



Unlicensed driving and other related health risk behaviors: A study of Montana high school students



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ARTICLE INFO

Article history:

Received 6 August 2012

Received in revised form 17 January 2013

Accepted 25 January 2013

Keywords:

Traffic safety
Unlicensed driving
Health risk behavior
Safety practice
Young drivers
Drinking driving

ABSTRACT

Purpose: Health risk behaviors tend to cluster in young people, not least among young drivers. Less is known about the health risk profile of young unlicensed drivers. This study investigates health risk behaviors among young unlicensed drivers compared to both their licensed and driving peers, and their non-driving peers.

Methods: High school students participating in the Youth Risk Behavior Surveillance System in Montana (US) and age-eligible to have a driver's license were studied ($n = 5985$), categorized according to their self-reported car driving and license practice (licensed driving, unlicensed driving, and non-driving). Ten health risk behaviors, of which four were related to car riding/driving, were considered. Multinomial logistic regression was used to compile sex-specific odds ratios (with 95% confidence intervals) of adopting those behaviors using licensed drivers as a reference and adjusting for age and race/ethnicity.

Results: Health risk behaviors tended to be more common among unlicensed drivers than other groups, although some behaviors were prevalent in all groups (i.e., alcohol use and lack of seat belt use). As a consequence, for both male and female students, there was a significant association between unlicensed driving and most health risk behaviors, except for being involved in a physical fight and riding with a drinking driver among female students.

Conclusions: Young unlicensed drivers are more likely than licensed drivers to adopt several health risk behaviors both in car driving/riding or otherwise, in particular alcohol use and cigarette smoking. This challenges any simplistic approach as unlicensed driving in youth is not an isolated act suggesting public health and traffic safety initiatives.

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1. Introduction

The road traffic environment represents one of the main sources of danger for young people with 400,000 people younger than 25 dying on the world's roads each year. In high-income countries, 65% of those fatalities involve motor vehicle occupants (WHO, 2011) among which young people are an acknowledged risk group, in particular young male drivers (Arnett, 2002; Bina et al., 2006; Turner and McClure, 2003).

Young people are in the most important developmental period between puberty and emerging adulthood and, the transition brings many important changes and increasing sources of influence. Those, in turn, affect one's way to deal with hazards and proneness to take health and safety risks (Arnett, 2002; Bingham

and Shope, 2004; Voas and Kelley-Baker, 2008). In young males and females, health risk behaviors also tend to co-occur both in individuals (Jessor, 1991) and in the peer group context (Voas and Kelley-Baker, 2008; Williams, 2003). They also develop and accumulate noticeably early among young males (Harré et al., 1996; Turner and McClure, 2003).

Studies indicate that, as a group, young licensed drivers adopt driving behaviors detrimental to their safety on the road (Begg and Gulliver, 2008; Ferguson et al., 2007; McCarthy and Brown, 2004; Petridou et al., 1997; Shope et al., 2003). The addition of other non-driving health risk behaviors partially explains their overrepresentation in injury statistics (Bingham and Shope, 2004; CDC, 2010; Tsai et al., 2008). This is particularly worrying in motorized countries like the United States (US) where car driving is a very common mode of transport and a driving license can be acquired at 14 years in some states, and 16 years in most (McCart et al., 2007).

In this study, special attention is paid to young people who drive unlicensed, a phenomenon that occurs not only prior to the eligible age for licensing but also thereafter (Stevenson and Palamara, 2001; Hanna et al., 2006, 2010, 2012; Hasselberg and Laflamme, 2009;

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Table 1
Characteristics of study group, number (n) and percentages (%) (n = 5895).

Characteristics	All		Female		Male	
	n	%	n	%	n	%
Sex						
Male	3031	51.4				
Female	2864	48.6				
Age						
16 years	2553	43.3	1275	44.5	1278	42.2
17 years	2139	36.3	1056	36.9	1083	35.7
>18 years	1203	20.4	533	18.6	670	22.1
Grade						
9th grade	143	2.4	54	1.9	89	2.9
10th grade	1779	30.2	804	28.1	975	32.2
11th grade	2127	36.1	1101	38.4	1026	33.9
12th grade	1779	30.2	875	30.6	904	29.8
Ungraded or other grade	20	0.3	9	0.31	11	0.4
Missing	47	0.8	21	0.73	26	0.9
Race/ethnicity						
American Indian/Alaskan Native	416	7.1	192	6.7	224	7.4
Asian	60	1.0	26	0.9	34	1.1
Black or African American	47	0.8	16	0.6	31	1.0
Hispanic/Latino	103	1.8	46	1.6	57	1.9
Multiple-Hispanic	170	2.9	77	2.7	93	3.1
Multiple-Non-Hispanic	166	2.8	84	2.9	82	2.7
Native Hawaiian or Other Pacific Islander	52	0.9	18	0.6	34	1.1
White	4881	83.0	2405	84.0	2476	81.7
Driving practice						
Non-driver	830	14.1	408	14.3	422	13.9
Licensed driver	4765	80.8	2313	80.8	2452	81.0
Unlicensed driver	300	5.1	143	5	157	5.2

