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Characteristics of crashes and injuries among 14 and 15 year old drivers, by rurality

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Abstract

Purpose: Motor-vehicle crashes continue to be the leading cause of death for teenagers in the United States. The United States has some of the youngest legal driving ages worldwide. The objective of this study was to determine rates and factors associated with injury crashes among 14- and 15-year-old drivers and how these varied by rurality.

Methods: Data for this cross-sectional study of 14- and 15-year-old drivers were obtained from the Iowa Department of Transportation from 2001 to 2013. Crash and injury crash rates were calculated by rurality. The relationship between crash and driver factors and injury was assessed using logistic regression.

Findings: Teen drivers, aged 14 and 15 years, had a statewide crash rate of 8 per 1,000 drivers from 2001 to 2013. The majority of crashes occurred in urban areas (51%), followed by in town (29%), remote rural areas (13%), and suburban areas (7%). Crash and injury crash rates increased as level of rurality increased. The odds of an injury crash increased more than 10-fold with the presence of multiple other teens as passengers, compared to no passengers (OR= 10.7, 95% CI: 7.1–16.2).

Conclusions: Although 14- and 15-year-old drivers in Iowa have either limited unsupervised (school permits) or supervised only driving restrictions, they are overrepresented in terms of crashes and injury crashes. Rural roads and multiple teen passengers are particularly problematic in terms of injury outcomes.

Practical applications: Results from this study support passenger restrictions and teen driving interventions designed with a rural focus.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Keywords

Teens; Young; Novice; Fatal

1. Introduction

Unintentional injuries are the leading cause of death for teenagers in the United States and motor vehicle injuries represent over two-thirds of all unintentional injury deaths in the past decade (Centers for Disease Control and Prevention, 2017; National Center for Injury Prevention and Control, 2017b). Compared to most other countries, current licensing practices throughout the United States allow for driving to start at early ages, in the early to mid-teens. Most states have some type of graduated licensing system that begins with supervised driving and then allows restricted unsupervised driving during an intermediate licensing period. After the intermediate phase is successfully completed, drivers graduate to non-restricted unsupervised driving. Ten states have graduated driver licensing (GDL) programs that start a supervised learner's phase at age 14 and 32 states at age 15 (Insurance Institute for Highway Safety, 2017b). Four states have intermediate licensing (unsupervised driving, with restrictions) starting at age 15, and in South Dakota the intermediate stage can start as early as age 14 years, 3 months if the teen has taken driver's education (Insurance Institute for Highway Safety, 2017b).

In the state of Iowa, the GDL learner's phase can begin at age 14 (Fig. 1). However, Iowa, along with just a couple of other states such as Nebraska, have legislation allowing 14- and 15-year-old teens to obtain a minor school license, which permits unsupervised driving to/from school and school-related events (AAA, 2018; Iowa Department of Transportation, 2017). The Iowa school permit requires completion of a driver's education course and to have had a learner's permit for six months.

Iowa is a largely rural state, so many teens with school permits drive on rural roads. Rural roads have increased fatality, injury, and crash rates compared to other road types (NHTSA, 2015; Zwerling et al., 2005). The combination of increased rural road exposure with limited driving experience, incomplete physical and cognitive development, and overall emotional immaturity puts these young teens, age 14 and 15, at a potentially higher risk of crash, compared to older teen drivers (Jonah, 1990, 1986; Mayhew, Simpson, & Pak, 2003).

Teen driver fatalities have been steadily declining in the past several decades (69% decrease from 1975 compared to 2015), indicating that prevention strategies have made progress, particularly among the higher risk male population (Insurance Institute for Highway Safety, 2017a). Recent data show a slight uptick, with a 7% increase from 2015 to 2017 (Centers for Disease Control and Prevention, 2017). Teen crash prevention remains a priority, as there are thousands of teens killed and injured each year in motor-vehicle crashes. In 2015, 2,715 teens were killed and nearly 292,000 visited emergency departments for injuries related to motor-vehicle crashes (Insurance Institute for Highway Safety, 2017a; National Center for Injury Prevention and Control, 2017b). Young drivers are at greatest risk of having a crash in the first months following licensure that permits unsupervised driving (Mayhew et al., 2003).

