

Cellphone laws and teens' calling while driving: analysis of repeated cross-sectional surveys in 2013, 2015, and 2017

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Abstract

Background

Distracted driving among teen is a public health and safety concern. Most states in the U.S. have sought to restrict cellphone use while driving by enacting laws. This study aims to examine the difference in prevalence of self-reported calling while driving (CWD) between states with different types of cellphone bans.

Methods

Demographics and CWD data were extracted from state Youth Risk Behavior Surveys (YRBS) from 14 states in 2013, 2015 and 2017. The state YRBS is conducted every two years with a representative sample of 9th through 12th grade students attending public school. States were grouped by type of enacted cellphone law(s): concurrent bans (concurrently enacted handheld calling ban and young driver ban); young driver ban (no handheld calling and enacted young driver ban only); and no ban (no handheld calling and no young driver ban). Poisson regression models with robust variance were used to estimate prevalence ratios comparing CWD prevalence across cellphone laws.

Results

In total, 109,069 high school students participated in the surveys, and 56,492 (56%) participants reached the minimum learner's permit age for their states and drove during the 30 days before the survey. Approximately 46% of participants reported CWD at least once during the previous 30 days and the percentages varied widely across states (range: 29%-62%). Compared to students from states with no ban enacted, those from states with concurrent bans were 14% less likely to engage in CWD (95% CI: 3%-23%). Students in states with concurrent bans were 15% less likely to engage in CWD compared to students in states with young driver bans (95% CI: 7%-21%). Young driver bans were not associated with a decrease of CWD.

Conclusions

Engaging in CWD is common among teen drivers. The concurrent implementation of a handheld calling ban and a young driver ban was associated with a decrease of CWD. States without a handheld calling ban are encouraged to implement such law to reduce teen drivers engaging in cellular-based distraction behind the wheel.

Background

Drivers aged 16–20 years old are disproportionately at risk for motor vehicle crashes. Compared to drivers of other age groups, teen drivers have the highest crash rate involvement (including fatal crashes, injury crashes, or property-damage-only crashes), even though they counted for the lowest percentage of licensed drivers on U.S. roadways.¹ One main risky driving behavior is engagement in cellphone-related distractions.² Although reducing cellphone-related distraction is of public health interest for drivers of all ages, surveillance studies have shown persistent engagement in the behavior over time among teen drivers.^{3–9}

Driving simulation and naturalistic driving studies have extensively investigated the negative impact of cellphone use on driving behaviors and outcomes. Consistently, studies have documented evidence of poorer speed maintenance abilities, increased reaction time to hazards, and a higher likelihood of experiencing near-crashes and crashes for drivers under the influence of distraction.^{10–18} When looking specifically at teen drivers, teens who talked on a cellphone while driving were twice as likely to be involved in property-damage or higher-severity crashes than those who were not talking on a cellphone.¹⁹

In response to these traffic safety concerns, U.S. states have enacted various laws to reduce cellphone use while driving, targeting either the mechanism of distraction or the experience-level of the driver. As of March 2020, most U.S. states (except for Montana and Missouri) have enacted texting bans for all drivers, which prohibits manually engaging in text-based communication while driving. Twenty five states and the District of Columbia (D.C.) have also enacted laws to ban phone conversation using a handheld mobile phone for drivers of all ages (i.e., handheld calling bans).^{20,21} In addition, 38 states and D.C. have implemented young driver bans that restrict any type of cellphone use while driving for novice drivers (\leq 18 years or drivers with a permit/intermediate driver license).²⁰