Boufous et al., 2010). Injury statistics and surveys reveal that some young people do not immediately obtain a license upon becoming age eligible (Elliott et al., 2008; Imai and Mansfield, 2008). As many as 11% of fatal crashes among US young drivers involve a young unlicensed driver under the age of 19, resulting in over 600 fatalities annually (Hanna et al., 2006). In fatal crashes, male unlicensed drivers and those age-eligible to be licensed are over-represented (Hanna et al., 2006). A recent survey indicates that as many as 5% of high school students in the US report unlicensed driving at least 1 h per week (Elliott et al., 2008). Driving unlicensed is illegal and it is unclear what kind of driver training and practice unlicensed drivers bring to the traffic environment.

There are good reasons to believe that, unlicensed driving is not an isolated risk behavior. Crash studies, for instance, have shown that dangerous driving practices (i.e., speeding, drinking and driving, traffic offenses, and neglecting to wear a seat belt are common denominators of young unlicensed drivers involved in crashes. Here again, male drivers are over-represented (Hanna et al., 2010; Hasselberg and Laflamme, 2009; Elliott et al., 2008; Blows et al., 2005; Heck et al., 2008; Begg et al., 2011; Huber et al., 2006). But there is limited knowledge whether young unlicensed drivers are more prone to risk taking behaviors such as alcohol and other drug use than their licensed peers of the same age (Elliott et al., 2008; Begg et al., 2011; Scott-Parker et al., 2012). The Youth Risk Behavioral Surveillance System (YRBSS) in Montana offers an opportunity to deal with this question in the current study (Brener et al., 2004).

This study aims to investigate both car driving/riding-related and other health risk behaviors among high school students and whether the health risk behavior differs depending on driving status, and sex.

2. Methods

2.1. Setting and data source

This study is based on data collected in the Youth Risk Behavioral Surveillance System (YRBSS) which is a biennial state-based, epidemiologic surveillance system coordinated by the US Centers for

Disease Control and Prevention (CDC). The YRBSS uses a two-stage, cluster randomized sample design to construct samples proportional to participating state's school enrolment in grades 9–12. State data are weighted to adjust for students' grade, sex, and race/ethnicity. YRBSS sampling strategies, reliability, and the psychometric properties of the questionnaire are described in detail elsewhere. Data are collected by self-administered questionnaires measuring 90 individual demographic and self-assessed health characteristics, including health risk behaviors (Brener et al., 2004). The Montana Office of Public Instruction (MOPI) added a unique question to their state YRBSS survey since 2003 to monitor participation in driver training which is optional to obtain a first year restricted license after age 15 (MOPI, 2003).

2.2. Design

For the current study, we collapsed the Montana YRBSS data from 2003, 2005, and 2007. The CDC selects fifty schools each study year in cooperation with the MOPI who conducts the survey. The average response rates for Montana schools over the three surveys were 97% and 82% for students. The group studied herein was restricted to students who were age eligible to hold a restricted license (i.e., 16 years old and above). A total of 5895 students (51.4% male) were included. The main characteristics of the study group are presented in Table 1 where it can be observed that eight out of ten students were licensed (80.8%). About one in twenty reported unlicensed driving, with similar proportions between sexes (5.2% among male students and 5.0% among females).

2.2.1. Health risk behaviors studied

Five YRBSS health risk behavior areas were selected based on the frequency and overall health and safety risks of high school students. The nine questions included: behaviors related to car driving/riding (4 questions), alcohol use (2 questions), tobacco use (1 question), use of marijuana (1 question), and violent behavior (2 questions). Half the questions used the previous 30 days as the reference period. The answers to the car driving/riding related,

Table 2
Description of specific health risk behaviors and categorizations.