The majority of current research on teen driving has focused on the transition from the learner's phase to the intermediate phase, which often occurs on or after the age of 16. Little is known about driving crash characteristics of 14- and 15-year-old drivers. The number of young teens seeking minor school licenses is increasing continuously in Iowa. As of 2016, there were over 48,000 14- and 15-year-old drivers with school licenses (Iowa Department of Transportation, 2017).

The overall goal of this study was to determine factors related to crashes and injury crashes among young teen drivers, age 14 and 15, by rurality. The central hypothesis was that young driver crash and injury rates would be higher on rural roads, as compared to urban. We had two specific aims: (1) compare the frequency of crashes and injury crashes by rurality for 14- and 15-year-old drivers, and (2) determine the driver and crash factors associated with rural injury crashes among 14- and 15-year-old drivers in Iowa from 2001 to 2013.

2. Methods

2.1. Study design and data

This is cross-sectional study of young (age 14 and 15) teen driver crashes in Iowa. Crash data were obtained from the Iowa Department of Transportation for 2001 to 2013 for crashes that involved drivers aged 14 and 15. These crash data include all reported motor-vehicle crashes that resulted in death, injury, or property damage greater than \$1500. The database is organized hierarchically, with three nested levels: crash, vehicle, and person. The unit of analysis was the teen driver.

Population data for each county were obtained from the State Data Center of Iowa, Iowa Census data (State Data Center of Iowa, 2010). These census data provided population data for the age group 14–17. Each county's average population of 14- to 17 year olds was divided in half to estimate the population of 14- and 15-year olds, assuming each age in years was equally represented. Data were only available for years 2000–2009, so the missing years (2010–2013) were estimated by calculating and applying the average annual change, with the assumption that the average annual change would not have drastically differed from the preceding years.

2.2. Variables

Crash and driver level variables were examined as part of this study. The following crash level factors were included and defined as follows: day of week (weekday/weekend); time of crash (morning: 6 a.m. to 9:59 a.m., afternoon: 10 a.m. to 2:59 p.m., evening: 3 p.m. to 9:59 p.m., and night: 10 p.m. to 5:59 a.m.); manner of collision (non-collision, head-on, rear-end, angle, sideswipe); number of vehicles involved in crash (single, multiple); weather (clear, not clear); and road surface condition (dry, not dry).

Driver level variables that were examined included: driver age (14 or 15); driver gender (male/female); injury severity (fatal/incapacitating, non-incapacitating/possible, and no injury); occupant protection (none, shoulder and lap belt, lap belt only, shoulder belt only, and other); driver contributing circumstances (no error, failure to yield right-of-way, improper action, failure to obey traffic signal, speeding, lost control, and other); and

passenger presence (none, one teen passenger, multiple teen passengers, at least one adult passenger-- regardless of other passengers). For purposes of this study, an adult was defined as a person at least 21 years old and a teen was defined as ages 13–19. All child passengers (aged <13) were captured within the ‘at least one adult passenger—regardless of other passengers’ category.

Rurality was assessed using Urban Influence Codes (UIC), which are defined at the county level. UIC classifies metropolitan counties by their metro area population size and nonmetropolitan counties by the population of their largest city or town, as well as their proximity to metro or micropolitan areas (USDA, 2016). County codes for each crash location were linked to UIC codes (1–12). These codes were then collapsed into four categories: urban (UIC codes 1 and 2), suburban (UIC codes 3–5), town (UIC codes 6–8), and remote rural (UIC codes 9–12).

2.3. Analysis

Distributions and descriptive statistics (chi-square) of all driver and crash characteristics were evaluated for all teen driver crashes and injury crashes and by rurality. Crash and injury crash rates per 1,000 teens and rate ratios were computed overall and by rurality.

The main exposure variable of interest for this analysis was rurality, measured through the four codes based on UIC categories of crash location. The main outcome variable was injury crash (versus non-injury crash). Multivariable logistic regression models were built to examine the association between crash and driver factors and injury crashes. Crash and driver characteristics that were associated with injury crashes at the $p \leq 0.20$ level were considered for model inclusion. Collinearity and model fit were examined for final variable selection.

