 10.9%.

Figure 1: Crash rate according to whether a citation was charged, Utah 1999-2005



The frequency distribution of the specific citations given to drivers in crashes is presented in Table 2. The most common citations charged include failure to yield right of way, improper lookout, and following too close. Some of the less common citations included hit and run, improper passing, driving on the wrong side of the road, improper start and stop, driving the wrong way on a one-way street, and vehicle homicide. About four percent of citations involved driving under the influence. Women were significantly more likely than men to be cited for failure to yield right of way, improper lookout, failure to stop at a red light, and failure to observe a stop sign. On the other hand, men were significantly more likely than women to be cited for following too close, speeding, reckless driving, negligent collision, DUI, improper lane change, hit and run, improper backing, improper passing, driving on the wrong side of the road, and vehicle homicide. In addition to DUI, crash cases in which alcohol was involved were significantly more likely to be cited for reckless driving, hit and run, driving the wrong way on a one way street, and vehicle homicide. Finally, crashes in which fatigue was involved were significantly more likely to be cited for reckless driving, negligent collision, DUI, improper lane change, hit and run, driving the wrong way on a one way street, and vehicle homicide.

The risk of visiting the emergency room or of being hospitalized is presented according to citation status for all drivers involved in crashes in Table 3. Crash cases attending the emergency room are significantly more likely to have been cited for not observing a red light, reckless driving, DUI, failing to observe a stop sign, driving on the wrong side of the road, driving the wrong way on a one way road, or vehicle homicide. Hospitalized crash cases were significantly more likely to be cited for speeding, not observing a red light, reckless driving, DUI, improper lane change, failure to observe a stop sign, driving on the wrong side of the road, driving the wrong way on a one way road, or vehicle homicide.

DISCUSSION

In this study, we have described associations between selected types of traffic citations and various factors influencing the cause of motor vehicle crashes. We have also considered associations between selected types of traffic citations and visiting the emergency department or being admitted to the hospital. Primary findings include: (1) drivers involved in crashes who receive a citation are more likely to be aged 16-17, male, not wearing a safety belt, intoxicated, fatigued, experiencing an injury as a result of the crash and to be driving a truck or flatbed truck;

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Table 2. Bivariate analyses of the specific citation by sex, intoxication, and fatigue among drivers in Utah crashes, aged 16 years and older, 1999-2005

			Male to Female Risk of Each Type of Citation		Alcohol to non-Alcohol Risk of Each Type of		Fatigue to non-Fatigue Risk of Each Type of Citation	
	No.	%	Risk Ratio*	95% CI	Risk Ratio†	95% CI	Risk Ratio†	95% CI
Failure to yield right of	43,067	18.6	0.78	0.76-0.79	0.11	0.09-0.14	0.07	0.05-0.09
Improper lookout	41,259	17.8	0.96	0.94-0.97	0.14	0.12-0.17	0.47	0.42-0.52
Following too close	36,204	15.6	1.07	1.05-1.10	0.1	0.09-0.13	0.3	0.26-0.35
Speeding	14,341	6.2	1.43	1.38-1.48	0.31	0.26-0.38	1.03	0.90-1.17
Red light	11,451	5	0.87	0.83-0.90	0.21	0.16-0.28	0.3	0.22-0.39
Reckless driving	10,165	4.4	1.54	1.48-1.60	7.73	7.34-8.14	3.27	2.99-3.56
Negligent collision	9,276	4	1.08	1.04-1.13	0.51	0.42-0.62	2.26	2.02-2.52
Driving under the	8,663	3.7	2.33	2.22-2.45			1.97	1.74-2.22
Improper lane change	7,252	3.1	1.19	1.14-1.25	0.46	0.36-0.57	5.33	4.90-5.80
Improper turn	6,761	2.9	0.98	0.93-1.02	0.18	0.12-0.27	0.11	0.06-0.20
Stop sign	3,673	1.6	0.91	0.85-0.97	0.2	0.12-0.33	0.31	0.19-0.49
Hit and run	2,274	1	2.42	2.19-2.66	3.98	3.46-4.58	1.84	1.45-2.33
Improper backing	2,239	1	1.41	1.29-1.54	0.18	0.09-0.34	0.24	0.12-0.49
Improper passing	1,916	0.8	1.23	1.12-1.35	0.45	0.29-0.70	0.55	0.34-0.90
Wrong side of road	1,702	0.7	1.38	1.25-1.53	0.71	0.49-1.04	6.49	5.51-7.64
Improper start and stop	1,138	0.5	0.98	0.87-1.11	0.2	0.08-0.48	0.12	0.03-0.49
Wrong way on one-way	75	0.03	1.13	0.71-1.79	14.12	8.20-24.33	2.9	0.92-9.20
Vehicle homicide	61	0.03	3.65	1.84-7.22	60.88	35.11-105.6	7.21	3.30-15.76
Other non-moving	29,935	13.4	1.31	1.28-1.34	0.79	0.73-0.86	3.99	3.82-4.17

*Adjusted for age and calendar year
†Adjusted for age, sex, and calendar year

(2) drivers who visited the emergency department following a crash were less likely to be issued a citation; and (3) specific types of citations issued are associated with increased risk of emergency department visits and hospitalization.

