Law enforcement officers' risk perceptions toward on-duty motor-vehicle events

Hope M. Tiesman
Division of Safety Research – National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, West Virginia, USA
Rebecca J. Heick
MCPHS Online, MCPHS University, Boston, Massachusetts, USA, and
Srinivas Konda and Scott Hendricks
Division of Safety Research – National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Morgantown, West Virginia, USA

Received 11 March 2015
Revised 11 March 2015
Accepted 20 April 2015

Abstract

Purpose – Motor-vehicle-related events (MVEs) are the leading cause of on-duty death for law enforcement officers, yet little is known about how officers view this significant job hazard. The purpose of this paper is to explore officers' motor-vehicle risk perception and examine how prior on-duty MVEs and the death or injury of a fellow officer influences this perception.

Design/methodology/approach – A state-wide random sample of 136 law enforcement agencies was drawn using publically accessible databases, stratified on type and size of agency. In total, 60 agencies agreed to participate and a cross-sectional questionnaire was distributed to 1,466 officers. Using six-point Likert scales, composite scores for motor-vehicle and intentional violence risk perception were derived. A linear regression multivariable model was used to examine factors affecting motor-vehicle risk perception.

Findings – Motor-vehicle risk perception scores were significantly higher than intentional violence scores. A prior on-duty motor-vehicle crash, prior roadside incident, or knowledge of fellow officer's injury or death from a MVE significantly increased motor-vehicle risk perception scores. After controlling for potential confounders though, only prior on-duty crashes and roadside incidents impacted motor-vehicle risk perception.

Research limitations/implications – The study comprised primarily small, rural agencies and generalizability may be limited. Also, although the data were collected anonymously, reporting and response biases may affect these findings.

Originality/value – This study involved a large and diverse cohort of officers and explored motor-vehicle risk perception. A better understanding of officers' risk perceptions will assist in the development and implementation of occupational injury prevention programs, training, and policy.

Keywords Risk perception, Law enforcement, Motor-vehicle crash, Occupational injury

Paper type Research paper

Introduction

In the USA in 2012, 4,383 workers died while on the job (Bureau of Labor Statistics (BLS), 2012a). This equates to approximately 12 workers dying every day in the USA while at work (2012). In that same year, nearly three million US workers experienced

This project was funded by the National Institute for Occupational Safety and Health. The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

Policing: An International Journal of Police Strategies & Management
Vol. 38 No. 3, 2015
pp. 563-577
Emerald Group Publishing Limited
1363-951X
DOI 10.1108/PIJPSM-03-2015-0028

non-fatal work-related illnesses and injuries for an overall incidence rate of 3.4 cases per 100 equivalent full-time workers (BLS, 2013). The costs of occupational injury and illness in the USA are an estimated $250 billion per year (Leigh, 2011). This dollar amount exceeds that of chronic diseases including cancer, diabetes, and chronic obstructive pulmonary disease (2011). However, substantial these numbers may appear, the true toll of work-related injury and illness is estimated to be two to three times greater due to inconsistent official data sources and likely underreporting of injuries by workers and employers (Leigh *et al.*, 2004; United States House of Representatives, 2008).

In 2012, according to the Bureau of Labor Statistics (BLS), 119 law enforcement officers (LEOs) died while on the job (BLS, 2012b). The Federal Bureau of Investigation's Law Enforcement Officers Killed and Assaulted report found 95 deaths during the same time period (Federal Bureau of Investigation, 2013). Different inclusion criteria may be one explanation for this difference (Tiesman *et al.*, 2013). Law enforcement work is a dangerous occupation due to the numerous hazards faced by LEOs. These hazards significantly increase the risk of dying or being seriously injured on the job and can occur in a dynamic environment. LEOs are exposed to physical hazards including violence and injury, physical exertion, armed and unarmed combat; psychological stressors such as exposure to crime scenes and exposure to death; organizational stressors such as shift work; mental health issues such as anxiety, depression, and post-traumatic stress disorder; cardiovascular disease; exposure to blood and bodily fluids; and increased risk for suicide (Hessl, 2003; Deschamps *et al.*, 2003; Violanti *et al.*, 2012; O'Hara and Violanti, 2009; Zimmerman, 2012; Gershon *et al.*, 2009). LEOs are also routinely exposed to a much less commonly considered job hazard, high-speed and high-risk driving situations as well as work performed along busy roadways (Tiesman *et al.*, 2010).

Across all occupations and industries, motor-vehicle-related events (MVEs) are consistently the leading cause of work-related death in the USA In 2012, MVEs accounted for 35 percent of all occupational injury fatalities in the USA ($n = 1{,}567$) (BLS, 2012a). Work-related motor-vehicle crashes are also expensive for employers. One study estimated that a single work-related motor-vehicle fatality cost employers approximately $500,000 in direct and liability costs and a non-fatal crash cost $74,000 (National Highway Traffic Safety Administration, 2003). MVEs were the leading cause of LEO fatalities in 2013 and have been for some time (National Law Enforcement Memorial Fund (NLEOMF), 2013). In the last decade, fatal MVEs, including motor-vehicle crashes and roadside incidents, outnumbered intentional acts of violence such as being shot, strangled, or stabbed (National Law Enforcement Memorial Fund, 2014). Besides spending numerous hours behind the wheel conducting vehicle patrols, LEOs have unique risk factors for MVEs including driving in inclement weather conditions, high-speed driving situations, working alongside interstates and roadways near speeding motor vehicles, and having a multitude of distractions inside the patrol car (Tiesman *et al.*, 2010; Clarke and Zak, 1999). However, given these unique risk factors, LEOs can be complacent toward their increased risk for motor-vehicle crashes and roadside incidents (Wehr *et al.*, 2012).