Occupant protection was excluded from the multivariable model, given the large proportion of missing data (51%; Table 2). Number of vehicles was excluded from the final model due to collinearity with manner of collision. Sex was retained in the final model, despite failure to meet inclusion criteria ($p = 0.44$), based on a priori evidence showing sex as an important to injury in a crash (Kahane, 2013).

Missing, unknown, and not reported data, as well as non-motor vehicle crashes (e.g., bicycle or pedestrian) were excluded from the final multivariable model ($n = 835$, 9.9%). All analyses for this study were generated using SAS Software, Version 9.4 (SAS, 2012).

3. Results

3.1. Young teen driver crashes in Iowa

Fourteen and 15-year-old drivers in Iowa were involved in a total of 8,466 crashes from 2001 to 2013 for an average of more than 700 per year, among which 22% ($N = 1824$) were injury crashes. Fig. 2 shows the changes over time in all crashes and injury crashes among 14- and 15-year-old drivers. After an increase in crashes from 2001 to 2003, both all crashes and injury crashes showed decreasing numbers until about 2011, at which time these decreases plateau.

The majority of crashes occurred in urban areas ($n = 4327$, 51%), followed by 29% in town, 13% in remote rural areas, and 7% in suburban areas (Table 1). Crash and injury crash rates per 1,000 teens increased with rurality, with the highest rates in remote rural areas. Compared with urban environments, minor school license crashes were 1.11 (95% CI 1.06–1.16) times more common in towns and 1.15 (95% CI 1.08–1.22) times more common in remote rural areas. Crash rate trends by rurality were more pronounced for injury crashes, in which, compared with urban crashes, town crashes were 1.44 (95% CI 1.33–1.55) times more frequent and remote rural crashes were 1.64 times more frequent (95% CI 1.51–1.77).

There were slightly more males (52%) represented in these crashes than females and the majority of the sample were 15 years old (81%; Table 2). Among the non-missing data, 95% of teens wore seat belts. However, 51% of the data for this variable were missing. The majority of crashes had no passengers in the vehicle with the teen driver (89%). Among the crashes that did have passengers, half had one teen passenger ($n = 417$, 49%) and 19% had multiple teen passengers. Sixty-five percent of the crashes with teen passengers resulted in injuries, compared to 16% of crashes with no passengers.

The majority of crashes reported the teen driver as having contributed to the crash ($n = 6109$, 77%). The most common contributing circumstances were loss of control (22%), failure to yield right-of-way (18%), other improper action (15%), and speeding (13%). Among injury crashes, loss of control was an even more pronounced contributor, at 38% overall. More teen crashes occurred during weekdays and in the evening (3 p.m.–9:59 p.m.; Table 3), compared to weekends and all other hours. Teen crashes were more likely to involve multiple vehicles and dry road surface conditions, compared to single vehicle and non-dry conditions.

3.2. Young teen crash and driver injury risk factors

We did not find a difference in injury risk between 14- and 15-year olds (Table 4). Male drivers had lower odds of injury in a crash compared to females (OR= 0.68, 95% CI = 0.60–0.77). Crashes that involved driver loss of control were 42% more likely to result in injury, compared to crashes with no driver error reported (OR= 1.42, 95% CI = 1.13–1.79).

Compared to no passengers, having passengers generally increased the odds of injury in a crash. Having multiple teen passengers in the car resulted in the highest odds of injury (OR= 10.73, 95% CI = 7.10–16.22). However, having one teen passenger also increased the likelihood of injury by nearly five times (OR= 4.88, 95% CI = 3.88–6.14) and at least one adult passenger (regardless of other passengers) presented increased odds of injury over seven times that of no passengers on board (OR= 7.22, 95% CI = 5.44–9.59). However, it should be noted that only 10% of all crashes included any passengers (one or more).