Health risk behavior	YRBSS Question	Non-risk	Risk
Seat belt use as a passenger	"How often do you wear a seat belt when riding in a car driven by someone else?"	Always	Never, rarely, sometimes and most of the time
Seat belt use as a driver	"How often do you wear a seat belt when driving a car?"	Always	Never, rarely, sometimes and most of the time
Drinking as a driver	"During the past 30 days, how many times did you drive a car or other vehicle when you had been drinking alcohol?"	0 times	1 time, 2 or 3 times, 4 or 5 times, 6 or more times
Riding with a drinking driver	"During the past 30 days, how many times did you ride in a car or other vehicle driven by someone who had been drinking alcohol?"	0 times	1 time, 2 or 3 times, 4 or 5 times, and 6 or more
Alcohol drinking	"During the past 30 days, on how many days did you have at least one drink of alcohol?"	Never: 0 days	Occasionally: 1 or 2 days, 3 to 5 days, 6 to 9 days, 10 to 19 days Often: 20 to 29 days, all 30 days
Alcohol binge drinking	"During the past 30 days, on how many days did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?"	Never: 0 days	Occasionally: 1 day, 2 days, 3 to 5 days, 6 to 9 days, 10 to 19 days, Often: 20 or more days
Cigarette smoking	"During the past 30 days, on how many days did you smoke cigarettes?"	Never: 0 days,	Occasionally: 1 or 2 days, 3 to 5 days, 6 to 9 days, 10 to 19 days, Often: 20 to 29 days, all 30 days
Use of marijuana	"During the past 30 days, how many times did you use marijuana?"	0 times	1 or 2 times, 3 to 9 times, 10 to 19 times, 20 to 39 times, 40 or more times
Weapon carrying	"During the past 30 days, on how many days did you carry a weapon such as a gun, knife, or club?"	0 days	1 day, 2 or 3 days, 4 or 5 days, 6 or more days
Involved in physical fighting	"During the past 12 months, how many times were you in a physical fight?"	0 times	1 time, 2 or 3 times, 4 or 5 times, 6 or 7 times, 8 or 9 times, 10 or 11 times, 12 or more times

marijuana and violent behavior were dichotomized into non-risk and risk behavior. For alcohol use and cigarette smoking we made further use of categorization into occasional and often. For each of the specific health risk behaviors, Table 2 presents a description of how the questions read and the categorizations.

2.2.2. Driving practice

Driving practice was defined based on the question that reads: "Do you drive, and did you complete driver education (classroom and behind-the-wheel)?" Based on the five response alternatives three categories of driving practice were created; non-driver, licensed driver and unlicensed driver. Non-drivers were defined as those responding (1) "I do not drive, I do not have a valid license or permit, and I did not complete driver education" or (2) "No, I do not drive, I do not have a valid license or permit, but yes, I completed driver education". Licensed drivers were defined as those responding (1) "I drive with a valid license or permit, and yes, I did complete driver education" or (2) "I drive with a valid license or permit, but no, I did not complete driver education". Unlicensed drivers were defined as those responding: "I drive regularly on public roads, but I do not have a valid license or permit" that did not consider driver education.

2.3. Statistical analyses

The sex-specific prevalence of each health risk behavior was assessed by driving and license practice and differences were tested by chi-square test. Further, the sex-specific association between licensed and non-licensed driving practice and car driving/riding-related health risk behaviors was estimated using logistic regression. The sex-specific associations between the three different car driving practices and other health risk behaviors were estimated using multinomial logistic regression. All multivariate analyses were weighted to adjust for the non-randomized sampling technique and results presented as odds ratios (ORs) with 95% confidence intervals (CIs). Licensed drivers were used as the comparison group. All independent variables were entered as categorical variables. Adjustments were made for age and race/ethnicity. Partially missing answers, for driving and license status (2.4%), were excluded from the analyses. The SAS Statistical Package (version 9.2) was used for all analyses.

The University of Michigan Institutional Review Board provided an ethical review and granted approval for the study.

3. Results

3.1. Health risk behaviors by car driving/riding practice and sex

Table 3 presents the prevalence of each health risk behavior by driving practice. The prevalence is high among both groups of drivers, but systematically higher among the unlicensed. Noteworthy is the prevalence of occasional alcohol drinking that exceeds 50% among female unlicensed drivers with the corresponding figure for non-drivers being 33.7% and 32.4% among female non-drivers. Overall, male unlicensed drivers more often report health risk behaviors than female unlicensed drivers. Among licensed drivers the prevalence of health risk behaviors was similar between the sexes; except for being involved in a physical fight and weapon carrying which was slightly higher among males.

The differences in car driving/riding-related health risk behaviors are presented in Table 4 as multivariate sex-specific analyses. Among both male and female students, the odds of an unlicensed driver to engage in all studied behaviors, except riding with a drinking driver, were higher than for a licensed driver.