Risk perception has been defined as acknowledgement of the probability of incurring harm (Cox and Tait, 1991). An individual's perception of risk plays a crucial role in occupational safety and health (Weyman and Kelly, 1999; Rosenstock *et al.*, 1988; Melia *et al.*, 2008; Arezes and Miguel, 2008). Not only does a worker's perception of risk accurately predict specific safety behaviors, it has also been identified as an independent predictive factor for work-related injury (Mullen, 2004). An inaccurate perception of risk may lead to a worker's inability to assess a situation and engage in

appropriate safety precautions or behaviors (Huang *et al.*, 2006; Harrel, 1998). This is pivotal for LEOs as they need to continually assess their risk for injury and death in an ever-changing environment. A better understanding of LEO's risk perception and attitude toward workplace hazards and job tasks is important for the effective development and communication of workplace prevention programs and policies – especially related to motor-vehicle safety.

This special edition journal focusses on traffic and motor-vehicle safety among LEOs and fills a significant gap in the literature dealing with on-duty MVEs. The purpose of this paper is to explore LEO's perception of risk of on-duty MVEs and identify factors that influence this risk including prior MVEs as well as knowledge of fellow officers' motor-vehicle-related injury or death using data gathered from a large state-based study. We also compare an officers' motor-vehicle risk perception to their risk perception of acts of intentional violence such as being assaulted or being shot on the job.

Data and methods

A cross-sectional design utilizing a stratified random sample was employed for this study. Data were collected via paper-and-pencil questionnaire. The questionnaire and research study were approved by the NIOSH Human Subjects Research Board and the US Government Office of Management and Budget. This project was funded by the National Institute for Occupational Safety and Health.

Study population

The study sample was developed in 2010 using publically accessible online resources to identify existing Iowa law enforcement agencies. A list of approximately 400 Iowa law enforcement agencies was compiled and stratified by type of agency (municipal, sheriff, state patrol) and size (small = 20 or fewer officers, medium = 21-50 officers, large = 51 or more officers). A total of 161 agencies were randomly selected for participation including 103 municipal agencies and 58 sheriff's departments. Although the Iowa State Patrol was not randomly selected, they were included in the study. After removal of 26 sites that were no longer active agencies (two sheriff's departments and 24 municipal agencies), 136 agencies remained. Recruitment activities, including phone calls, mailings of study flyers, and e-mails were directed at agency leadership. Of the 136 agencies invited, 60 agreed to participate for an overall agency response rate of 44 percent. This included 32 municipal agencies, 27 sheriff's departments, and the Iowa State Patrol and comprised 1,466 sworn officers.

Data collection

The questionnaire comprised five sections: demographics, occupational characteristics, motor-vehicle safety and operations training, occupational safety practices and perceptions, and prior motor-vehicle crashes and roadside incidents. Sections were derived using existing validated tools when possible. Risk perception questions were independently developed for the study by the authors. The questionnaire was pilot-tested and peer-reviewed prior to use in the field. The questionnaire was distributed between September and December 2011. Questionnaire packets were delivered to agency leadership for distribution to sworn LEOs and included an introduction letter, paper-and-pencil questionnaire, and self-addressed stamped return envelope. Officers used the self-addressed stamped envelope to return completed questionnaires directly to researchers. Questionnaires were coded with a unique

alpha-numeric string mapped to each agency, but not to individual officers. These codes were used to monitor survey returns by agency. Four weeks after the distribution of the questionnaires, agency leadership was informed of the number of non-respondents and asked to remind officers to return them. Returning a survey indicated consent to participate in the research study. In total, 79 percent of LEOs (1,157/1,466) returned a questionnaire.

Variable definitions

For this study, MVEs encompassed two types of on-duty events: motor-vehicle crashes and roadside incidents. Motor-vehicle crashes included all crashes, whether they were reported to administration or not. A roadside incident was defined as being struck by or nearly struck by a moving vehicle while working outside of a patrol car. Officers were asked to recall all MVEs occurring in the prior three years. Risk perception was assessed using a six-point Likert-type scale (1 = very unlikely to 6 = very likely) where respondents were asked to estimate the likelihood of being seriously injured or killed on the job related to four hypothetical situations: gunshot wound, assault, motor-vehicle crash, and roadside incident. Single-item stress-level questions have been shown to be reliable, valid, and accurate (Clark *et al.*, 2011; Locke *et al.*, 2007).

A principal component analysis using SAS PROC PRINCOMP was performed to identify the underlying structure of the risk perception variables. The first principal component accounted for 69 percent of the variance between the four variables (eigenvalue = 2.79). The second principal component accounted for 17 percent of the variation (eigenvalue = 0.638). Based on this second principal component, we decided to group the four risk perception variables into two composite scores: motor-vehicle risk perception score (motor-vehicle crash risk + roadside incident risk) and intentional violence risk perception score (gunshot risk + assault risk). Together, these two factors explain 86 percent of the variation within the four variables which is nearly the maximum desired explained variance of 90 percent (Kresta *et al.*, 1994; Hatcher, 1994).

Statistical analyses

Data analyses were conducted using SAS V9.2. Descriptive statistics including counts, proportions, averages, and standard deviations were used to describe the study sample. Mean risk perception scores for each unique situation (assault, gunshot, motor-vehicle crash, and roadside incident) were calculated. Average motor-vehicle and intentional violence risk perception composite scores were then calculated and compared across the two primary risk factors: knowledge of a fellow officer's death or injury and prior on-duty MVEs. First, mean composite risk perception scores were compared across officers who knew a fellow officer to be injured or killed in the last 12 months due to intentional violence (assault or shot), MVE (motor-vehicle crash or roadside incident), multiple causes, and no serious injury or fatality, with one-way analysis of variance. *t*-tests were used to compare average risk perception scores across respondents who were in an on-duty motor-vehicle crash in the last three years with those who were not, as well as those who were involved in a roadside incident in the last three years with those who were not.