To assess the effectiveness of these laws, studies have investigated the association between cellphone laws and driving outcomes including driver cellphone use and fatal crash rates.^{4,22} When specifically looking at young drivers, previous research has found that handheld calling bans were related to a 55% reduction of self-reported calling while driving,²³ a 58% decrease of roadside-observed phone conversations,²⁴ and a significant reduction in driver fatalities and the rate of involvement in fatal crashes.^{25,26} When assessing texting bans, studies have reported no significant associations between the enactment of texting bans and the reduction of self-reported engagement in texting^{23,27} and have seen inconclusive findings with reducing crash fatalities among young drivers.^{26,28} Furthermore, studies have found young driver bans lack effectiveness in reducing both short-term (five months after enactment) and long-term (two years after enactment) observed cellphone use.^{29,30} However, none of these studies assess the combined effect of a handheld calling ban and a young driver ban in reducing self-reported talking on a phone while driving among teen drivers. To fill the research gap, our study aimed to estimate the association between cellphone laws and the prevalence of talking on a phone while driving among teen drivers by using state level Youth Risk Behavior Surveys data from multiple states and years.

Methods

Data source and study population

Data was obtained from state Youth Risk Behavior Surveys (YRBSs), which are repeated cross-sectional surveys using a two-stage cluster sample design. State YRBSs are anonymous, voluntary surveys conducted every two years to obtain a representative state sample of 9th through 12th grade students attending public school.⁷⁻⁹

The YRBSs sampling design and methodology for combining and analyzing state-level data has been described previously.^{7-9,31} Only state with a response rate $\geq 60\%$ would be weighted and access to public. States that asked a question about talking on a cellphone while driving in at least one of the years from 2013 to 2017 were included in this analysis. Participating states are listed in Additional File Table 1. The study inclusion criteria were students who had reached their state's minimum age to obtain a learner's permit license and had driven at least once 30 days prior to the survey administration date.

State cellphone bans and components of their graduated driver license system (GDL) were obtained from the Insurance Institute for Highway Safety.^{20,32} The ban amendments and effective dates were identified using the LexisNexis Academic database and state legislative documents.³³ The total number of public school districts and the number of districts in rural areas were obtained from the National Center for Education Statistics.³⁴ Detailed values of these variables for each state are listed in Additional File Table 2.

Measures

The study outcome was self-reported talking on a phone while driving (we used calling while driving, CWD as an abbreviation not TWD because TWD usually refers to texting while driving), which was measured with the question: "During the past 30 days, on how many days did you talk on a cell phone while driving a car or other vehicle?" Response options included seven ordinal categories ranging from 0 to 30 days. Students who responded "I did not drive" were excluded from the analysis. For the descriptive analysis, we categorized responses into never (0 days), sometimes (1-9 days) and frequent (10-30 days) engagement in CWD. For multivariable analysis, we created a binary outcome (never versus at least once) as any exposure to talking on a phone while driving may increase crash risk for teen drivers. A similar categorization was consistent with a previously published study using YRBSs data on texting/emailing while driving.³⁵

The state status of handheld calling bans and young driver bans were classified as 1) the absence of a handheld calling ban and a young driver ban (no ban); 2) the absence of a handheld calling ban but an enacted young driver ban (young driver ban); and 3) the enactment of both a handheld calling ban and a young driver ban (concurrent bans). No YRBSs participating state had an enacted handheld calling ban but an absence of a young driver ban during the study period. Cellphone law information for each state is listed in Additional File Table 2.

Previous studies have reported that teen driver cellphone use, varies by age, sex, race/ethnicity, and urban/rural status.^{23,27,35-37} For our study, urban/rural status was presented by the proportion of state's public school districts that were in rural areas, which was calculated by dividing the number of public school districts in rural areas by the total number of public school districts in that states. We categorized the district proportion into three groups by approximately equal tertiles (17%-50%; 51%-78%; 79%-90%). Given that studies have shown states that implemented stronger GDL systems had larger reductions in the frequencies of teen driver crashes and rate related injury and fatality, state GDL system strength was included.³⁸⁻⁴² The strength of the GDL system for each state was based on scores suggested by Steadman et al.,⁴³ and categorized as: fair to moderate (<8 points); good (=8 points); and excellent (>8 points; see Additional File Table 2).

