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Bans on Cellphone Use While Driving and Traffic Fatalities in the United States

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Background: As of January 2020, 18 of 50 US states comprehensively banned almost all handheld cellphone use while driving, 3 states and the District of Columbia banned calling and texting, 27 states banned texting on a handheld cellphone, and 2 states had no general cellphone ban for all drivers. However, it remains unknown whether these bans were associated with fewer traffic deaths and whether comprehensive handheld bans are more effective than isolated calling or texting bans. We evaluated whether cellphone bans were associated with fewer driver, non-driver, and total fatalities nationally.

Methods: We conducted a longitudinal panel analysis of traffic fatality rates by state, year, and quarter. Population-based rate ratios and 95% CIs were estimated comparing state–quarters with and without cellphone bans.

Results: From 1999 through 2016, 616,289 persons including 344,003 drivers died in passenger vehicle crashes in the United States. Relative to no ban, comprehensive handheld bans were associated with lower driver fatality rates (adjusted rate ratio aRR = 0.93, 95% CI = 0.90, 0.97) but not for non-driver fatalities (aRR = 1.01, 95% CI = 0.95, 1.07) or total fatalities (aRR = 0.98, 95% CI = 0.94, 1.01). We found no differences in driver fatalities for calling-only bans (aRR = 1.00, 95% CI = 0.97, 1.03), texting-only bans (aRR = 1.02, 95% CI = 0.99, 1.05), texting plus phone-manipulating bans (aRR = 0.99, 95% CI = 0.93, 1.04), or calling and texting bans (aRR = 0.98, 95% CI = 0.88, 1.09).

Conclusions: Comprehensive handheld bans were associated with fewer driver fatalities.

Keywords: Automobile driving; Cause of death; Cell phone use; Traffic crashes; Text messaging

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Traffic crashes are a leading cause of death and a major contributor to lower life expectancy in the United States (US), relative to other countries with a very high human development index.[1] Approximately 3.4 million injured roadway users are treated in emergency departments annually in the US, and many victims suffer brain injury, spinal cord damage, extended or lifelong chronic pain, and other disabilities.[2,3] The societal costs of traffic crashes were $432 billion in 2016 in the US.[4]

Drivers' cellphone use is a prevalent traffic safety hazard. The National Highway Traffic Safety Administration estimated that one in 10 US states drivers were using a cellphone at any daylight moment in 2018.[5] Cellphone use may include calling, texting, and various other uses (e.g., social media apps) with handheld and hands-free use forms. A 2015 national survey reported that approximately one in five drivers read messages or viewed information on social media apps at least once a month.[6]

Cellphone use may involve manual distraction (hands off the steering wheel), visual distraction (eyes off the road), and cognitive distraction (mind off driving).[7] Two early studies reported that cellphone use was associated with increased crash risk.[8,9] Recent research that continuously monitored drivers in a large US study found that cellphone use was associated with 2 to 6 times higher risk of crashes.[10] More specifically, cellphone use with visual–manual distractions (e.g., texting and dialing) was associated with 3 to 24 times higher risk.[10] Talking on a handheld cellphone was related to a 2 to 3-fold increased risk for drivers under 30 but was not associated with increased risk meaningfully for drivers 30 to 64 years.[10]

Many states have banned cellphone use while driving. Talking on a handheld cellphone was first banned for drivers of any age (i.e., a universal ban rather than age-delimited ban) in

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The computer code used to conduct analyses for this paper, as well as all the policy data are available from the study authors upon request. The driver fatality data are publicly available at https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars.