4. Discussion

Findings from this study indicate motor-vehicle crashes among 14- and 15-year-old drivers are a public health problem in need of intervention and often lead to injury, especially in rural areas. This finding is consistent with previous younger teen driver research that included drivers ages 10–15 (Peek-Asa, Britton, Young, Pawlovich, & Falb, 2010). However, when compared to older teen and novice drivers (ages 16–24) research, urban areas have

been identified as more problematic than rural areas in terms of crash rates (Chen, Ivers, & Martiniuk, 2009; Peek-Asa et al., 2010).

Possible explanations for this difference between 14- and 15-year-olds and their older novice counterparts is exposure. In Iowa, teens can get a minor school license (school permit) as early as age 14 and a half, which allows them to drive to school and school activities unsupervised (Iowa Department of Transportation, 2018). This young age of unsupervised driving is an exception to the overall graduated driver licensing system, which does not otherwise allow for unsupervised driving until age 16. A teen must live over one mile from school in order to obtain a school permit and, generally, there is an overrepresentation of rural teens with school permit. Only a few states have similar options for limited minor licenses (Insurance Institute for Highway Safety, 2017b), school, or farm permits (e.g., Nebraska allows for a limited license/school permit for teens age 14 years and two months of age to drive independently to and from school; Kansas has an option for farm permits for 14- and 15-year olds that allows unsupervised driving to or from farm jobs or farm-related work) (Kansas Department of Revenue, 2018).

The increased unsupervised driving exposure by inexperienced young drivers with school permits is problematic, especially when driving on rural roads, which have unique designs challenges (e.g., gravel, higher speeds, uncontrolled intersections, low visibility) that contribute to increased crash risk (Peek-Asa et al., 2010, 2004; Zwerling et al. 2005). Rural roadway exposure in combination with inexperience may also partially explain why one of the main contributors to crashes and injuries was loss of control.

Consistent with previous studies of 16-year-old drivers, we found that young teen drivers have many evening crashes. This trend was originally used to support night driving restrictions for graduated driver licensure legislation (Williams & Preusser, 1997; Rice, Peek-Asa, & Kraus, 2003). The school permit allows unsupervised evening and nighttime driving for school events, which is not allowed in the intermediate phase of GDL. Presence of any passenger was also associated with higher odds of an injury crash, regardless of passenger age, and having multiple teen passengers had higher odds than one teen passenger or at least one adult passenger (regardless of other passengers). This is a similar trend used to support passenger restrictions for GDL (Chen et al., 2000; Williams, Ferguson, & McCartt, 2007; Williams, 2003). The school permit limits the car to one minor passenger without an adult present, and our data indicate that this limitation is violated, and this violation is related to crash risk.

In general, states have found that stronger GDL laws, including longer nighttime driving restriction windows and passenger restrictions, to be beneficial (Rice et al., 2003; Curry et al., 2012; Chen et al., 2000; Williams, 2017; Williams & Preusser, 1997). Iowa GDL nighttime unsupervised driving restrictions are only in effect between 12:30 a.m. and 5 a.m. (Iowa Department of Transportation, 2018). Iowa also has a teen passenger restriction, but there is an option for parents to waive this restriction at the time the license is issued (Iowa Department of Transportation, 2018) and a majority elect this waiver (Lucey, 2015).

5. Limitations

Data for this study are limited to that among teens who crashed and the crash was reported, which poses a potential for bias toward fatal/incapacitating crashes, which are more likely to have been reported (compared to more minor crashes). This lack of base population data also did not allow us to examine overall crash risk factors. Instead, we examined risk factors for an injury occurring in a crash. Driving exposure data (which teens drive and how much) were also not available. Therefore, the base population of teenage drivers and exposure was not known and rates were calculated using overall teen population. This likely resulted in conservative estimates, biased toward the null, if rural teens drive more overall miles than urban teens.

The measure of rurality in this analysis was based on crash location, not teen residence, which did not allow for examination of crash rates by teen rurality. Instead, we measured the overall burden of crashes by rurality. Prior research has shown that most of a driver's miles (exposure) are driven within the same area as which they live (i.e., rural residents drive most miles in rural areas and urban residents drive most miles in urban areas) (Blatt & Furman, 1998; McAndrews, Beyer, Guse, & Layde, 2016; Baker, Whitfield, & O'Neill, 1987) and this pattern has also been seen in crash location versus driver residence (Blatt et al., 1998). The use of UIC as the measure of rurality was also limited to the county-level, so any within-county rurality variance was not captured.