McCartt et al. (2003) studied citations issued to novice drivers. Crash rates among novice drivers, primarily teenagers, were independently analyzed. Findings concluded that teenagers have a substantially higher crash risk and citation rate following licensure, especially within the first miles and weeks after receiving their license. Although young males and females had similar crash rates, the study found that males had higher citation rates (McCartt et al., 2003).

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Table 3. Bivariate analyses of the specific citation by emergency room visit and hospitalization among drivers in Utah crashes, aged 16 years and older, 1999-2005

	Risk of Visiting the Emergency	95% CI	Risk of being Hospitalized*	95% CI
Failure to yield right of way	0.92	0.90-0.95	0.81	0.72-0.92
Improper lookout	0.49	0.47-0.51	0.30	0.25-0.37
Following too close	0.42	0.40-0.44	0.20	0.15-0.26
Speeding	1.03	0.98-1.07	1.55	1.31-1.82
Red light	1.41	1.35-1.47	1.33	1.12-1.59
Reckless driving	1.17	1.11-1.23	2.32	1.99-2.71
Negligent collision	0.64	0.59-0.69	0.55	0.40-0.77
Driving under the influence (DUI)	2.44	2.35-2.53	6.75	0.08-7.49
Improper lane change	0.85	0.79-0.91	1.40	1.12-1.76
Improper turn	0.63	0.58-0.68	0.70	0.51-0.95
Stop sign	1.35	1.25-1.46	1.67	1.27-2.20
Hit and run	0.38	0.31-0.47	0.31	0.13-0.74
Improper backing	0.12	0.09-0.17	0.11	0.03-0.45
Improper passing	0.71	0.61-0.83	1.00	0.59-1.69
Wrong side of road	1.61	1.45-1.78	2.65	1.90-3.69
Improper start and stop	0.41	0.32-0.54	0.34	0.11-1.06
Wrong way on one-way street	1.49	0.83-2.36	4.40	1.46-13.26
Vehicle homicide	5.09	3.97-6.52	19.66	10.30-37.51
Other non-moving violations	1.23	1.20-1.27	1.23	1.09-1.39

*Adjusted for age, sex, and calendar year

This is consistent with the findings of the current study in that young, inexperienced male drivers involved in a crash are more likely to receive a citation. Using well-known behavior models, indications can be made that young drivers are more likely to violate driving laws such as speeding and dangerous over-taking (Forward, 2009). Moving violations such as speeding and dangerous over-taking have been well studied as major causes of motor vehicle crashes. Therefore, understanding citation rates among novice drivers is valuable information when developing interventions. As crashes will also occur among young, inexperienced drivers who have no prior citation record, restricting driving privileges for all novice drivers should continue.

Graduated drivers license programs are a type of driving restriction for novice drivers and have a solid history of preventing motor vehicle crashes (Williams & Shults, 2010). Additional restrictions could be extended to novice drivers with a history of citations.

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Avoiding citations is a major reason for obeying many traffic laws. In a national survey, 71% of motorists cited the primary reason for wearing a safety belt as "I don't want to get a ticket" (National Highway Traffic Safety Administration, 2004). The current study showed that drivers not wearing a safety belt are more likely to receive a citation than those who are wearing a safety belt. The citation issued in this case would be any type of moving violation listed in Table 2, and not necessarily a citation given only for safety belt non-use. One could speculate that drivers who do not wear a safety belt may display other driving behaviors that lead to culpability in a crash that those who wear a safety belt would not. Seatbelt use was associated with culpability and may be an indicator for risky behaviors, particularly among alcohol drinkers (Kufera et al., 2006). Comparatively, safety belt violations were shown to be positively associated with MVC injury (MacNab, 2004). Another study determined factors associated with safety belt non-use among emergency department patients. Only 11% of participants in the study reported having received a citation for safety belt non-use. This decreases to 4% when a multiple measure for safety belt use is used (Fernandez et al., 2006). This begins to show the difficultly of enforcement of safety belt use in motor vehicles.