Multivariate linear regression models were run to identify the effect of prior on-duty MVEs and knowledge of a fellow officer's motor-vehicle-related death or injury on motor-vehicle risk perception scores, while controlling for potential confounders. Socio-demographic variables including race, ethnicity, age, gender, education, and

relationship status were examined as potential confounders. Occupational variables including size of agency, type of agency, years of law enforcement experience, rank, division, shift, hours worked, hours of weekly driving, presence of agency-wide motor-vehicle policy, and yearly number of hours spent on motor-vehicle training were also examined. These variables were further included into models when p-values equaled at least 0.20.

Findings

Sample characteristics

Table I displays the characteristics of the study sample. Officers were primarily male ($n = 1{,}062$, 93 percent), white ($n = 1{,}093$, 94 percent), and in a committed relationship ($n = 1{,}013$, 88 percent). Their average age was 40.1 years (SD = 9.4) (data not shown). In total, 40 percent had a bachelors' degree or higher ($n = 461$) and 29 percent had a technical certificate, vocational certificate, or associates degree ($n = 333$). On average, officers had been in law enforcement for 15.1 years (sd = 9.1) and over 30 percent had been in law enforcement for 20 years or more ($n = 359$, 31 percent). In total, 41 percent of officers were employed at a sheriff's agency ($n = 479$), 38 percent at a municipal agency ($n = 449$), and 17 percent with the Iowa State Patrol ($n = 196$). Well over half of the officers were considered "officer," "officer first class," "specialist," or "trooper" ($n = 749$, 65 percent).

Perception of occupational injury and fatality risk

Officers were asked about the likelihood of serious injury or death due to four occupational situations: assault, gunshot wound, motor-vehicle crash, and roadside incident (Table II). Each situation was ranked using a six-point Likert-type scale (1 = very unlikely to 6 = very likely). The occupational situation which resulted in the highest average risk perception score was roadside incident (mean = 3.99, SE = 0.04, SD = 1.31), followed closely by motor-vehicle crash (mean = 3.95, SE = 0.04, SD = 1.27). The percentage of officers who believed it was "very likely" that they could be seriously injured or killed due to a motor-vehicle crash or roadside incident was double that of officers who held this belief due to assault or gunshot wounds (12 and 13 percent vs 6 and 2 percent). The mean composite score for perceived motor-vehicle risk was significantly higher than the mean composite score for perceived risk of acts of intentional violence (7.94 vs 6.70, $p < 0.0001$).

Effect of fellow officer's occupational injury or death on risk perception

Table III displays the average motor-vehicle and intentional violence risk perception scores stratified by a fellow officer's occupational injury or death. Four mutually exclusive categories were considered: injury/death due to intentional violence (assaults or gunshot wounds), injury/death due to a motor-vehicle event (motor-vehicle crash or roadside incident), multiple injuries/deaths from any of the four causes, and no known serious injury or death. For both motor-vehicle and intentional violence risk perception, scores were highest for those officers who knew of a fellow officer's death or injury due to a MVE (mean = 8.31 and mean = 6.67, respectively). Both motor-vehicle and intentional violence risk perception scores were lowest among those officers who knew a fellow officer who had been injured or killed due to an assault or gunshot wound (mean = 7.59 and mean = 6.65, respectively). Knowledge of a fellow officers death or injury significantly impacted motor-vehicle risk perception scores ($p = 0.0197$), but not intentional violence risk perception scores ($p = 0.91$).

Characteristic	*n* (%)
Age	
21-24	25 (2%)
25-29	147 (13%)
30-34	190 (16%)
35-39	186 (16%)
40-44	214 (18%)
45-49	160 (14%)
50-59	189 (17%)
60+	22 (2%)
Gender	
Female	78 (7%)
Male	1,062 (93%)
Race	
White	1,093 (94%)
Non-white	29 (2%)
Relationship status	
In a committed relationship	1,013 (88%)
Not in a committed relationship	117 (10%)
Education	
High school diploma/GED/some college	346 (30%)
Technical/Vocational Cert./Associate's degree	333 (29%)
Bachelors or greater	461 (40%)
Rank	
Officer/Officer First Class/Specialist/Trooper/Reserve	749 (64%)
Sergeant/Lieutenant/Corporal	226 (19%)
Major/Captain/Chief/Sheriff/Assistant Chief	93 (8%)
Other	86 (7%)
Years in law enforcement	
Less than 5	158 (13%)
5-9	203 (17%)
10-14	222 (19%)
15-19	194 (16%)
20+	359 (31%)
Type of agency	
Sheriff	479 (41%)
State Patrol	196 (17%)
Municipal	449 (38%)
Total	1,157

Table I.
Socio-demographic and occupational characteristics of study participants

Effect of prior on-duty motor-vehicle crash or roadside incident on risk perception

Table IV displays the average motor-vehicle and intentional violence risk perception scores stratified by personal experience with on-duty motor-vehicle crashes and roadside incidents. Officers who had been involved in an on-duty motor-vehicle crash in the prior three years had significantly higher motor-vehicle risk perception scores than officers who had not been involved in a crash (8.49 vs 7.79, $p = 0.0001$). This same trend extended to those officers who had been involved in a roadside incident in

the prior three years compared to those who had not (8.65 vs 7.81, $p < 0.0001$). On-duty motor-vehicle crashes and roadside incidents did not significantly impact risk perception scores for intentional violence ($p = 0.09$ and $p = 0.39$, respectively).