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New York in 2001.[11] Connecticut was the first state to ban both handheld calling and texting in 2005.[11] Utah was the first state to comprehensively ban any handheld cellphone use (comprehensive handheld cellphone ban) in 2007 but backtracked to allow calling while driving in 2014.[11] As of January 2020, 18 of 50 states had comprehensive handheld cellphone bans, 3 states and the District of Columbia (DC) banned calling and texting, 27 states banned texting, and 2 states had no prohibition on cellphone use for drivers of any age. Bans on handheld calling were associated with >40% reductions in roadside-observed handheld cellphone use in Connecticut, DC, and New York.[12] However, 2 studies based on self-reported texting while driving found that bans on handheld texting were not associated with less texting among adults and adolescents.[13,14]

To the authors' knowledge, 10 studies have investigated fatal crashes in association with universal bans on cellphone use while driving for drivers of all ages.[15–24] The inconsistent findings of these studies may be due, at least in part, to the varied analytic approaches, data years or outcomes studied. In term of analytic approaches, 4 studies used linear regression to fit fatal crash rate[17,20,22,23] and 5 studies used count models such as Poisson or negative binomial models,[15,16,18,19,24] which are advised to analyze counts of rare events.[25,26] Another study was a graphical analysis that did not attempt to adjust for confounders of the association between cellphone bans and fatal crashes.[21] In term of data years, 8 of 10 studies did not include the years of 1999–2000 to establish the precellphone ban baseline[15,16,18–20,22–24]; the first cellphone ban was implemented in 2001. The remaining 2 studies examined data years up to 2007 only.[17,21] In terms of outcomes, most studies examined drivers involved in fatal crashes, but one study examined total traffic fatalities, including pedestrians and bicyclists[19]; another study somewhat puzzlingly looked only at motorcyclist fatalities.[18] Motor vehicle drivers (not motorcyclists) are directly regulated by cellphone use while driving bans, therefore driver fatalities might be a more sensitive indicator for the impact of cellphone bans. Even among studies using Poisson or negative binomial analyses and driver fatal crashes or fatalities as the outcome, inconsistent findings are reported.[15,16,24] Lim and Chi[16] analyzed 2000–2010 fatal crashes and found that prohibitions of handheld calling while driving were associated with a 7% reduction in fatal crashes by drivers of all ages. Rudisill et al[15] reported that prohibitions on handheld calling from 2000 to 2014 were associated with a 10% reduction in driver fatalities, but bans on texting while driving had no effect among drivers of all ages. In contrast, Flaherty et al[24] found that prohibitions of handheld calling were associated with a 26% reduction in driver fatalities for ages 16–19 years and a 24% reduction for ages 40–55 years. Flaherty et al[24] also reported that bans on driver texting that allowed primary enforcement were associated with a 29% reduction on driver fatalities for ages 16–19 years and a 12% reduction for ages 40–55 years. This study did not adjust year as a confounder, but year is associated with the enactment of cellphone bans and the decrease of driver fatalities.[27]

Although these studies are informative, several gaps in the literature persist. It is difficult to separately estimate the effects of handheld calling bans and handheld texting bans, because they are often included in the same legislation, or were enacted or upgraded simultaneously in a state. Since 2010 an increasing number of states have enacted comprehensive legislation that prohibits almost all handheld cellphone use including texting, calling, reading, or posting to social media, internet browsing, etc. No previous studies have examined the scope or comprehensiveness of bans on driver cellphone use. A comprehensive ban on all handheld cellphone use should be more effective than a ban on calling or texting alone. We hypothesized that a comprehensive ban conveys a message that the state views cellphone-based distractions seriously. By excluding loopholes, comprehensive bans also facilitate enforcement and increase the likelihood drivers will believe they can—and will—be enforced. We used national data on traffic fatalities to evaluate the effectiveness of cellphone bans while avoiding methodologic complications that have affected previous findings. Our study is among the first to evaluate the association between comprehensive handheld cellphone use while driving bans and driver, non-driver, and total fatalities.

METHODS

Study Population and Study Design

We examined drivers, non-drivers (passengers, pedestrians, bicyclists, motorcyclists), and total fatalities involved in passenger vehicle (passenger car, sport utility vehicle, van, and pickup truck) crashes from 1999 through 2016 in 50 US states. We excluded DC because it is entirely urban with few fatalities and many commuters come from Maryland and Virginia. We used a longitudinal panel design. We linked the population estimates, traffic fatalities, presence and characteristics of cellphone bans, and various confounders for each state, year, and quarter.