Occupant protection was not included in our models, given the large amount of missing data. This is a limitation, given that the use of protection is known to impact injury outcomes. However, among non-missing data 95% of the study population were belted. Finally, these results have limited generalizability beyond the 14- and 15-year-old age group. However, this is a minimal limitation, given this population is understudied and uniquely vulnerable.

6. Conclusions and practical applications

Results from this study support the strengthening of Iowa's GDL and licensing policies related to school permits, nighttime driving, and passenger restrictions. This research also highlights the need for targeted crash and injury prevention approaches for this vulnerable population of young teen drivers and rural roadways.

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Biography

Cara Hamann is a Clinical Assistant Professor in Epidemiology and the Injury Prevention Research Center at the University of Iowa. Her main research interest is transportation safety, with a focus on vulnerable and high-risk road users, including novice and older drivers, motorcyclists, bicyclists, and pedestrians. She has a PhD in epidemiology from the University of Iowa and a Master's in Public Health from the University of North Texas Health Science Center.

Morgan Price is a Human Factors Design Engineer at Apple. Prior to this position she was a Graduate Research Assistant in the Human Factors division in the Department of Industrial & Systems Engineering at the University of Wisconsin-Madison. Working in the Cognitive Systems Lab, her interests were in modeling driver's behavioral adaptation to varying levels of automation as well as developing coordinative mechanisms by which highly automated vehicles can convey capability and establish trust with drivers. She has a MS in Epidemiology and a BSE in Biomedical Engineering both from the University of Iowa and a doctorate and MS in Industrial & Systems Engineering from the University of Wisconsin-Madison.

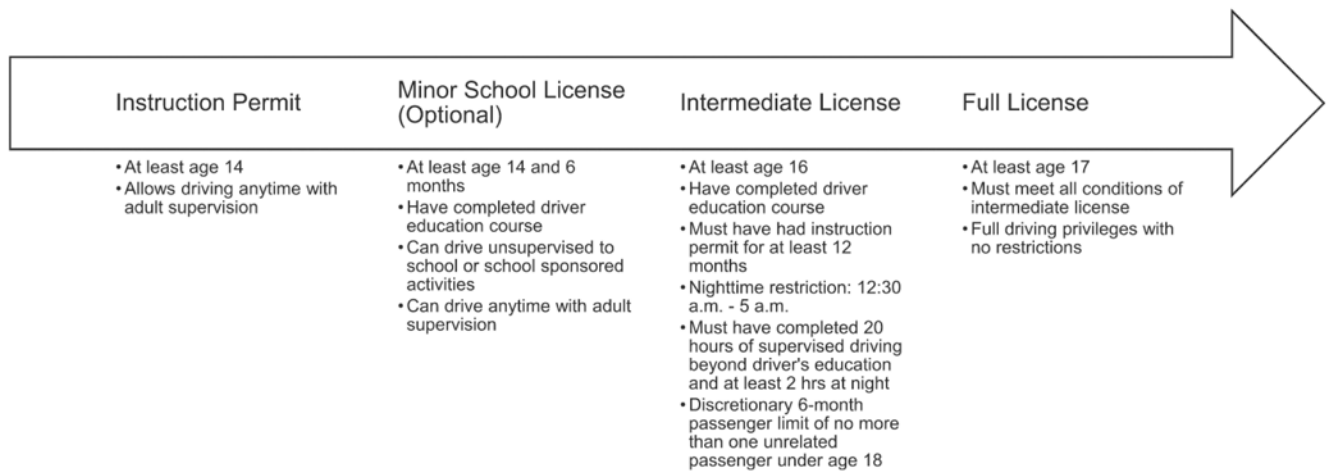
Corinne Peek-Asa is the Associate Dean for Research for the University of Iowa College of Public Health and professor in the Department of Occupational and Environmental Health. She is also the Director of the University of Iowa Injury Prevention Research Center. Her area of expertise is injury and violence prevention. She conducts research in the areas of global road traffic safety, interpersonal violence, workplace violence, residential fire injuries, poisoning, and acute care. Her work includes surveillance; risk factor identification; design, implementation, and evaluation of prevention programs; design and evaluation of safety policy; and, translation and dissemination methods.