Statistical analysis

The association of cellphone laws and CWD was examined by adjusting for student demographics, the state GDL score, the proportion of state's public school districts in rural areas, and survey year. Crude and adjusted prevalence ratios (PRs) with 95% confidence intervals (CIs) for CWD were estimated using Poisson regression models with robust variances estimation.⁴⁴ Complete case analysis was used to handle missing data as the percentage of missing was small (approximately 3% of students reached permit age but did not answer the question on CWD).

All reported results were weighted and considered the survey design.³¹ Data analyses were performed in 2019 using SAS Enterprise Guide 7.1 (SAS Institute Inc., Cary, NC) and STATA 14.0 (StataCorp LLC, College Station, TX).

Sensitivity analysis

Several sensitivity analyses were conducted to assess potential bias: 1) restricting the analysis to the five states that participated in all three survey years (Connecticut, Massachusetts, Missouri, Montana, North Dakota); 2) excluding Utah, which enacted their young driver ban during the same year the survey was conducted (2013), thus limiting the sample to states that enacted young driver bans before survey administration; 3) excluding Texas, which was weighted as 41% of the total study population (the total population in Texas is much larger than other participating states); 4) excluding Maryland, which conducted a census instead of a two-stage cluster survey.

We further restricted our analysis to students who had reached the state-dependent age to begin unsupervised driving under certain driving conditions as driving under the supervision of an adult driver may prohibit teen's CWD behavior.^{29,32} Lastly, to estimate how cellphone laws are associated with a nominal outcome, we fitted Poisson regression models to estimate the prevalence ratio for 1) sometimes CWD vs. never CWD, and 2) frequent CWD vs. never CWD.

Results

In total, 109,069 high school students participated in the surveys during 2013, 2015 and 2017 from 14 states. Approximately 56% (56, 492) of total participants reached the minimum permit age in their states and indicated that they had driven in the past 30 days. Among students who met the inclusion criteria, 46% engaged in CWD during the past 30 days. The prevalence of CWD was highest among older students (≥ 18 years, 63%) and lowest for the youngest students (14 years, 27%). A higher prevalence of White students (53%) reported CWD compared to students of other races/ethnicities (38% for Black students, and 40% for Hispanic students). (Table 1)

CWD prevalence varied across states, from 29% in Maryland to 62% in North Dakota (Table 1). States with concurrent bans had a higher percentage of students who never engaged in CWD (63%) compared to states with a young driver ban or states with no ban (53% and 47% respectively) (Fig. 1). Students in states with a young driver ban had a lower prevalence of CWD compared to states with no ban (47% vs 53%), but this difference was not statistically significant in the adjusted model (Table 2).

Multivariable analysis showed that students in states with concurrent bans were 14% less likely to report CWD compared to students in states with no ban (adjusted PR = 0.86, 95% CI: 0.77–0.97) (Table 2). Similarly, students in states with concurrent bans were 15% less likely to engage in CWD compared to students in states with only a young driver ban (adjusted PR = 0.85, 95% CI: 0.79–0.93; data not shown).

Results of the sensitivity analyses were similar to the main analysis (Additional File Table 3 and Table 4). When categorizing CWD as a nominal outcome, students in states with concurrent bans had a lower risk of sometimes engaging in CWD compared to students in states with no ban (adjusted PR = 0.83, 95% CI: 0.72–0.95). The concurrent bans were associated with a 13% decrease in frequent CWD, but the decline was not statistically significant perhaps due to the limited sample size. (adjusted PR = 0.87, 95% CI: 0.69–1.09) (Additional File Table 4).

Discussion

This study is the first to assess the combined effect of two types of state cellphone legislation (concurrently enacted handheld calling bans and young driver bans) on teens' self-reported CWD. We found that nearly half of teen drivers engaged in CWD at least once during the 30 days prior to the survey. Compared to states with no bans, the prevalence of CWD was 14% lower in states with concurrent bans.