STUDY VARIABLES

Bans on Cellphone Use While Driving

The primary policy intervention was cellphone bans for drivers of all ages. These were classified as (1) no ban, (2) calling-only ban, (3) texting-only ban, (4) texting plus ban (bans activities such as accessing the internet or social media as well as texting), (5) calling and texting ban (bans calling and texting, but not activities such as accessing the internet or social media applications), (6) comprehensive handheld bans that prohibit almost all handheld cellphone use (eTables 1 and 2; http://links.lww.com/EDE/B827, which presents the implementation dates and types of cellphone bans). Some states with comprehensive handheld bans prohibit the act of holding or using a cellphone while driving and do not specify

tasks such as texting and calling (California, Hawaii, Illinois, Maine, Maryland, Oregon, Utah, Vermont). For example, Hawaii states "No person shall operate a motor vehicle while using a mobile electronic device. 'Using' means holding a mobile electronic device while operating a motor vehicle."[28] Other states with comprehensive handheld bans list almost all phone tasks (Delaware, Nevada, New Hampshire, New York, West Virginia). For example, Delaware bans "a. viewing or transmitting images or data; b. playing games; c. composing, sending, reading, viewing, accessing, browsing, transmitting, saving or retrieving e-mail, text messages or other electronic data; or d. engaging in a call"[29] (eTable 3; http://links.lww.com/EDE/B827, which presents the texts for texting plus bans and comprehensive handheld bans). Because the effectiveness of seatbelt laws is degraded by allowing only secondary enforcement,[30] we classified cellphone bans according to mode of enforcement allowed. Primary enforcement allows officers to cite an individual specifically for cellphone use, whereas a secondary enforcement law prohibits stopping a vehicle for cellphone use alone. Drivers can be cited for a phone violation only if observed in conjunction with a primary violation (e.g., speeding).

We retrieved details of state cellphone laws from the Insurance Institute for Highway Safety,[11] and LexisNexis. Two research assistants coded the laws independently. Discrepancies were resolved with input from a third researcher and a lawyer.

Outcome

The outcome measure was the number of driver, non-driver, and total fatalities per 100,000 residents. We used the population-based measure because national data on the number of licensed drivers may not be reliable.[31,32] We obtained fatalities from the Fatality Analysis Reporting System, a census of US fatal crashes. We retrieved resident estimates from the National Center for Health Statistics.[33]

Confounders

We developed a directed acyclic graph to guide the selection of confounders (eAppendix; http://links.lww.com/EDE/B827: directed acyclic graph: Cellphone bans and traffic deaths). Additional traffic safety laws, socio-economic, and travel factors could confound the association by changing driving behavior or crash risk.[34] We gathered information on seatbelt laws,[34,35] maximum speed limits,[34,35] impaired driving laws (preconviction administrative license suspension for driving under the influence),[34,35] unemployment-population ratio,[36] income per capita,[37] cellphone ownership,[38] vehicle miles traveled,[39] state highway expenditure,[40] gasoline price,[41] and the percentage of rural roadway length out of total roadway length.[39] Monetary information, such as income and highway expenditure, was adjusted to 2016 dollars using the Consumer Price Index (eTable 4; http://links.lww.com/EDE/B827, which lists these confounders including definition, classification, and source).

Statistical Analysis

We estimated driver, non-driver, and total fatality rates per person–year by dividing counts of fatalities by population estimates. We plotted the driver, non-driver, and total fatality rates by year for each of the 46 intervention states (states with cellphone bans) versus control states without cellphone bans by 2016 (Arizona, Missouri, Montana, and Texas; eFigures 1–3; http://links.lww.com/EDE/B827). Although the pre-intervention trends in the intervention states and the control states were not identical, they did not differ sufficiently to call into question the parallel trend assumption that the difference between intervention and control states was constant over time in the absence of cellphone bans.