The odds of an unlicensed driver to engage in the studied health risk behaviors are systematically higher among both male and female compared to the odds among their licensed peers (Table 5). The odds ratios are comparable between male and female with unlicensed drivers the exception of physical fighting among females. Also of note is the graded association among unlicensed drivers and drinking alcohol and smoking when considering the frequency of use, a pattern that is consistent for both sexes.

When considering the odds ratios of non-drivers compared to licensed drivers, the patterns are not unidirectional and as consistent. The odds of drinking alcohol are lower among male and female non-drivers (although not statistically significant for frequent use among females). The odds a non-driver to be smoking cigarettes everyday on the other hand is almost twice as high compared to the odds among licensed drivers. Further, higher odds are also found for weapon carrying among female non-drivers and physical fighting among male non-drivers compared to the odds among their licensed peers. Adjustment for age and ethnicity only slightly altered the estimates presented in Tables 4 and 5.

Table 3Percentage (%) of health risk behaviors by driving practice and sex ($n = 5895$).

Health risk behavior	Female ($n = 2864$)				Male ($n = 3031$)			
	Non drivers ($n = 408$) %	Licensed drivers ($n = 2313$) %	Unlicensed drivers ($n = 143$) %	p -Value ^a	Non drivers ($n = 422$) %	Licensed drivers ($n = 2452$) %	Unlicensed drivers ($n = 157$) %	p -Value ^a
Neglect to use seat belt as a driver	–	50.1	74.1	<.0001	–	61.2	82.1	<.0001
Drinking as a driver	–	21.1	25.4	0.24	–	25.2	39.3	<.0001
Neglect to use seat belt as a passenger	65.0	58.3	84.4	<.0001	71.2	66.4	82.6	<.0001
Riding with a drinking driver	29.3	35.8	59.2	<.0001	32.5	35.1	52.9	<.0001
Alcohol drinking				<.0001				<.0001
occasionally	33.7	43.6	50.8		32.4	41.9	44.8	
often	7.5	7.8	15.9		7.3	11.7	29.4	
Alcohol binge drinking				<.0001				<.0001
occasionally	23.2	28.7	37.5		22.3	28.9	39.0	
often	6.4	8.1	20.6		7.3	11.5	24.0	
Cigarette smoking				<.0001				<.0001
occasionally	14.0	15.9	34.9		17.5	14.2	23.6	
everyday	11.3	6.1	23.3		10.9	5.7	22.1	
Use of marijuana	21.3	21.0	41.3	<.0001	26.1	22.0	56.7	<.0001
Weapon carrying	10.3	7.3	14.7	0.0014	27.7	31.3	44.6	0.0005
Involved in physical fighting	25.5	20.4	37.1	<.0001	41.2	33.5	63.7	<.0001

^a p -Value for chi-square test.**Table 4**Odds ratios (OR) of unlicensed driving by sex and 95% confidence interval (CI) according to health risk behaviors related to car driving/riding.^a

Traffic-related health risk behavior	Female		Male	
	Unlicensed driver		Unlicensed driver	
	Crude OR (95% CI)	Adjusted ^b OR (95% CI)	Crude OR (95% CI)	Adjusted ^b OR (95% CI)
Neglect to use seat belt as passenger	4.1 (2.3–7.5)	2.3 (1.4–3.6)	2.9 (1.8–4.5)	2.0 (1.4–3.0)
Neglect to use seat belt as driver	2.9 (1.9–4.4)	1.7 (1.2–2.5)	3.6 (2.2–6.0)	2.7 (1.7–4.3)
Drinking as driver	2.5 (1.8–3.6)	2.3 (1.5–3.5)	1.9 (1.3–2.7)	1.8 (1.3–2.4)
Riding with a drinking driver	1.3 (0.8–1.9)	1.3 (0.8–2.1)	1.4 (0.9–2.3)	1.5 (0.9–2.4)

^a Licensed was used as reference group.^b Adjusted for age and race/ethnicity.

4. Discussion

This study reveals an association between car driving and license practice and health risk behaviors among high school students, with unlicensed drivers tending to disclose health risk behaviors to a greater extent than their licensed peers. This applies to both male and female students. It is also of note that health risk behaviors related to car driving/riding practice are prevalent not only among

unlicensed but also licensed drivers, even if this is more the case with the former.