Our findings on the association between the presence of a handheld calling ban and CWD support and extend previous findings. Rudisill et al., found the percentage of adolescent drivers (16-18 years) engaging in self-reported CWD was lower in states with a handheld calling ban compared to states without a ban.²³ The association was stronger than what was seen in this study, PR= 0.45 (95% CI: 0.32-0.63) versus PR=0.86 (95% CI: 0.77-0.97). This difference could result from differences between selected study populations. For example, our study population was comprised of high school students aged ≥ 14 years whereas the study population in Rudisill et al., was comprised of adolescents aged ≥ 16 years from household samples where the parent was affiliated with an online probability-based research panel.

Depending on the state, our study population may include more teens in the permit or intermediate license phases, resulting in a more novice group of teen drivers. It is important to include teen drivers in the earlier phases of licensure into the analysis as nearly one in four students aged 14-15 years engaged in CWD. They are the most inexperienced and youngest drivers under the restriction of both young driver bans and GDL. Furthermore, the two studies adjusted for different covariates. For example, our study controlled for the strength of the state GDL system, which could adjust the bias resulting from exposed driving time and supervised driving period. Since states with a stronger GDL system tend to have stricter nighttime driving restrictions and longer supervised driving practice, teens have fewer opportunities to engage in risky driving behaviors like CWD.

One possible explanation for the lack of an association between young driver ban and self-reported CWD may include the level of ban awareness teen drivers possess. A survey conducted in North Carolina found that less than two-thirds of teens were aware of the cellphone restriction in their state as far as two years after the implementation of the young driver ban.³⁰ Another issue is the challenge of enforcing cellphone laws. Analysis of citation data from 14 states and D.C. has found that overall enforcement of cellphone bans was low, with cellphone-related distracted driving citations comprising only 1% of all written citations.⁴⁵ Young driver ban violations accounted for only 2.7/1000 of all teen traffic citations, less than handheld violations for young drivers (9.6/1000).⁴⁵ Qualitative research also has shown that police officers have a sense of discomfort in ticketing for cellphone-related distracted driving, as it can be ambiguous what drivers are actually doing with their phone while driving along with the low rate of admittance from drivers on their engagement in distracted driving.^{46,47}

Along with the effectiveness of cellphone bans, culture and environment have critical roles in shaping young drivers' behavior.^{48,49} As driving is a learned behavior, parents/guardians serve as the primary role models for teen drivers and contribute to the overall traffic safety culture.^{48,50,51} Survey results from Carter et al. reported that teens with parents who engaged in distracted driving had a higher percent of engaging in distraction tasks.⁵² In states with a young driver ban only, teen passengers may be more likely to observe their parents and other adults engaging in CWD. This could potentially send a mixed message that once driving is "mastered," engagement in CWD is safe. On the other hand, in states with handheld calling bans, irrespective of driver age, adults were less likely to engage in CWD,⁵³ and their teen drivers would potentially be less likely to be exposed to adult drivers engaging in cellphone-related distracted driving.

From a clinical and policy perspective, these findings, in combination with previous findings on cellphone bans provide further support for the utility of handheld bans for drivers of all ages. Pediatricians should routinely discuss avoidance of distracted driving with teens during yearly physical exams. Promotion of safer alternatives such as hands-free options or technology which blocks cellular use while driving (e.g. Do Not Disturb mode), should be recommended as motor vehicle crashes remain a leading cause of injury and death for this age group. Although young driver bans target a population of vulnerable road

users, legislative effort that acknowledges unsafe driving behavior irrespective of age will promote a safer driving culture and will translate into safer roads for all drivers.