The current study could not report specifically on safety belt use violations. This was reported in the dataset with other non-moving violations that could not be differentiated. Of all the reported crashes in Utah between 1999 and 2005, 6.4% of those crashes had occupants not wearing a safety belt with 8.7% of the reports not having any data on safety belt use. Non-use of safety belts had been shown to be a significant factor in increased injury severity for all occupants in MVCs (Thygerson, Merrill, Cook, Thomas, & Wu, 2011). Consistency in reporting safety belt use violations was one area for improvement when documenting MVCs.

Were drivers who visit the emergency department as a result of an MVC less likely to receive a citation? A study in Wisconsin determining the age-neutrality of issuing traffic citations stated that older drivers in Wisconsin were more likely to receive a citation as a result of an MVC. However, that same study did not include information on driver culpability. This is mainly due to a perceived reluctance on the part of the police officer to issue a citation where the MVC resulted in severe injuries (Dulisse, 1997). In relation to this current study's findings, drivers who visited the emergency department as a result of the MVC were significantly less likely to be issued a citation. Factors contributing to this finding were not analyzed. Research on the citation practices of the police had been studied in some detail. Since many states do not require the police to issue a citation during a traffic stop, certain types of violations may give an investigating officer greater discretion when deciding to issue a citation or not (Schafer & Mastrofski, 2005). This may be especially true for police investigating severe injuries resulting from MVCs. Other traffic citation practices may be due to neighborhood characteristics (Ingram, 2007). While culpability will still be assigned, using citations as an indicator of culpability may be difficult to use given our findings.

In the current study, drivers in crashes receiving a citation for running red lights, reckless driving, driving under the influence, stop sign violations, driving on a one-way street, driving on the wrong side of the street and vehicle homicide were at greater risk of visiting the emergency department (ED) and of being hospitalized. ED visits and hospitalization were generally associated with greater injury severity as a result of the MVC. It would be assumed that drivers who deliberately violate traffic laws mentioned here would be at greater risk of severe injury and citation. These same drivers may also have citation for many other committed violations. For example, drivers who run red lights have significantly more citations for other moving violations. Additionally, drivers who run red lights were less likely to use safety belts, were younger, and had poorer driving records when compared to drivers who abide by current traffic laws (Retting & Williams, 1996; Retting, Ulmer, & Williams, 1999). Reckless driving leads to crashes and is a major reason that adolescents have such high rates of crashes and severe injuries from those crashes (Arnett, Offer, & Fine, 1997).

Vehicle homicide involves death resulting from the negligent driving of a vehicle.

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There were 61 citations given by the police for vehicle homicides in the state of Utah between 1999 and 2005. There were multiple factors involved with the cause of these homicides. Those factors included being male, being intoxicated while driving and being fatigued while driving. In 2009, Utah had the lowest percentage of DUI-related deaths of all 50 states and the District of Columbia with 14% compared to 32% for the nation (NHTSA, 2009a). Along with 46 other states, Utah has specific laws targeting vehicle homicide. In 2009, of 348 drivers involved in fatal MVCs, 48 had blood alcohol concentrations at or above 0.01 (NHTSA, 2009b). Comparing the number of drivers involved in DUI fatalities in 2009 to the 5-year period in this current study, citations rates for drivers under the influence of alcohol is low. Another study confirmed these findings that citation and prosecution rates of intoxicated drivers injured in MVCs and hospitalized were low (Cydulka et al., 1998).

Of the drivers cited for vehicle homicide, 20 (32.8%) involved alcohol and fatigue, 3 (4.9%) involved only alcohol, and 34 (55.7%) involved only fatigue. 4 (6.6%) involved neither alcohol nor fatigue. Fatigued drivers were given citations for 88.5% of vehicle homicides in Utah. This points to the great risk that fatigued drivers pose to other occupants of motor vehicles and pedestrians. The percentage of fatigued-related vehicle homicides is unknown from state to state but should be a readily available statistics for each state. Investigators of MVCs should make the reporting of fatigue-related crashes a priority.

Limitations of this study should be considered. Only reported crashes occurring on public roads were included in the database. This may lead to an underestimation of the number of crashes. Some factors such as safety belt use, alcohol involvement and fatigue may be less reliable for this database because of the method of reporting by police reports and the difficulty that exists in capturing this information at a crash scene. Additionally, much of the information on the crash report is self-reported by the drivers and passengers. This is likely to overestimate variables such as safety belt use.

However, this study has several strengths. CODES uses statewide data for all reported crashes. Multiple data sources are linked to provide both event and outcome data. This data then allows better understanding of the contributing factors in the crash. With CODES, one is able to obtain much more detail on these and many other conditions. The knowledge gained by data analysis of citations and culpability will help driver education instructors focus efforts when training new drivers. Injury prevention professionals should also focus on the additional contributory factors identified in this study. Law enforcement should also use this information to understand the importance of the citations that are given and how they are used in conducting research about MVCs.

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