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**Fig. 1.**

Summary of Iowa's Graduated Driver's License System for Drivers under age 18.

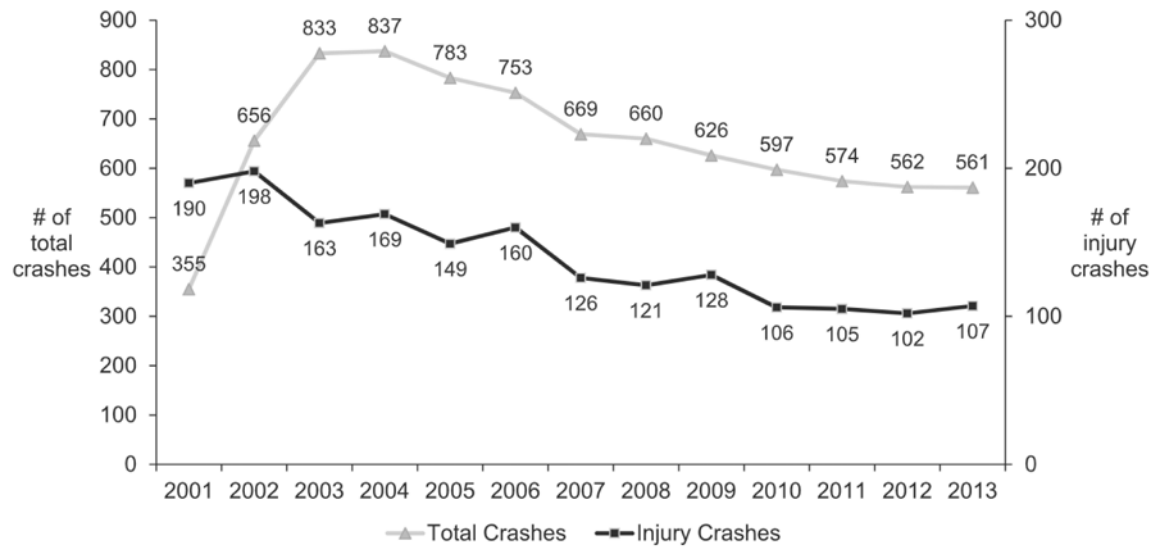


Fig. 2.
Frequency of total and injury crashes among 14- and 15-year-old drivers, Iowa, 2001–2013.

Table 1

Rates and rate ratios of all crashes and injury crashes among 14- and 15-year-old drivers by rurality, Iowa, 2001–2013.

	Rate of All Crashes			Rate of Injury Crashes		
	Number of crashes	Population of 14–15 year olds in Iowa	Rate per 1000 teens (95% CI)	Number of crashes	Population of 14–15 year olds in Iowa	Rate Ratio (95% CI)
Total Rurality*	8,466	1,089,605	7.77	1,824	1,089,605	1.67
Urban	4,327	584,224	7.41	813	584,224	1.39
Suburban	568	74,322	7.64	110	74,322	1.48
Town	2,442	298,299	8.19	598	298,299	2.00
Remote Rural	1,129	132,760	8.50	303	132,760	2.28
						1.64 (1.51, 1.77)

* Rurality by Urban Influence Category.

Table 2

Distributions of *driver* characteristics by rurality, all crashes ($n = 8466$).