Limitations

There are several limitations in our study. First, the questionnaire was framed to inquire about CWD and information was not available for differentiating handheld or hands-free calling behavior. Environmental factors such as the use of Bluetooth while driving would affect the proportion of drivers engaging in handheld calling. The proportion of smartphone owners that have access to Bluetooth or other hands-free devices that work in their vehicles increased about 12% from 2012 to 2015.^{36,54} Self-reported data also showed that the enactment of a handheld cellphone ban reduced overall handheld cellphone use while driving, but increased the use of hands-free technology.^{55,56} Therefore, our analysis might underestimate the effect of a handheld calling ban as drivers in states with the ban may switch to hands-free technology to avoid a ticket. Second, due to social desirability, students in a state with a cellphone ban may be less likely to report CWD compared to a state without a ban, which may overestimate the effectiveness of a ban. Third, since this was a cross-sectional study, the analysis cannot imply causality of legislation on drivers' behavior. Fourth, limited states adapted the question on CWD, restricting the analysis to 14 states with only five states having data for all three years. The difference of CWD across law types may also be attributed to differences between states. In an effort to account for this potential bias, we controlled for two state-level covariates and conducted several sensitivity analyses which yielded similar results between law type and the prevalence of CWD. As none of the participating states had a handheld calling ban without a young driver ban, we cannot estimate the association of a handheld calling ban versus no ban, or directly compare the handheld calling ban versus a young driver ban. However, the prevalence ratio between concurrent bans versus no ban was similar to the prevalence ratio between concurrent bans versus a young driver ban, and the young driver ban was non-statistically associated with a reduction in CWD. It is reasonable to believe that a handheld calling ban only would also be associated with a reduction in CWD, but further data and investigation is needed.

Conclusions

Overall, teens in states with concurrent bans (handheld calling ban and young driver ban) had a lower prevalence of CWD. While the overall effectiveness of cellphone laws need further investigation, it is apparent that restricting drivers of all ages, including teens, may influence the traffic safety culture on distracted driving. Further research with more states and more years of data to compare the concurrent bans and handheld calling ban in reducing CWD among teens would provide more insight into the effectiveness of different types of cellphone laws.

Abbreviations

CWD: calling while driving (talking on a phone while driving for this study)

CI: Confidence interval

D.C.: District of Columbia

GDL: Graduate driver license

PR: Prevalence ratio

U.S.: United States

YRBS: Youth Risk Behavior Survey

Declarations

Ethics approval and consent to participate: This study did not include personal identifiers and was exempt from IRB review at Nationwide Children's Hospital.

Consent for publication: Not applicable.

Availability of data and materials: The datasets generated and analyzed during the current study are available in the CDC Youth Risk Behavior Surveillance System website:
<https://www.cdc.gov/healthyyouth/data/yrbs/data.htm>

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: MTZ and LL had full access to all of the data in the study and take responsibility for the integrity of the data accuracy of the data analysis.

Concept and design: MTZ and LL;

Acquisition, analysis, or interpretation of data: All authors;

Statistical analysis: LL and RRA;

Drafting of the manuscript: LL and CNP;

Critical revision of the manuscript for important intellectual content: JKB and GQH. All authors read and approved the final manuscript.

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Tables

Table 1 Study population characteristics and prevalence of calling while driving (CWD) ^a