Officers' perception of specific job hazards

Officers were asked to categorize their perceived level of danger for several types of job tasks using a four-point Likert scale ranging from "not at all dangerous" to "very dangerous" (Table V). Over a third of officers considered responding to scenes of other violence (non-domestic) to be "very dangerous" ($n = 411$, 36 percent), followed closely by responding to domestic violence calls ($n = 397$, 35 percent). Driving under non-emergency conditions was generally considered to be the least dangerous. Only 1 percent of officers considered this job task to be "very dangerous" ($n = 8$, 1 percent).

Table II. Perception of occupational injury and fatality risk by type of event

	Very likely *n* (%)	Likely *n* (%)	Somewhat likely *n* (%)	Somewhat unlikely *n* (%)	Unlikely *n* (%)	Very unlikely *n* (%)	Mean score (SE, SD)	Mean composite score (SE, SD)
Assaulted	68 (6)	333 (30)	198 (18)	204 (18)	254 (23)	70 (6)	3.52 (0.03, 1.30)	6.70 (0.07, 2.25)
Being shot	20 (2)	238 (21)	147 (13)	208 (19)	417 (37)	93 (8)	3.17 (0.04, 1.17)	
Motor-vehicle crash	136 (12)	362 (32)	246 (22)	114 (10)	226 (20)	39 (3)	3.95 (0.04, 1.27)	7.94 (0.07, 2.33)
Roadside incident	147 (13)	303 (27)	289 (26)	111 (10)	233 (21)	45 (4)	3.99 (0.04, 1.31)	

Table III. Effect of a fellow officers' occupational injury or death on risk perception scores

	Fellow officers' occupational injury or death from				
	Intentional violence (assault or gunshot) ($n = 61$) Mean (SE, SD)	Motor-vehicle event ($n = 254$) Mean (SE, SD)	Multiple causes (both intentional and motor-vehicle) ($n = 305$) Mean (SE, SD)	No officer death or serious injury ($n = 790$) Mean (SE, SD)	*p*-value
Perception of motor-vehicle risk	7.59 (0.37, 2.27)	8.31 (0.16, 2.61)	8.11 (0.16, 2.73)	7.90 (0.08, 2.32)	0.0197
Perception of intentional violence risk	6.65 (0.32, 2.50)	6.67 (0.14, 2.27)	6.67 (0.13, 2.31)	6.74 (0.08, 2.20)	0.91

Table IV. Effect of prior on-duty motor-vehicle crash or roadside incident on risk perception

	MVC prior 3 years ($n = 220$) Mean (SE, SD)	No MVC in prior 3 years ($n = 894$) Mean (SE, SD)	*p*-value	Roadside incident in prior 3 years ($n = 179$) Mean (SE, SD)	No roadside incident in prior 3 years ($n = 921$) Mean (SE, SD)	*p*-value
Perception of motor-vehicle risk	8.49 (0.16, 2.43)	7.79 (0.08, 2.42)	0.0001	8.65 (0.18, 2.43)	7.81 (0.08, 2.42)	< 0.0001
Perception of intentional violence risk	6.92 (0.14, 2.13)	6.63 (0.07, 2.26)	0.09	6.83 (0.17, 2.20)	6.68 (0.07, 2.24)	0.39

Multivariable modeling

Multivariable linear regression models were used to predict association with a higher motor-vehicle risk perception score, while controlling for potential confounders (Table VI). In the bivariate analysis, prior motor-vehicle crashes ($p = 0.0001$), prior roadside incidents ($p < 0.0001$), and knowledge of a fellow officer's motor-vehicle-related injury/death ($p = 0.006$) were significantly associated with higher motor-vehicle risk perception. In the bivariate analysis, several other variables were found to be independently associated with motor-vehicle risk perception scores: age of officer ($p = 0.08$), size of agency ($p = 0.12$), type of agency ($p = 0.001$), rank of officer ($p = 0.14$), division ($p < 0.0001$), weekly hours behind the wheel ($p < 0.001$), years as a LEO ($p = 0.20$), and education ($p = 0.05$). All of these variables were considered for further analysis. Since age of officer and years as a LEO were significantly correlated, only years of law enforcement experience was further

Table V. Officers' perception of specific job hazards

	Not at all dangerous *n* (%)	Somewhat dangerous *n* (%)	Dangerous *n* (%)	Very dangerous *n* (%)
Driving				
Driving under emergency conditions	12 (1)	222 (20)	569 (50)	328 (29)
Driving under non-emergency conditions	294 (26)	700 (62)	130 (11)	8 (1)
Response				
Responding to domestic violence calls	6 (1)	191 (17)	535 (47)	397 (35)
Responding to other scenes of violence	7 (1)	148 (13)	563 (50)	411 (36)
Roadway				
Working crash scenes on roadways	13 (1)	240 (21)	566 (50)	310 (27)
Making traffic stops on roadways	14 (1)	329 (29)	568 (50)	219 (19)

Table VI. Multivariable analyses of motor-vehicle crash risk perception[a]

	Parameter estimates	*p*-value
On-duty motor-vehicle crash in prior 3 years		
Yes	−0.484	0.011
No		
Roadside incident in prior 3 years		
Yes	−0.457	0.028
No		
Fellow officer motor-vehicle injury/death		
Yes	0.233	0.36
No		

Note: [a]Adjusted for education, size of agency, type of agency, years of law enforcement experience, and driving hours per week

considered. Interaction terms were examined and none were found to be significant. After controlling for education, size of agency, type of agency, years of law enforcement experience, and driving hours per week, prior motor-vehicle crashes and prior roadside incidents were both found to be significant predictors of high motor-vehicle risk perception scores ($p = 0.011$ and $p = 0.028$, respectively).