We estimated adjusted rate ratios (aRR) using negative binomial regression. The outcome variables were the quarterly counts of traffic fatalities (i.e., driver, non-driver, and total fatalities), with the natural log of the population estimates for that quarter used as an offset, to adjust for different populations across states and quarters.[42] We used generalized estimating equations with an independent correlation matrix to account for possible correlation between quarterly counts attributable to repeated measures from each state over the study period. We assessed model fit using the quasi-likelihood independent model criterion.[43]

We used state indicator variables to adjust for differences in state crash rates and safety environments such as quality of highways. We used year indicator variables to control crash trends, because fatality rates were not linearly increasing or decreasing over 1999–2016. Seasonality was controlled by quarter indicator variables.

We conducted sensitivity analyses: (1) examining the cellphone bans by durations of implementation (< 1, 1–2, ≥ 2 years) to account for the fact that it takes time for drivers to become aware of a ban; (2) excluding the three large states that implemented calling-only bans well before texting while driving had become a concern (California, New Jersey, and New York, which account for about 20% of US drivers); (3) analyzing the 27 states with cellphone bans that took effect between 2010 and 2016 along with the 4 states without any bans by 2016. This was to avoid the period when the 2008–2009 economic recession affected the amount and type of driving; (4) restricting analyses to years of 2010–2016 and comparing comprehensive handheld bans versus everything else as the referent group. The data for comprehensive handheld bans came predominantly from 2010–2016. This analysis compared comprehensive handheld bans with less comprehensive (or no) cellphone bans during the same period. This was to avoid a discrepancy in the time periods when no bans were common (1999–2009) and when comprehensive handheld bans became common (2010–2016); (5) examining non-alcohol-related driver fatalities to exclude alcohol as a contributing factor.

Analyses were conducted using SAS, version 9.4 (Statistical Analysis System, Cary, NC). The study was

exempted by the Institutional Review Board at Nationwide Children's Hospital as it used publicly available, de-identified data.

RESULTS

The number of states with cellphone bans increased slowly from 1999 to 2009 (Figure). Beginning in 2010 many more states enacted bans, and the focus shifted strongly to texting, as well as more comprehensive bans. In 2016, a texting-only ban was in effect for 80 (40%) of 200 state–quarters (4 quarters × 50 states), a texting plus ban for 24%, a calling and texting ban for 6%, a comprehensive handheld ban for 22%, and no ban for 8% of state–quarters.

From 1999 through 2016, 616,289 persons including 344,003 drivers and 272,286 non-drivers died in passenger vehicle crashes in the US (Table 1). Twenty-nine percent of traffic fatalities were under age 25, and 68% were males. For driver fatalities, calling-only bans (aRR = 1.00, 95% CI = 0.97, 1.03), texting-only bans (aRR = 1.02, 95% CI = 0.99, 1.05), texting plus bans (aRR = 0.99, 95% CI = 0.93, 1.04), and calling and texting bans (aRR = 0.98, 95% CI = 0.88, 1.09) were not associated with a lower fatality rate, relative to no ban (Table 2). Comprehensive handheld bans, which more clearly prohibit cellphone use while driving, were associated with a lower driver fatality rate (aRR = 0.93, 95% CI = 0.90, 0.97). For non-driver and total fatalities, none of the various types of cellphone bans, including comprehensive handheld bans, was associated with a lower fatality rate. The adjusted rate ratio was 1.01 (95% CI = 0.95, 1.07) for non-driver fatalities and 0.98 (95% CI = 0.94, 1.01) for total fatalities, comparing comprehensive handheld bans with no cellphone bans.

Additional analyses by enforcement level were limited to driver fatalities because no effects were observed for non-driver and total fatalities. For driver fatalities, the aRR was 0.93 (95% CI = 0.90, 0.97) for comprehensive handheld bans allowing primary enforcement and 0.95 (95% CI = 0.90, 1.00) for comprehensive handheld bans without primary enforcement for all banned activities (Table 3).