Variables	Unweighted N	% of CWD (95%CI) ^b		
		Never (0 day)	Sometimes (1-9 days)	Frequent (10-30 days)
Overall	56,492	54 (52, 56)	32 (31, 34)	14 (13, 15)
Survey year				
2013	14,346	50 (48, 52)	34 (33, 36)	16 (15, 17)
2015	9,868	51 (48, 53)	36 (34, 38)	13 (12, 14)
2017	32,278	55 (52, 58)	32 (29, 34)	13 (11, 14)
Age (Years)				
14	1,023	73 (67, 79)	23 (17, 29)	4 (0, 9)
15	9,903	78 (74, 82)	17 (14, 20)	5 (3, 6)
16	18,975	63 (61, 65)	28 (26, 30)	9 (7, 11)
17	18,492	43 (40, 46)	39 (36, 41)	18 (16, 20)
≥18	7,990	37 (33, 41)	41 (38, 44)	22 (19, 25)
Missing	109			
Sex				
Female	27,456	54 (52, 57)	33 (31, 35)	13 (11, 14)
Male	28,717	54 (51, 56)	31 (29, 34)	15 (13, 17)
Missing	319			
Race				
White	36,097	47 (45, 50)	36 (34, 37)	17 (15, 18)
Black or African American	5,859	62 (57, 67)	27 (22, 31)	11 (9, 14)
Hispanic/Latino	6,720	60 (56, 64)	30 (27, 33)	10 (8, 12)
Other ^c	6,347	62 (58, 66)	30 (25, 34)	8 (6, 10)
Missing	1,469			
States				
AK	790	63 (57, 68)	30 (25, 35)	7 (5, 9)
AR	1,185	45 (40, 50)	34 (30, 37)	21 (18, 25)
CT	2,982	63 (60, 65)	29 (27, 32)	8 (7, 9)
MD	20,335	71 (70, 72)	22 (21, 23)	7 (7, 8)
MA	4,209	54 (50, 57)	35 (32, 37)	12 (10, 13)
MO	3,465	47 (45, 50)	36 (34, 39)	16 (15, 17)
MT	10,902	41 (40, 43)	42 (41, 43)	17 (15, 18)
NE	2,293	42 (39, 45)	41 (38, 44)	16 (14, 19)
NJ	810	59 (53, 64)	29 (25, 33)	13 (9, 16)
ND	5,007	38 (36, 40)	44 (42, 46)	18 (17, 20)
RI	861	49 (46, 53)	40 (34, 46)	11 (7, 14)
SC	1,007	46 (42, 51)	33 (29, 38)	20 (17, 23)
TX	1,150	56 (51, 61)	30 (26, 34)	13 (11, 16)
UT	1,496	47 (41, 53)	40 (35, 44)	14 (11, 16)

Notes:

CI: Confidence Interval;

a: Data were from state Youth Risk Behavior Surveys in 14 states (2013, 2015 and 2017), the United States;

b. Weighted percentage of students that reported talking on a phone while driving during the 30 days before the survey (among students who drove). Percentages may not total 100 due to rounding;

c: Other included: American Indian/Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, and Multiple- Non-Hispanic/Latino.

Table 2 Association between cellphone laws and calling while driving (CWD) ^a

Variables	CWD ^b (95%CI)	Prevalence Ratios (95%CI)	
		Crude	Adjusted ^c
Cellphone laws			
No ban	53 (51, 55)	Reference	Reference
Young driver ban	47 (44, 50)	0.93 (0.88, 0.99)	1.01 (0.94, 1.09)
Concurrent bans ^d	37 (34, 40)	0.70 (0.65, 0.75)	0.86 (0.77, 0.97)
Age (Years)			
14	27 (21, 33)	0.64 (0.54, 0.76)	0.51 (0.43, 0.61)
15	22 (18, 26)	0.62 (0.54, 0.70)	0.55 (0.48, 0.63)
16	37 (35, 39)	Reference	Reference
17	57 (54, 60)	1.57 (1.49, 1.66)	1.60 (1.52, 1.67)
≥18	63 (59, 67)	1.72 (1.63, 1.82)	1.76 (1.66, 1.85)
Sex			
Female	46 (43, 48)	Reference	Reference
Male	46 (44, 49)	1.02 (0.98, 1.06)	1.02 (0.98, 1.06)
Race			
White	53 (50, 55)	Reference	Reference
Black or African American	38 (33, 43)	0.70 (0.64, 0.77)	0.70 (0.64, 0.77)
Hispanic/Latino	40 (36, 44)	0.77 (0.71, 0.83)	0.76 (0.71, 0.82)
Other ^e	38 (34, 42)	0.74 (0.70, 0.79)	0.75 (0.70, 0.80)
Public school district in rural area			
17%-50%	44 (42, 46)	Reference	Reference
51%-78%	46 (43, 50)	1.17 (1.1, 1.25)	0.98 (0.91, 1.05)
79%-90%	56 (54, 57)	1.33 (1.27, 1.4)	1.13 (1.06, 1.20)
Graduated driver license law			
Fair/Moderate	54 (51, 56)	Reference	Reference
Good	47 (44, 51)	0.96 (0.91, 1.02)	0.95 (0.90, 1.01)
Excellent	40 (37, 42)	0.78 (0.73, 0.83)	0.71 (0.64, 0.79)
Year			
2013	50 (48, 52)	Reference	Reference
2015	49 (47, 52)	0.99 (0.92, 1.05)	0.95 (0.90, 1.01)
2017	45 (42, 48)	0.89 (0.82, 0.96)	0.93 (0.87, 0.99)