Discussion and conclusion

Our findings indicate that LEOs were aware of the likelihood of injury and death associated with on-duty MVEs. Officers' motor-vehicle risk perception scores were significantly higher than intentional violence risk perception scores. However, this perception of risk did not extend to officers' view of the danger of specific job activities. Officers deemed the most hazardous job tasks to be those that involved a risk for intentional injury, such as responding to calls of potential violence. Another main finding from our study was that personal experience with on-duty MVEs significantly impacted officers' perception of motor-vehicle risk.

With the exception of 2011, MVEs have been the leading cause of on-duty death among LEOs for the prior 16 years (NLEOMF, 2013). Since the 1960s, overall law enforcement fatalities have declined; however, motor-vehicle-related deaths have risen (NLEOMF, 2013). Recently, the law enforcement community has re-focussed their efforts on improving their understanding of MVEs, and more importantly, how best to prevent them (Ashton, 2012; Batiste *et al.* (2011); Ashton, 2011; Gustafson, 2013). Language on officer safety and health now includes topics like seat belt use, speed caps, cell phone restriction, and intersection crossing policies. Also, programs that raise knowledge of on-duty MVEs such as Below 100 and the MoveOver campaign may also add to this increased awareness among LEOs (Stockton *et al.*, 2010; Moveoveramerica, 2013). It is possible that this messaging is impacting how LEOs view motor-vehicle hazards. Our study demonstrated that officers were aware of the likelihood of occupational injury and death associated with on-duty MVEs as indicated by the high motor-vehicle risk perception scores. This finding is important as it demonstrates that there is a baseline awareness of the seriousness of the hazards associated with motor vehicles in law enforcement.

While officers had significantly higher motor-vehicle risk perception scores compared to intentional violence risk perception scores, officers still deemed the most hazardous job tasks to be those involving the potential for assault. In fact, literature supports that these calls can be very dangerous for LEOs (Kercher *et al.*, 2013). In our study, nearly 90 percent of officers reported that responding to "other" scenes of violence was "dangerous" or "very dangerous." This is in stark comparison with the 12 percent of officers who believed that driving under non-emergency conditions to be "dangerous" or "very dangerous." Studies have found that when workers regularly perform tasks and become familiarized with them, they are more likely to underestimate the risks associated with them (Fleming and Buchan, 2002). On average, officers in our study spent over 50 percent of their workweek behind the wheel of a patrol car (mean = 22.4 hrs, data not shown). It is feasible that officers come to view driving-related job tasks as non-threatening because they are routine.

Another possible explanation of this finding is the association between perceived risk and perceived control. Studies have demonstrated that when workers perceive they have control over tasks, they generally perceive less risk for those tasks (Weyman and Kelly, 1999). It has been well-documented that many drivers consider themselves to be more skilled behind the wheel and safer than the "average" driver

(Svenson *et al.*, 1985; Dejoy 1989). This "optimism bias" also extends to driver's views on crash risk. Many drivers believe they are less likely to be involved in a motor-vehicle crash than others (Svenson *et al.*, 1985; Dejoy, 1989). While there are no data specific to LEOs to support this hypothesis, there is also no reason to believe LEOs would be exempt from the optimism bias.

We found that prior on-duty MVEs significantly increased officers' perception of motor-vehicle risk. Research has demonstrated that an individual's experience with workplace injuries helps to shape their perception of risk and in turn, response to specific workplace hazards (Nelkin and Brown, 1984; Wiegman *et al.*, 1991; Cree and Kelloway, 1997; Rundmo, 1995). Generally, people with a history of specific injuries score higher on perceived risk measures of those injury events recurring (Watzke and Smith, 1994; Glik *et al.*, 1991; Rundmo, 1995; Tversky and Kahneman, 1973). In our study, the impact of prior MVEs was specific to motor-vehicle risk perception; occurrence of prior MVEs did not significantly impact intentional violence risk perception scores. What is currently unknown is how long after an on-duty MVE does it continue to impact an officers' perception of risk. Also, is the severity of the MVE correlated with changes in perception of risk? Regardless, we believe that our data support a recommendation to provide LEOs with increased motor-vehicle training soon after an on-duty MVE. Intervening soon after a MVE, regardless of severity, capitalizes on this time period.

Knowledge of a motor-vehicle-related death or injury of a fellow officer was also associated with significantly higher motor-vehicle risk perception scores. Such knowledge also increased intentional violence risk perception scores, although not significantly. It may be that knowledge of a motor-vehicle death or injury affects overall perception of risk among officers. While this finding did not reach statistical significance, it may suggest a possible intervention for agencies. Prior research has found that the use of personal stories has a strong influence on workers (Lavack *et al.*, 2008; Ricketts *et al.*, 2010). Advances in technology such as body-worn and dash-mounted cameras allow agencies to capture events as they unfold (National Law Enforcement and Corrections Technology Center, 2012). Programs like Below 100 and the Street Survival Seminar are widely available in the USA and utilize images captured by these technologies to tell the stories of officers involved in critical incidents (Stockton *et al.*, 2010; Calibre Press, 2013). Agencies could also consider adding personal testimonies of their own officers who have been involved in serious crashes in their driving safety training as a way to increase perception of risk and encourage others to engage in safety behaviors.

In the multivariate analysis, while motor-vehicle crashes in the previous three years had the greatest impact on motor-vehicle risk perception, prior roadside incidents were also an important predictor of motor-vehicle risk perception. While officers are trained on a variety of roadway procedures including parking a vehicle offset and using passenger-side approaches, these cannot fully prevent officers from being struck by moving vehicles. Civilian drivers must also be educated on safe roadway procedures. The Move Over America public health campaign is intended to increase public awareness of move over laws which require motorists to move into another lane of traffic when an emergency vehicle or responder is on the side of the road (Moveoveramerica, 2014). While every US state with the exception of Hawaii has a move-over law in place, a recent phone survey found that 71 percent of Americans had not heard of these laws.