Sensitivity analyses suggested that the aRRs were virtually identical across durations of cellphone bans (< 1, 1–2, ≥ 2 years; eTable 5; http://links.lww.com/EDE/B827). Excluding the 3 large urban states that implemented calling-only bans resulted in a similar aRR for comprehensive handheld bans (eTable 6; http://links.lww.com/EDE/B827). When analyzing the 27 states that implemented cellphone bans following the Great Recession, between 2010 and 2016, along with the 4 states without any bans by 2016, the aRR remained the same for comprehensive handheld bans, although the CI was wider due to the reduced sample size. When comparing compressive handheld bans versus everything else as the reference and during the years of 2010–2016, the aRR was the same and the 95% CI was similar as the aRR for comprehensive handheld bans in the main analysis. Analyses excluding alcohol-related driver fatalities produced virtually identical aRRs to those including all driver fatalities.

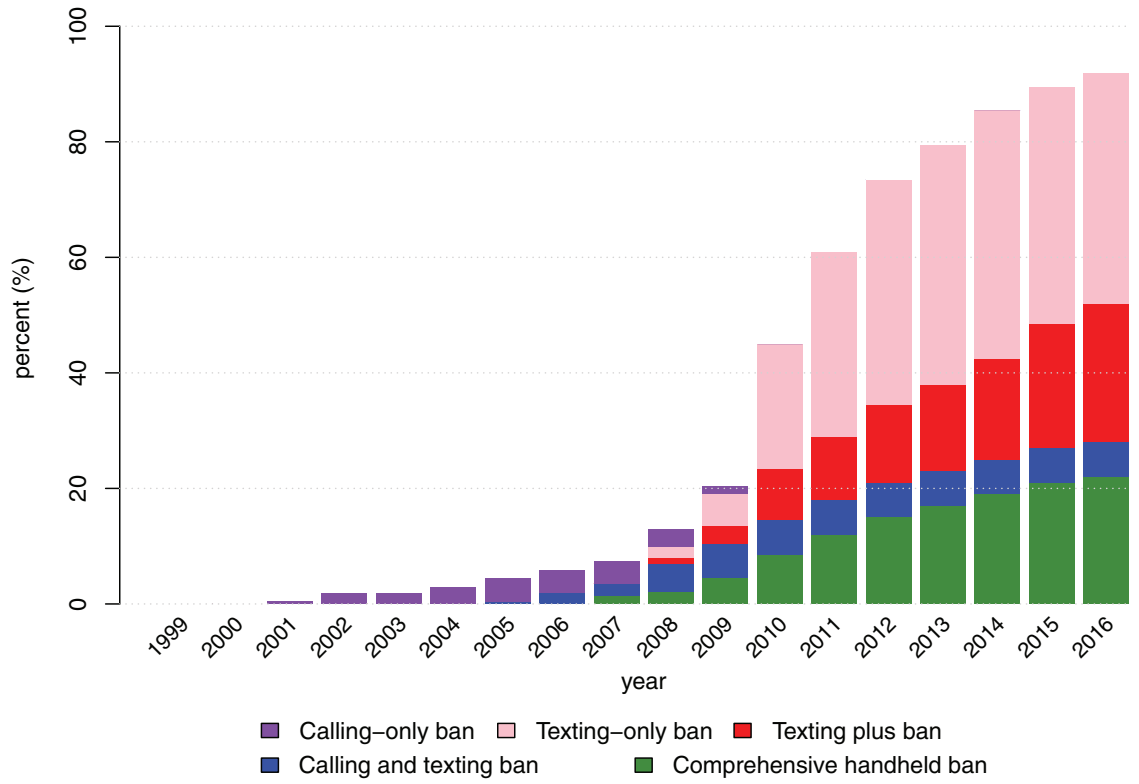

FIGURE. Distribution of cellphone ban status among US states, 1999–2016.