Characteristic	Total	Urban <i>n</i> (%)	Suburban <i>n</i> (%)	Town <i>n</i> (%)	Remote Rural <i>n</i> (%)	Chi-square * <i>p</i> -value
Driver age						
14 years old	1,579 (19%)	765 (18%)	112 (20%)	472 (19%)	230 (20%)	0.12
15 years old	6,887 (81%)	3,562 (82%)	456 (80%)	1970 (81%)	899 (80%)	0.44
Driver gender						
Female	4,012 (48%)	2,053 (48%)	260 (46%)	1,181 (49%)	518 (46%)	
Male	4,425 (52%)	2,252 (52%)	307 (54%)	1,256 (51%)	610 (54%)	
Missing	29 (0.3% of all crashes)					
Injury status						
Fatal/incapacitating	145 (2%)	58 (1%)	6 (1%)	57 (2%)	24 (2%)	<0.0001
Non-incapacitating/possible	1,679 (20%)	755 (18%)	104 (18%)	541 (22%)	279 (25%)	
No Injury	6,642 (78%)	3,514 (81%)	458 (81%)	1,844 (76%)	826 (73%)	
Occupant protection						
None used	237 (4%)	96 (3%)	13 (4%)	91 (6%)	37 (5%)	0.0021
Should & lap belt	5,305 (95%)	2859 (96%)	353 (95%)	1455 (93%)	638 (93%)	
Lap belt	24 (0.4%)	11 (0.4%)	1 (0.3%)	7 (0.5%)	5 (1%)	
Shoulder belt	20 (0.4%)	6 (0.2%)	3 (1%)	6 (0.4%)	5 (1%)	
Other	9 (0.2%)	3 (0.1%)	1 (0.3%)	4 (0.3%)	1 (0.2%)	
Missing	2871 (51% of crashes)					
Driver contributing circumstance						
No error	1,824 (23%)	956 (24%)	125 (23%)	490 (21%)	253 (24%)	<0.0001
FTYROW	1,395 (18%)	707 (18%)	115 (21%)	402 (18%)	171 (16%)	
Improper action	1,214 (15%)	682 (17%)	66 (12%)	320 (14%)	146 (14%)	
Failure to obey traffic signals	296 (4%)	182 (5%)	25 (5%)	70 (3%)	19 (2%)	
Speeding	1,021 (13%)	488 (12%)	72 (13%)	314 (14%)	147 (14%)	
Lost control	1,718 (22%)	806 (20%)	112 (21%)	527 (23%)	273 (25%)	
Other	465 (6%)	195 (5%)	29 (5%)	171 (7%)	70 (7%)	
Missing	533 (7% of crashes)					
Passengers						

Characteristic	Total	Urban n (%)	Suburban n (%)	Town n (%)	Remote Rural n (%)	Chi-square p-value [*]
No passengers	7,491 (89%)	3,886 (91%)	516 (92%)	2115 (88%)	974 (88%)	0.0017
One teen passenger only	417 (5%)	183 (4%)	25 (4%)	149 (6%)	60 (5%)	
Multiple teen passengers only	157 (2%)	67 (2%)	12 (2%)	46 (2%)	32 (3%)	
At least one adult passenger	271 (3%)	136 (3%)	11 (2%)	85 (4%)	39 (4%)	
Missing	103 (2% of crashes)					

^{*} Test for independence.

Table 3

Distributions of *crash* characteristics by rurality, all crashes ($n = 8,466$).