While officers may feel that the prevention of roadside incidents is largely outside of their control, there are several strategies that could significantly reduce officer's

chances of being struck and killed while on the roadway. High-visibility personal protective equipment, such as reflective vests, and the use of flares and cones, alert motorists to crash scenes. The code of federal regulations states that all workers within the right-of-way of a federal-aid highway who are exposed to traffic shall wear high-visibility safety apparel (Code of Federal Regulation, 2007). The safety of officers can be further protected at crash scenes with the use of an incident management system and proper traffic management, especially for large crash scenes or scenes involving multiple vehicles. However, the decision of when to use an incident management system may be made by other non-law enforcement agencies like the Department of Transportation or local highway crews whose primary concern may be traffic backups and delays. Actively including these groups in crash response decisions may help to create a safer work environment for officers.

This study was not without limitations. First, the study was conducted in the state of Iowa and consisted of mostly small and rural law enforcement agencies. It is unknown if these findings are applicable to agencies in larger or more urban locations. Second, since the study was cross-sectional in nature, the results represent associations only and determining causation is not possible. Third, standardized and validated tools were not used to measure the construct of risk perception. Fourth, the recall period used in this study was three years. When deciding on an appropriate recall period to be used in survey research, the trade-off between minimizing recall bias and maximizing rate estimates must be balanced. Here, we used a longer recall period to calculate LEOs' prior history of on-duty MVEs to improve capture of low-frequency events. However, by doing so we could have increased the likelihood of recall bias (Zwerling *et al.*, 1995). Finally, the participation rate at the agency level was low at 44 percent. It is possible that agencies that chose not to participle differed from those agencies that did. However, among those agencies who did participate, the officer response rate was high at 79 percent.

We found that officers were aware of the likelihood of occupational injury and death associated with on-duty MVEs and this awareness may be due to the recent cultural change in law enforcement toward an emphasis on the prevention of on-duty MVEs. We also found that officers who had been involved in a prior on-duty MVE had higher motor-vehicle risk perception scores. There is little research on the occupational risk perception from a LEO standpoint, or even the risk perception of occupational motor-vehicle crashes with which to compare our results to. Knowledge of how an officer perceives specific job hazards and situations would be useful when developing and implementing evidence-based programs in the workplace. The adoption of protective behaviors and equipment is very much dependent on the workers' perception of specific hazards (Huang *et al.*, 2006). For example, restrictive driving policies, such as speed caps, may be viewed in a more favorable light if the officer is aware of the true fatality risk associated with job tasks that appear to be mundane. Perhaps working to change the culture of safe motor-vehicle operations among LEOs is a needed first step in the prevention of MVEs. Based on our findings, we believe that capitalizing on officers' knowledge of this risk is a possible avenue for highly impactful prevention programs, which in turn may foster a safer workplace and potentially reduce occupational injuries and fatalities.

Future research needs

Much more information is needed on the causes, trends, and risk factors for officers' on-duty motor-vehicle crashes and roadside incidents, especially on a national scale. At the agency level, such data can be obtained from workers' compensation reports,

motor vehicle crash reports, and on-site investigative reports. These quantitative data can be pivotal in furthering our understanding of on-duty MVEs and in the development of comprehensive evidence-based prevention programs. The use of qualitative research methods may also be beneficial in gaining greater insight into both officers' and leaderships' perceptions and experiences related to MVEs, allowing for more clear understanding of how and why these events occur, how officers are impacted by them, and how best to reduce the number and severity of these events. Finally, as agencies implement new training programs, standard operating procedures, and policy in an effort to reduce on-duty MVEs, these changes should be evaluated to determine their effectiveness.

References

Arezes, P.M. and Miguel, A.S. (2008), "Risk perception and safety behavior: a study in an occupational environment", *Safety Science*, Vol. 46 No. 6, pp. 900-907.

Ashton, R.J. (2011), "Could changing our ways mitigate officers' traffic deaths: highway safety initiatives", *The Police Chief*, Vol. 78, August, pp. 118-122.

Ashton, R.J. (2012), "Speeding cops", *The Police Chief*, Vol. 79, pp. 72-74.

Batiste, J.R., Wagers, M.L. and Ashton, R.J. (2011), "Preventing traffic-related line-of-duty deaths", *The Police Chief*, Vol. 78, July, pp. 52-55.

Bureau of Labor Statistics (BLS) (2012a), "Census of Fatal Occupational Injuries Summary, 2012", available at: www.bls.gov/news.release/cfoi.nr0.htm (accessed June 6, 2014).

BLS (2012b), "Fatal occupational injuries by occupation and event or exposure, all US, (2011)", available at: www.bls.gov/iif/oshwc/cfoi/cftb0263.pdf (accessed June 6, 2014).

BLS (2013), "Occupational injuries and illnesses", Annual news release, available at: www.bls.gov/news.release/archives/osh_11072013.htm (accessed June 6, 2014).

Calibre Press (2013), "Street survival seminar", available at: http://calibrepress.com/calibre-press/street-survival-seminar/ (accessed June 28, 2014).

Clark, M.M., Warren, B.A., Hagen, P.T., Johnson, B.D., Werneburg, B. and Olsen, K.D. (2011), "Stress level, health behaviors, and quality of life in employees joining a wellness center", *Am J Health Promot*, Vol. 26 No. 1, pp. 21-25.

Clarke, C. and Zak, M.J. (1999), *Fatalities to Law Enforcement Officers and Firefighters, 1992-1997*, Publication CF AR CWC, Department of Labor, Bureau of Labor Statistics, Washington, DC, pp. 1-10.

Code of Federal Regulations (2007), "Code of Federal Regulations (CFR) 23, Part 634.4", available at: http://edocket.access.gpo.gov/cfr_2007/aprqtr/pdf/23cfr634.4.pdf (accessed June 11, 2014).