TABLE 1. Descriptive Statistics of the Study Population and State Data, United States, 1999–2016

	Fatally Injured Drivers, N (%) (N=344,003)	Fatally Injured Non-Drivers, N (%) (N=272,286)	All Fatalities, N (%) (N=616,289)
Age, y			
<18	13,578 (3.9)	44,856 (16.5)	58,434 (9.5)
18–24	69,542 (20.2)	48,619 (17.9)	118,161 (19.2)
25–39	88,520 (25.7)	56,177 (20.6)	144,697 (23.5)
40–59	93,596 (27.2)	67,713 (24.9)	161,309 (26.2)
≥60	78,720 (22.9)	54,840 (20.1)	133,560 (21.7)
Missing	47	81	128
Sex			
Male	242,397 (70.5)	174,561 (64.1)	416,958 (67.7)
Female	101,556 (29.5)	97,603 (35.9)	199,159 (32.3)
Missing	50	122	172
State data (n=3,600 state-quarters)			
			N (%)
Cellphone bans			
No ban			2,430 (67.5)
Calling-only ban			48 (1.3)
Texting-only ban			531 (14.8)
Texting-plus ban			231 (6.4)
Calling and texting ban			115 (3.2)
Comprehensive handheld ban			245 (6.8)
Maximum speed limit (miles per hour)[a]			
< 70			1,247 (34.6)
= 70			1,366 (37.9)
> 70			987 (27.4)
Seatbelt law			
Primary seatbelt law			1,794 (49.8)
Secondary seatbelt law			1,734 (48.2)
No law			72 (2.0)
Administrative license suspension for driving under the influence			2,992 (83.1)
			Mean (SD)
Gasoline price (US dollars per gallon)[b,c]			2.6 (0.7)
Income per capita (US $1,000)[c]			43.6 (7.2)
Vehicle miles traveled (1 million miles)[a]			14.7 (15.0)
			Median (range)
Cellphone ownership (%)			80.9 (13.3–118.8)
Percentage of rural roadway length out of total roadway length			75.4 (13.7–97.7)
Unemployment-population ratio (%)			2.6 (0.9–7.2)

[a]1 mile = 1.61 kilometers.
[b]1 gallon = 3.79 liters.
[c]Adjusted to the 2016 US dollar based on each year's consumer price index.

DISCUSSION

Comprehensive handheld bans were associated with fewer driver fatalities, but calling-only, texting-only, texting plus, and calling and texting bans were not. This could be due to greater compliance; comprehensive bans clearly send the message that cellphones are not to be handled at all while driving.[44] In addition, drivers may be more likely to believe that enforcement is possible when the laws govern cellphone use broadly. A survey found that drivers became more anxious when touching a cellphone after a comprehensive handheld ban was implemented in Georgia in 2018.[45] Drivers may doubt that texting-only bans are enforceable.[44,46] For example, drivers may believe that if stopped by a police officer, they can avoid a citation by claiming they were calling, not texting. A comprehensive ban is easier to enforce, because it is impossible for police to differentiate texting from dialing and other phone use.[44,46] A cross-sectional comparison of 14 US states found that more citations were issued when both calling and texting were prohibited, compared with texting-only (2,022 versus 14 per 100,000 person–years).[47]

TABLE 2. Driver, Non-Driver, and Total Fatalities, Fatality Rates, and Unadjusted and Adjusted Rate Ratios for Different Cellphone Ban Status, United States, 1999–2016