4.1. Health risk behaviors in car driving/riding

The higher propensity of all young drivers to take risks while driving a car compared to older drivers has been discussed at length in previous work and attributed largely to lack of experience and

Table 5Odds ratios (OR) of driving practice by sex and 95% confidence intervals (CI) according to other health risk behaviors.^a

Health risk behavior	Female				Male			
	Non drivers		Unlicensed drivers		Non drivers		Unlicensed drivers	
	Crude OR (95% CI)	Adjusted ^b OR (95% CI)	Crude OR (95% CI)	Adjusted ^b OR (95% CI)	Crude OR (95% CI)	Adjusted ^b OR (95% CI)	Crude OR (95% CI)	Adjusted ^b OR (95% CI)
Alcohol drinking ^c								
Occasionally	0.6 (0.5–0.8)	0.6 (0.5–0.9)	1.5 (1.2–2.0)	1.5 (1.2–2.0)	0.6 (0.4–0.8)	0.6 (0.4–0.8)	1.9 (1.3–2.9)	1.9 (1.3–2.8)
Often	0.9 (0.6–1.5)	1.0 (0.6–1.5)	2.4 (1.3–4.4)	2.6 (1.3–5.3)	0.5 (0.3–0.7)	0.5 (0.3–0.9)	3.4 (2.1–5.5)	4.0 (2.4–6.7)
Alcohol binge drinking ^c								
Occasionally	0.7 (0.6–1.0)	0.7 (0.6–1.0)	1.7 (1.2–2.4)	1.6 (1.0–2.5)	0.6 (0.4–0.8)	0.6 (0.4–0.9)	2.1 (1.4–3.1)	2.0 (1.4–2.9)
Often	0.9 (0.5–1.4)	0.9 (0.6–1.4)	3.3 (1.8–6.0)	3.4 (1.8–6.7)	0.6 (0.5–0.8)	0.6 (0.4–1.0)	2.7 (1.7–4.4)	3.2 (1.9–5.4)
Cigarette smoking ^c								
Occasionally	1.0 (0.7–1.5)	0.9 (0.6–1.2)	3.9 (2.5–5.9)	2.0 (1.4–3.0)	1.3 (0.9–1.8)	1.2 (0.9–1.9)	2.2 (1.2–4.1)	1.7 (0.9–3.1)
Everyday	1.8 (1.3–2.7)	1.7 (1.2–2.5)	6.0 (3.6–9.9)	4.1 (2.4–7.1)	2.3 (1.4–3.4)	2.6 (1.6–4.2)	4.8 (2.6–9.1)	5.7 (2.8–11.7)
Use of marijuana	1.2 (0.9–1.5)	1.0 (0.8–1.4)	3.0 (2.1–4.3)	2.0 (1.3–3.1)	1.2 (1.0–1.6)	1.2 (0.9–1.6)	4.4 (3.0–6.4)	3.9 (2.6–5.9)
Weapon carrying	1.5 (1.1–2.2)	1.6 (1.1–2.3)	1.9 (1.1–3.2)	2.3 (1.3–4.1)	0.9 (0.7–1.2)	0.9 (0.7–1.2)	1.5 (1.0–2.4)	1.7 (1.2–2.6)
Involved in physical fighting	1.3 (0.9–1.8)	1.1 (0.8–1.4)	2.3 (1.5–3.5)	1.5 (0.9–2.4)	1.5 (1.2–1.9)	1.3 (1.0–1.7)	3.4 (2.1–5.5)	2.8 (1.8–4.6)

^a Licensed was used as comparison group.^b Adjusted for age and race/ethnicity.^c Never was used as reference group.

maturity (Arnett, 2002; Bingham and Shope, 2004; Ivers et al., 2009; Møller and Gregersen, 2008). Among Montana high school students, we find that close to half of the licensed drivers do not wear a seat belt when driving. Further, one in five (21.1%) female and one in four (25.2%) male students reported drinking and driving. These behaviors are a concern for all young drivers recognized as major contributors to road traffic injuries (Bingham et al., 2008; Carpenter and Stehr, 2008; McCarthy and Brown, 2004; Vaez and Laflamme, 2005; Zhang et al., 2010). For its part, the higher propensity of young unlicensed drivers to adopt health risk behaviors while driving and riding in motor vehicles compared to their licensed peers has received little attention. The finding however echoes earlier self-report studies revealing dangerous driving behaviors among young unlicensed drivers (Elliott et al., 2008; Heck et al., 2008; Begg et al., 2011). Which particular factors – or groups of factors – contribute to an explanation of greater health risk taking remains to be determined. A developmental need to act as an adult and receive the respect of peers is a possible factor that is also shared with same age licensed drivers (Voas and Kelley-Baker, 2008). Alternative explanations are differences in accessibility to driving education and training (Imai and Mansfield, 2008), variability in mobility needs (Ferguson et al., 1996), or peer group and contextual influences (Voas and Kelley-Baker, 2008).