Cox, S. and Tait, R. (1991), *Reliability, Safety and the Human Factor*, Butterworth-Heineman, Stoneham, MA.

Cree, T. and Kelloway, K. (1997), "Responses to occupational hazards: exit and participation", *J Occup Health Psychol*, Vol. 2 No. 4, pp. 304-311.

Dejoy, D.M. (1989), "The optimism bias and traffic accident risk perception", *Accid Anal Prev*, Vol. 21 No. 4, pp. 333-340.

Deschamps, F., Paganon-Badinier, I., Marchand, A.C. and Merle, C. (2003), "Sources and assessment of occupational stress in the police", *Journal of Occupational Health*, Vol. 45 No. 6, pp. 358-364.

Federal Bureau of Investigation (2013), "2012 statistics on law enforcement officers killed and assaulted", available at: www.fbi.gov/about-us/cjis/ucr/leoka/2012/press-release-summary-of-2012/press-release_leoka_-2012 (accessed June 6, 2014).

Fleming, M. and Buchan, D. (2002), "Risk is in the eye of the beholder", *Safety Health Practitioner*, Vol. 20, pp. 30-32.

Gershon, R.M., Barocas, B., Canton, A.N., Li, X. and Vlahov, D. (2009), "Mental, physical, and behavioral outcomes associated with perceived work stress in police officers", *Criminal Justice and Behavior*, Vol. 36 No. 3, pp. 275-289.

Glik, D., Kronenfeld, J. and Jackson, K. (1991), "Predictors of risk perceptions of childhood injury among parents of preschoolers", *Health Educ Q*, Vol. 18 No. 3, pp. 285-301.

Gustafson, B.G. (2013), "Realizing safe driving: effects of multi-disciplinary research and intervention in California", *The Police Chief*, Vol. 80, May, pp. 14-15.

Harrel, W.A. (1998), "Perceived risk of work-related injury and intentions to change employment", *Psychological Report*, Vol 84 No. 1, pp. 273-276.

Hatcher L. (1994), *A Step-by-Step Approach to Using the SAS System for Factor Analysis and Structural Equation Modeling*, SAS Publishing, Cary, NC.

Hessl, S.M. (2003), "Introduction to the history, demographics, and health effects of law enforcement work", *Clin Occup Environ Med*, Vol. 3 No. 3, pp. 369-384.

Huang, Y.H., Ho, M., Smith, G.S. and Chen, P.Y. (2006), "Safety climate and self-reported injury: assessing the mediating role of employee safety and control", *Accid Analy Preevntion*, Vol. 38 No. 3, pp. 425-433.

Kercher, C., Swedler, D.I., Pollack, K.M. and Webster, D.W. (2013), "Homicides of law enforcement officers responding to domestic disturbance calls", *Injury Prevention*, Vol. 19 No. 5, pp. 331-335.

Kresta, J.V., Marlin, T.E. and MacGregor, J.F. (1994), "Development of inferential process models using PLS", *Computer and Chemical Engineering*, Vol. 18 No. 7, pp. 597-611.

Lavack, A.M., Magnuson, S.L., Deshpande, S., Basil, D.Z. and Mintz, J.H. (2008), "Enhancing occupational health and safety in young workers: the role of social marketing", *International Journal of Nonprofit and Voluntary Sector Marketing*, Vol. 13 No. 3, pp. 193-204.

Leigh, J.P. (2011), "Economic burden of occupational injury and illness in the United States", *Milbank Quarterly*, Vol. 89 No. 4, pp. 728-772.

Leigh, J.P., James, P., Marcin, J. and Miller T.R. (2004), "An estimate of the US government's undercount of nonfatal occupational injuries", *Journal of Occupational and Environmental Medicine*, Vol. 46 No. 1, pp. 10-18.

Locke, D.E., Decker, P.A., Sloan, J.A., Brown, P.D. and Malec, J.F. (2007), "Validation of single-item linear analog scale assessment of quality of life in neuro-oncology patients", *J Pain Symptom Manag*, Vol. 34 No. 6, pp. 628-638.

Melia, J.L., Mearns, K., Silva, S.A. and Lima, M.L. (2008), "Safety climate responses and the perceived risk of accidents in the construction industry", *Safety Science*, Vol. 46 No. 6, pp. 949-958.

Moveoveramerica (2014), "Protect law enforcement and emergency responders", available at: www.moveoveramerica.com (accessed June 16, 2014).

Mullen, J. (2004), "Investigating factors that influence individual safety behavior at work", *Journal of Safety Research*, Vol. 35 No. 3, pp. 275-285.

National Highway Traffic Safety Administration (2003), *The Economic Burden of Traffic Crashes on Employers: Costs by State and Industry and by Alcohol and Restraint Use*, Department of Transportation, Washington, DC.

National Law Enforcement and Corrections Technology Center (2012), *A Primer on Body-Worn Cameras for Law Enforcement*, ManTech Advanced Systems International Inc., Fairmount, WV.

National Law Enforcement Memorial Fund (NLEOMF) (2013), "Law enforcement fatalities dip to lowest level in six decades", available at: www.nleomf.org/assets/pdfs/reports/2013-End-of-Year-Preliminary-Report.pdf (accessed June 2, 2014).

National Law Enforcement Memorial Fund (2014), "Causes of law enforcement deaths", available at: www.nleomf.org/facts/officer-fatalities-data/causes.html (accessed June 2, 2014).

Nelkin, D. and Brown, M.S. (1984), *Workers at Risk: Voices from the Workplace*, University of Chicago Press, Chicago, IL.

O'Hara, A.F. and Violanti, J.M. (2009), "Police suicide – a web surveillance of national data", *Int J of Emerg Mental Health*, Vol. 11 No. 1, pp. 17-24.