Type of Road Users and Cellphone Ban	No. of Fatalities	Person-years	Unadjusted Fatality rate per 100,000 person-years	Unadjusted rate ratio[a] (95% CI[b])	Adjusted rate ratio[c] (95% CI)
Driver					
No ban	254,540	13,769,497,319	7.4	Reference	Reference
Calling-only ban	6,572	807,937,398	3.3	0.40 (0.33–0.47)	1.00 (0.97–1.03)
Texting-only ban	42,237	2,850,754,590	5.9	0.75 (0.67–0.84)	1.02 (0.99–1.05)
Texting plus ban[d]	16,053	1,132,802,727	5.7	0.76 (0.60–0.97)	0.99 (0.93–1.04)
Calling and texting ban	5,442	714,898,375	3.0	0.38 (0.31–0.46)	0.98 (0.88–1.09)
Comprehensive handheld ban	19,159	2,426,218,371	3.2	0.47 (0.37–0.58)	0.93 (0.90–0.97)
Non-driver					
No ban	193,915	13,769,497,319	5.6	Reference	Reference
Calling-only ban	7,154	807,937,398	3.5	0.61 (0.53–0.69)	0.98 (0.95–1.00)
Texting-only ban	31,823	2,850,754,590	4.5	0.74 (0.67–0.81)	1.03 (0.99–1.06)
Texting plus ban[d]	11,725	1,132,802,727	4.1	0.76 (0.64–0.91)	0.98 (0.94–1.03)
Calling and texting ban	5,422	714,898,375	3.0	0.51 (0.47–0.56)	1.05 (0.96–1.16)
Comprehensive handheld ban	22,247	2,426,218,371	3.7	0.66 (0.57–0.76)	1.01 (0.95–1.07)
Total					
No ban	448,455	13,769,497,319	13.0	Reference	Reference
Calling-only ban	13,726	807,937,398	6.8	0.48 (0.42–0.56)	0.99 (0.96–1.01)
Texting-only ban	74,060	2,850,754,590	10.4	0.74 (0.67–0.82)	1.02 (0.99–1.05)
Texting plus ban[d]	27,778	1,132,802,727	9.8	0.76 (0.62–0.94)	0.98 (0.94–1.03)
Calling and texting ban	10,864	714,898,375	6.1	0.43 (0.39–0.49)	1.02 (0.93–1.13)
Comprehensive handheld ban	41,406	2,426,218,371	6.8	0.55 (0.47–0.65)	0.98 (0.94–1.01)

[a]We calculated unadjusted rate ratios by including the characteristics of cellphone bans as the only predictor variable in the negative binomial regression with robust standard error estimates.

[b]Confidence interval.

[c]We estimated aRR using negative binomial regression with robust standard error estimates. The aRR compares the rates per quarter–year exposed to the corresponding status of cellphone bans with no ban on cellphone use while driving. Comparisons are adjusted for state, year, quarter, traffic laws (i.e., seatbelt laws, maximum speed limits, and preconviction administrative license suspension for driving under the influence), socio-economic factors (i.e., unemployment-population ratio, income per capita, cellphone ownership, and highway expenditure), and travel factors (vehicle miles traveled, gasoline price, and the percentage of rural roadway length out of total roadway length).

[d]Bans that prohibit holding a cellphone for texting and some additional activities such as accessing the internet or social media applications.

We found that comprehensive handheld bans were associated with fewer driver fatalities but not for non-driver and total fatalities. Driver fatalities might be a more sensitive indicator for the impact of cellphone bans because motor vehicle drivers are directly regulated by bans on cellphone use while driving. Although the examination of non-driver and total fatalities measured the impacts of cellphone bans on passengers, motorcyclists, pedestrians, and bicyclists that might be involved in passenger vehicle crashes, this increases the chance that any crash will be fatal regardless of driver cellphone use. Non-driver fatalities also depend on extraneous factors, such as motorcyclist helmet use, belt use by occupants in other vehicles, adding error variance to estimates. The incidence of all these varies by crash, and all but passenger count vary systematically by state.

Our analysis of 1999–2016 driver fatalities found that comprehensive handheld bans were associated with a lower driver fatality rate (aRR = 0.93). To our knowledge, no previous studies have specifically estimated the association between comprehensive handheld bans and driver fatalities. Comprehensive handheld bans were first implemented in 2007 and more states have been enacting such bans since 2010. On the other hand, previous studies have examined bans on handheld calling, which include comprehensive handheld bans and handheld calling-only bans.