In light of the above, it seems there is room for improvement in providing additional training and education in preparing not only novice drivers but those young people in the pre-licensed phase (Begg et al., 2011; Scott-Parker et al., 2012). Monitoring the access to motor vehicles for all young people can be enhanced by parents and law enforcement. This is especially true at times when risk is high for drinking alcohol and dangerous driving behaviors (e.g. weekends and night) (Hanna et al., 2006; Blows et al., 2005; Tsai et al., 2008).

4.2. Additional health risk behaviors

More broadly, unlicensed drivers showed a greater propensity to also exhibit other health risk behaviors such as alcohol use, marijuana use, and weapon carrying. This suggests that unlicensed driving among young people forms part of a broader profile of health risk taking. This, in turn, may call for greater understanding of their attitudes toward health and safety if unlicensed driving is to be tackled.

This holistic approach may also be needed when dealing with licensed drivers – or those under training and education – as the high prevalence of health risk behaviors in all young people suggests that simple and uni-dimensional solutions will be insufficient to solve a complicated problem. To be effective, road traffic safety interventions aiming at influencing youth driving behavior should also consider the influences of normative development and that of parents, peers, and the community on the behavior of young unlicensed drivers (Voas and Kelley-Baker, 2008). Specifically, recognizing the role of health risk behaviors by the road traffic safety authorities can broaden the support to young people during the transition to early adulthood when the risk is high. This is especially true for the vulnerable subpopulation of unlicensed drivers

Further, in this study, the unlicensed and non-driving students represent not only a relatively smaller group in of the sample, which is to be expected in a highly motorized and car-dependent rural state in the US, but also a group with a different health risk taking profile. These young people adopt far fewer health risk behaviors than their licensed and unlicensed driving peers, suggesting different individual priorities, peer group norms, and family values (Voas and Kelley-Baker, 2008).

4.3. Strengths and limitations

The main strength of the study is that the YRBSS is a current surveillance system that employs a valid and reliable instrument to monitor health behaviors among high school students (Brenner et al., 2004). However, the measure of “driving practice”, split in three categories, was derived from a single question with multiple response alternatives, which may have led to response errors. For instance, the response choice including the word “regularly” when referring to driving unlicensed might be vague and subjective. The self-reporting of health risk behaviors and unlicensed driving are susceptible to social desirability bias and under-reporting is a potential source of bias. If both the health behaviors and driving practices are under-reported, the relative association may be underestimated. Although the study is limited to a selected group of high school students in Montana, the number of young people not attending school in that age group is rather small. It was not possible to assess if the prevalence of unlicensed driving is comparable to other states as the question on driver training is unique to the Montana YRBSS. Montana is a large, rural state continually ranks highest in the US for motor vehicle fatality rates and drinking and driving crashes (Fell et al., 2009). With regard to health risk behaviors, Montana students report significantly more health risk behaviors such as drinking while driving, binge drinking, weapon carrying, cigarette smoking, and other tobacco use compared to all US students (CDC, 2011; Eaton et al., 2008). Nonetheless, generalization of these results must be made with caution considering the study setting.

Cross sectional studies using self-reported surveillance systems are limited in predicting or explaining any causation in the association of driving and health risk behaviors. Questions remain as to whether there are other factors such as peer influence (Elliott et al., 2008), area socioeconomic status (Hanna et al., 2012), and community factors (Ferguson et al., 1996) that might explain the association between driving and health risk behaviors not available through the YRBSS for this study.

5. Conclusion

Driving a motor vehicle without a license is associated with elevated driving-related and other health risk behaviors among high school students. Unlicensed driving does not occur in isolation but it is a part of a larger profile of health risk behaviors for both male and female students compared to their licensed peers. Research is needed on prevention practices toward countermeasures for both the on and off road behaviors of young people.

Acknowledgment

Initial financial support was provided by the Michigan Center for Advancing Safe Transportation throughout the Lifespan (M-CASTL) at the University of Michigan.