Ricketts, M., Shanteau, J., McSpadden, B. and Fernandez-Medina, K.M. (2010), "Using stories to battle unintentional injuries: narratives in safety and health communication", *Social Science and Medicine*, Vol. 70 No. 9, pp. 1441-1449.

Rosenstock, I.M., Strecher,V.J. and Becker M.H. (1988), "Social learning theory and the health belief model", *Health Education Quarterly*, Vol. 15 No. 2, pp. 175-183.

Rundmo, T. (1995), "Perceived risk, safety status, and job stress among injured and noninjured employees on offshore petroleum installations", *J Safety Res*, Vol. 26 No. 2, pp. 87-97.

Stockton, D., Graham, G., Yates, T., Chudwin, J., Willis, B. and Young, M. (2010), "Below 100: an initiative to change our profession – & you", *Law Officer Magazine*, October 10, available at: www.lawofficer.com/article/below-100/below-100 (accessed June 15, 2014).

Svenson, O., Fischhoff, B. and MacGregor, D. (1985), "Perceived driving safety and seatbelt usage", *Accid Anal Prev*, Vol. 17 No. 2, pp. 119-133.

Tiesman, H.M., Hendricks, S.A., Bell, J.L. and Amandus, H.A. (2010), "Eleven years of occupational mortality in law enforcement: the census of fatal occupational injuries, 1992-2002", *Am J Ind Med*, Vol. 53 No. 9, pp. 940-949.

Tiesman, H.M., Swedler, D.I., Konda, S. and Pollack, K.M. (2013), "Fatal occupational injuries among US law enforcement officers: a comparison of national surveillance systems", *American Journal of Industrial Medicine*, Vol. 56 No. 6, pp. 693-700.

Tversky, A. and Kahneman, D. (1973), "Availability: a heuristic for judging frequency and probability", *Cogn Psychol*, Vol. 5, pp. 207-232.

United States House of Representatives (2008), "Hidden tragedy: underreporting of workplace injuries and illnesses", available at: www.gpo.gov/fdsys/pkg/CHRG-110hhrg42881/pdf/CHRG-110hhrg42881.pdf (accessed June 6, 2014).

Violanti, J.M., Fekedulegn, D., Andrew, M.E., Charles, L.E., Hartley, T.A., Vila, B. and Burchfiel, C.M. (2012), "Shift work and the incidence of injury among police officers", *Am J Ind Med*, Vol. 55 No. 3, pp. 217-227.

Watzke, J.R. and Smith, D.B.B. (1994), "Concern and knowledge of safety hazards among older people: implications for research and prevention", *Exp Aging Res*, Vol. 20 No. 3, pp. 177-188.

Wehr, K., Alpert, G. and Rojek, J. (2012), "The fear of the ninja assassin: understanding the role of agency culture in injurious and fatal on-duty vehicle collisions", *Journal of California Law Enforcement*, Vol. 46, pp. 18-26.

Weyman, A.K. and Kelly, C.J. (1999), "Risk perception and risk communication: a review of the literature", Research Report No. 248/99, Health and Safety Executive, available at: www.hse.gov.uk/index.htm (accessed June 8, 2014).

Wiegman, O., Gutteling, J.M. and Boehr, H. (1991), "Verification of information through direct experience with an industrial hazard", *Basic and Applied Social Psychology*, Vol. 12 No. 3, pp. 325-339.

Zimmerman, F.H. (2012), "Cardiovascular disease and risk factors in law enforcement personnel: a comprehensive review", *Cardiol Rev*, Vol. 20 No. 4, pp. 159-166.

Zwerling, C., Sprince, N.L., Wallace, R.B., Davis, C.S., Whitten, P.S. and Heeringa, S.G. (1995), "Effect of recall period on the reporting of occupational injuries among older workers in the health and retirement study", *Am J Ind Med*, Vol. 28 No. 5, pp. 583-590.

About the authors

Dr Hope M. Tiesman is a Research Epidemiologist with the National Institute for Occupational Safety and Health (NIOSH). Dr Tiesman completed her MSPH in Epidemiology from the University of South Florida and her PhD in Epidemiology from the University of Iowa. While at Iowa, she was a Fellow in the occupational injury prevention research program at the Heartland Center for Occupational Health & Safety. She has an Adjunct Academic appointment in the West Virginia University (WVU) College of Public Health and is an Affiliate Faculty at the WVU Injury Control Research Center. At NIOSH, her research focusses on motor-vehicle crashes among law enforcement officers, workplace suicide, and workplace violence prevention. Dr Hope M. Tiesman is the corresponding author and can be contacted at: htiesman@cdc.gov

Dr Rebecca J. Heick is an Assistant Professor of Public Health at MCPHS University, Boston, MA. She completed her MS in Community Health Education at Western Illinois University, Macomb, IL and her doctorate in Occupational & Environmental Health at the University of Iowa College of Public Health, Iowa City, IA. Her work focuses primarily on occupational injury epidemiology and prevention. Current areas of interest include psychological health and occupational safety for first responders and health-related surveillance during disasters for responders and impacted populations.

Dr Srinivas Konda is an Associate Service Fellow with the National Institute for Occupational Safety and Health in Morgantown, WV. He completed his MPH in Epidemiology and Biostatistics from the University of Southern Mississippi, Hattiesburg, MS. His work focusses on projects related to the prevention of workplace injury and violence. Current areas of research include occupational traumatic brain injuries, injuries to emergency medical service workers, and occupational safety of law enforcement officers.

Dr Scott Hendricks is a Statistician employed by the NIOSH. He received his MS in statistics degree from the West Virginia University. Dr Hendricks has published numerous articles in the topic area of occupational injury and fatality.