Characteristic	Total <i>n</i> (%)	Urban <i>n</i> (%)	Suburban <i>n</i> (%)	Town <i>n</i> (%)	Remote Rural <i>n</i> (%)	Chi-square* <i>p</i> -value
Day of Week						
Weekday	7,029 (83%)	3,535 (82%)	482 (85%)	2,049 (84%)	963 (85%)	0.0066
Weekend	1,437 (17%)	792 (18%)	86 (15%)	393 (16%)	166 (15%)	
Time of Day						
Morning	1,837 (22%)	918 (21%)	105 (18%)	547 (22%)	267 (24%)	<0.0001
Afternoon	1,717 (20%)	998 (23%)	128 (23%)	414 (17%)	177 (16%)	
Evening	4,392 (52%)	2,143 (50%)	300 (53%)	1331 (55%)	618 (55%)	
Night	500 (6%)	262 (6%)	35 (6%)	141 (6%)	62 (5%)	
Missing	22 (0.24% of crashes)					
Manner of Collision						
Non-collision	2,566 (31%)	1,086 (26%)	176 (31%)	873 (36%)	431 (39%)	<0.0001
Head-on	199 (2%)	101 (2%)	17 (3%)	61 (3%)	20 (2%)	
Rear-end	2,180 (26%)	1,263 (30%)	118 (21%)	542 (23%)	257 (23%)	
Angle	2,601 (31%)	1,361 (32%)	200 (36%)	723 (30%)	317 (28%)	
Sideswipe	769 (9%)	431 (10%)	49 (9%)	200 (8%)	89 (8%)	
Missing	151 (2% of crashes)					
Number of Vehicles						
Single Vehicle (non-collision)	2,580 (30%)	1,086 (25%)	178 (31%)	886 (36%)	430 (38%)	<0.0001
Multiple Vehicles	5,886 (70%)	3,241 (75%)	390 (69%)	1,556 (64%)	699 (62%)	
Weather						
Clear	4,745 (58%)	2,454 (58%)	324 (58%)	1,323 (56%)	644 (58%)	<0.0001
Not Clear	3,494 (42%)	1,763 (42%)	230 (42%)	1,039 (44%)	462 (42%)	
Missing	241 (3% of crashes)					
Road Surface Condition						
Dry	5,588 (68%)	2,990 (71%)	379 (68%)	1,505 (64%)	714 (64%)	<0.0001
Not Dry	2,661 (32%)	1,229 (29%)	178 (32%)	857 (36%)	397 (36%)	
Missing	217 (3% of crashes)					

* Test for independence.

Table 4

Predictors of injury crashes among 14- and 15-year-old drivers involved in motor vehicle crashes, Iowa, 2001–2013 ($n = 8,466$).

Characteristic	Total injury crashes n (%)	Univariable analysis		Multivariable model	
		Crude OR ^a	95% CI	Adjusted OR ^a	95% CI
Driver age					
14 years old	376 (21%)	REF.		REF.	
15 years old	1,448 (79%)	0.85	(0.75, 0.97)	1.02	(0.87, 1.19)
Driver gender					
Female	975 (54%)	REF.		REF.	
Male	843 (46%)	0.73	(0.66, 0.81)	0.68	(0.60, 0.77)
Occupant protection					
None used	140 (10%)	REF.			
Shoulder & lap belt	1,309 (89%)	0.23	(0.17, 0.30)		
Lap belt only	9 (0.3%)	0.42	(0.18, 0.99)		
Shoulder belt only	11 (1%)	0.85	(0.34, 2.12)		
Other	2 (0.1%)	0.19	(0.04, 0.97)		
Driver contributing circumstances					
No error	282 (16%)	REF.		REF.	
FTYROW ^b	185 (11%)	0.84	(0.69, 1.02)	0.87	(0.69, 1.10)
Improper action	152 (9%)	0.78	(0.63, 0.97)	0.88	(0.69, 1.12)
Failure to obey traffic signals	60 (3%)	1.39	(1.02, 1.89)	1.34	(0.94, 1.91)
Speeding	308 (18%)	2.36	(1.96, 2.84)	1.22	(0.96, 1.56)
Lost control	662 (38%)	3.43	(2.92, 4.02)	1.42	(1.13, 1.79)
Other	105 (6%)	1.60	(1.24, 2.05)	0.84	(0.62, 1.15)
Passenger age					
No passengers	1,199 (69%)	REF.		REF.	
One teen passenger	250 (14%)	7.86	(6.40, 9.65)	4.88	(3.88, 6.14)
Multiple teen passengers	122 (7%)	18.29	(12.50, 26.77)	10.73	(7.10, 16.22)
Day of week					
At least one adult passenger	165 (10%)	8.17	(6.35, 10.51)	7.22	(5.44, 9.59)

Characteristic	Total injury crashes n (%)	Univariable analysis		Multivariable model	
		Crude OR ^a	95% CI	Adjusted OR ^a	95% CI
Weekday	1,476 (81%)	REF.		REF.	
Weekend	348 (19%)	1.20	(1.05, 1.37)	0.88	(0.74, 1.04)

^a Odds ratio.

^b Failure to yield right-of-way.