References

- Arnett, J.J., 2002. Developmental sources of crash risk in young drivers. *Injury Prevention* 8 (Suppl. II), ii17–ii23.
- Begg, D.J., Gulliver, P., 2008. A longitudinal examination of the relationship between adolescent problem behaviors and traffic crash involvement during young adulthood. *Traffic Injury Prevention* 9, 508–514.
- Begg, D.J., Sullman, M., Samaranayaka, A., 2011. The characteristics of young pre-licensed drivers: evidence from the New Zealand Study. *Accident Analysis and Prevention* 45, 539–546.
- Bina, M., Graziano, F., Bonino, S., 2006. Risky driving and lifestyle in adolescence. *Accident Analysis and Prevention* 38, 472–481.
- Bingham, C.R., Shope, J.T., 2004. Adolescent developmental antecedents of risky driving among young adults. *Journal of Studies on Alcohol and Drugs* 65, 84–94.

- Bingham, C.R., Shope, J.T., Parow, J.E., Raghunathan, T.E., 2008. Crash types: markers of increased risk of alcohol-involved crashes among teen drivers. *Journal of Studies on Alcohol and Drugs* 70, 528–535.
- Blows, S., Ivers, R.Q., Connor, J., Ameratunga, S., Woodward, M., Norton, R., 2005. Unlicensed drivers and car crash injury. *Traffic Injury Prevention* 6, 230–234.
- Boufous, S., Ivers, R., Senserrick, T., Norton, R., Stevenson, M., Chen, H.Y., Lam, L.T., 2010. Risky driving behavior and road traffic crashes among young Asian Australian drivers: findings from the DRIVE study. *Traffic Injury Prevention* 11 (3), 222–227.
- Brener, N.D., Kann, L., Kinchen, S.A., Grunbaum, J.A., Whalen, L., Eaton, D., Hawkins, J., Ross, J.G., 2004. Methodology of the Youth Risk Behavior Surveillance System. *Morbidity and Mortality Weekly Report Recommendations R* 53, 1–13.
- Carpenter, C.S., Stehr, M., 2008. The effects of mandatory seatbelt laws on seatbelt use motor vehicle fatalities, and crash-related injuries among youths. *Journal of Health Economics* 27, 642–662.
- Centers for Disease Control Prevention, 2010. Drivers aged 16 or 17 years involved in fatal crashes—United States, 2004–2008. *MMWR Morbidity and Mortality Weekly Report* 59, 1329–1334.
- Centers for Disease Control and Prevention (CDC), 2011. Trends in the Prevalence of Selected Risk Behaviors and Obesity for All Students National YRBS: 1991–2011. Available at: http://www.cdc.gov/healthyyouth/yrbs/pdf/us_summary_all_trend_yrbs.pdf (accessed 11.06.12).
- Eaton, D.K., Kann, L., Kinchen, S., Shanklin, S., Ross, J., Hawkins, J., Harris, W.A., Lowry, R., McManus, T., Chyen, D., Lim, C., Brener, N.D., Wechsler, H., 2008. 2007 Youth Risk Behavior Surveillance—United States. *Morbidity and Mortality Weekly Report Surveillance Summaries* 6, 1–131.
- Elliott, M.R., Ginsburg, K.R., Winston, F.K., 2008. Unlicensed teenaged drivers: who are they, and how do they behave when they are behind the wheel? *Pediatrics* 122, 994–1010.
- Fell, J.C., Tippetts, A.S., Voas, R.B., 2009. Fatal traffic crashes involving drinking drivers: what have we learned? *Annals of Advances in Automotive Medicine* 53, 63–76.
- Ferguson, S.A., Teoh, E.R., McCartt, A.T., 2007. Progress in teenage crash risk during the last decade. *Journal of Safety Research* 38, 137–145.
- Ferguson, S.A., Leaf, W.A., Williams, A.F., Preusser, D.F., 1996. Differences in young driver crash involvement in states with varying licensure practices. *Accident Analysis & Prevention* 28, 171–180.
- Hanna, C.L., Hasselberg, M., Laflamme, L., Möller, J., 2010. Road traffic crash circumstances and consequences among young unlicensed drivers: a Swedish cohort study on socioeconomic deprivation. *BMC Public Health* 10, 14.
- Hanna, C.L., Laflamme, L., Bingham, C.R., 2012. Fatal crash involvement of unlicensed young drivers: county level differences according to material deprivation and urbanicity in the United States. *Accident Analysis & Prevention* 45, 291–295.
- Hanna, C.L., Taylor, D.M., Sheppard, M.A., Laflamme, L., 2006. Young unlicensed drivers involved in fatal crashes in the U.S. *Journal of Safety Research* 37, 385–393.