Notes:

CI: Confidence Interval;

a. Data were from state Youth Risk Behavior Surveys in 14 states (2013, 2015 and 2017), the United States;

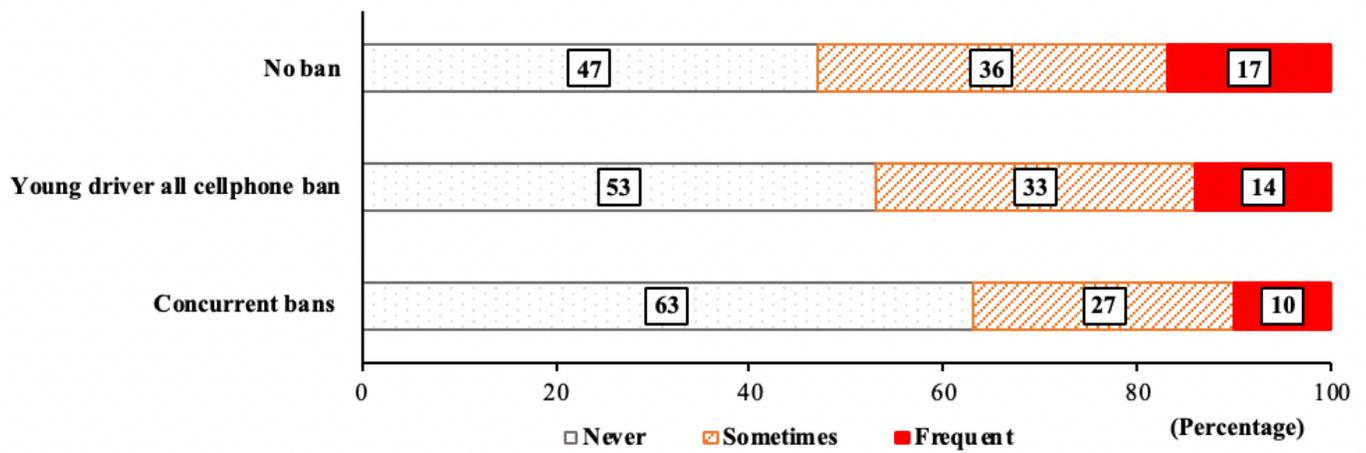
b. Weighted percentage of calling while driving (CWD): Percentage of students that reported talking on a phone while driving at least once during the 30 days before the survey (among students who drove);

c. Model adjusted for cellphone laws, age, sex, race, the proportion of state's public school district in rural areas, strength of state's graduated driver license system, and survey year;

d. Concurrent bans: handheld calling ban along with young driver ban;

e. Other included: American Indian/Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, and Multiple- Non-Hispanic/Latino.

Figures



Notes:

- a. Data were from state Youth Risk Behavior Surveys in 14 states (2013, 2015 and 2017), the United States;
- b. Weighted percentage of calling while driving: Percentage of students that reported talking on a phone while driving at least once during the 30 days before the survey (among students who drove);
- c. Concurrent bans: concurrent of a universal handheld ban and a young driver all cellphone ban.

Figure 1

Percentage of teens' calling while driving by cellphone laws

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