- Harré, N., Field, J., Kirkwood, B., 1996. Gender differences and areas of common concern in the driving behaviors and attitudes of adolescents. *Journal of Safety Research* 27, 163–173.
- Hasselberg, M., Laflamme, L., 2009. How do car crashes happen among young drivers aged 18–20 years? Typical circumstances in relation to the license status, alcohol impairment and injury consequences. *Accident Analysis & Prevention* 41, 734–738.
- Heck, K.E., Sousa, C., Hanna, C.L., Nathaniel, K., 2008. Driving experiences among California high school seniors 2006. *Californian Journal of Health Promotion* 6, 36–48.
- Huber, J.C., Carroza, S.E., Gorman, D.M., 2006. Underage driving as an indicator of risky behaviors in children and adolescents. *Journal of Adolescent Health* 38, 612–616.
- Imai, S., Mansfield, C.J., 2008. Disparities in motor vehicle crash fatalities of young drivers in North Carolina. *North Carolina Medical Journal* 69, 182–187.
- Ivers, R., Senserrick, T., Boufous, S., Stevenson, M., Chen, H.Y., Woodward, M., Norton, R., 2009. Novice drivers' risky driving behavior risk perception, and crash risk: findings from the DRIVE study. *American Journal of Public Health* 99, 1638–1644.
- Jessor, R., 1991. Risk behavior in adolescence: a psychosocial framework for understanding and action. *Journal of Adolescent Health* 12, 597–605.
- McCarthy, D.M., Brown, S.A., 2004. Changes in alcohol involvement cognitions and drinking and driving behavior for youth after they obtain a driver's license. *Journal of Studies on Alcohol* 65, 289–296.
- McCartt, A.T., Helling, L.A., Haire, E.R., 2007. Age of license and monitoring teenagers' driving: survey of parents of novice teenage drivers. *Journal of Safety Research* 38, 697–706.
- Møller, M., Gregersen, N.P., 2008. Psychosocial function of driving as predictor of risk-taking behaviour. *Accident Analysis and Prevention* 40, 209–215.
- Montana Office of Public Instruction, 2003. Montana Youth Risk Behavior Surveillance System, Available at: http://www.opi.mt.gov/pdf/YRBS/11/Trend/11Trend_HS.pdf (accessed 01.10.10).
- Petridou, E., Zavitsanos, X., Dessypris, N., Frangakis, C., Mandyla, M., Doxiadis, S., Trichopoulos, D., 1997. Adolescents in high-risk trajectory: clustering of risky behavior and the origins of socioeconomic health differentials. *Preventive Medicine* 26, 215–219.
- Scott-Parker, B., Watson, B., King, M.J., Hyde, M.K., 2012. Young and unlicensed: risky driving before entering the licensing system. *Traffic Injury Prevention* 13 (3), 213–218.
- Shope, J.T., Raghunathan, T.E., Patil, S.M., 2003. Examining trajectories of adolescent risk factors as of subsequent high-risk driving behavior. *Journal of Adolescent Health* 32, 214–223.
- Stevenson, M.R., Palamara, P., 2001. Behavioural factors as predictors of motor vehicle crashes: differentials between young urban and rural drivers. *The Australian and New Zealand Journal of Public Health* 25, 245–249.
- Tsai, V.W., Anderson, C.L., Vaca, F.E., 2008. Young female drivers in fatal crashes: recent trends 1995–2004. *Traffic Injury Prevention* 9, 65–69.
- Turner, C., McClure, R., 2003. Age and gender differences in risk-taking behaviour as an explanation for high incidence of motor vehicle crashes as a driver in young males. *Injury Control & Safety Promotion* 10, 123–130.
- Vaez, M., Laflamme, L., 2005. Impaired driving and motor vehicle crashes among Swedish youth: an investigation into drivers' sociodemographic characteristics. *Accident Analysis & Prevention* 37, 605–611.
- Voas, R., Kelley-Baker, T., 2008. Licensing teenagers: nontraffic risks and benefits in the transition to driving status. *Traffic Injury Prevention* 9, 89–97.
- Williams, A.F., 2003. Teenage drivers: patterns of risk. *Journal of Safety Research* 34, 5–15.
- World Health Organization (WHO), 2011. Global Status Report on Road Safety: Time for Action. Geneva, Available at: www.who.int/violence_injury_prevention/road_safety_status/ (accessed 06.04.11).
- Zhang, L., Wieczorek, W.F., Welte, J.W., Colder, C., Nochajski, T.H., 2010. Delinquency and alcohol-impaired driving among young males: a longitudinal study. *Journal of Criminal Justice* 38, 439–445.