Our analysis found that comprehensive handheld bans were associated with fewer driver fatalities, but texting bans were not associated with driver fatality rates. A study examining motor vehicle-related emergency department visits in 16 states from 2007–2014 found that handheld bans (mainly handheld calling bans) were associated with approximately 5% fewer emergency department visits, and that texting bans were associated with approximately 4% fewer visits.[48] An investigation of traffic collision insurance claims reported that texting bans in California, Louisiana, Minnesota, and Washington were not associated with fewer traffic collision insurance claims.[49] A study of Michigan traffic crashes from 2005–2012 found that a texting ban was associated with a small increase in crashes involving fatal, disabling, or visible injuries, but a small decrease in crashes involving possible injury or property damage only.[50] Future research is needed to examine whether the lower driver fatality rate associated with comprehensive handheld bans in the present study extends to less severe crashes.

TABLE 3. Driver Fatalities, Fatality Rates, and Unadjusted and Adjusted Rate Ratios for Cellphone Bans According to Allowed Enforcement, United States, 1999–2016

Cellphone Ban and Enforcement Allowed	No. of Fatalities	Person-Years	Unadjusted Fatality Rate per 100,000 Person-Years	Unadjusted Rate Ratio[a] (95% CI[b])	Adjusted Rate Ratio[c] (95% CI)
No ban	254,540	13,769,497,319	7.4	Reference	Reference
Calling-only ban: primary	5,398	686,674,323	3.1	0.37 (0.33–0.42)	1.00 (0.97–1.03)
Calling-only ban: secondary	1,174	121,263,075	3.9	0.46 (0.41–0.51)	0.99 (0.93–1.06)
Texting-only ban: primary	32,392	2,098,884,415	6.2	0.77 (0.67–0.88)	1.03 (0.99–1.06)
Texting-only ban: secondary	9,845	751,870,175	5.2	0.68 (0.59–0.78)	0.99 (0.96–1.03)
Texting plus ban: primary	16,053	1,132,802,727	5.7	0.76 (0.60–0.97)	0.99 (0.93–1.05)
Texting plus ban: secondary[d]	—	—	—	—	—
Calling and texting ban: primary[e]	4,983	661,606,465	3.0	0.38 (0.31–0.46)	0.99 (0.88–1.11)
Calling and texting ban: secondary[e]	459	53,291,911	3.4	0.41 (0.37–0.46)	0.95 (0.90–0.99)[f]
Comprehensive handheld ban: primary[e]	16,787	2,134,672,330	3.1	0.46 (0.37–0.58)	0.93 (0.90–0.97)
Comprehensive handheld ban: secondary[e]	2,372	291,546,041	3.3	0.49 (0.38–0.62)	0.95 (0.90–1.00)

[a]We calculated unadjusted rate ratios by including the characteristics of cellphone bans as the only predicting variable in the negative binomial regression with robust standard error estimates.

[b]Confidence interval.

[c]We estimated adjusted rate ratios (aRR) using negative binomial regression with robust standard error estimates. The aRR compares the rates per quarter–year exposed to the corresponding status of cellphone bans with no ban on cellphone use while driving. Comparisons are adjusted for state, year, quarter, traffic laws (i.e., seatbelt laws, maximum speed limits, and preconviction administrative license suspension for driving under the influence), socio-economic factors (i.e., unemployment-population ratio, income per capita, and cellphone ownership, highway expenditure), and travel factors (vehicle miles traveled, gasoline price, and the percentage of rural roadway length out of total roadway length).

[d]No observations for the texting plus ban at the secondary enforcement level.

[e]If all the banned activities are at the primary enforcement level, it is defined as primary enforcement. Otherwise, it is defined as secondary enforcement (e.g., primary enforcement for texting, but secondary enforcement for calling).

[f]The estimate is unreliable because this category included only one state (Washington).

The mechanism through which cellphone bans might reduce driver fatalities is reducing calling, texting, and other cellphone behaviors that interfere with drivers' attention. Roadside-observed handheld cellphone calls declined by 41%–47% immediately after a calling-only ban was implemented in New York and DC, and 76% immediately after a calling and texting ban was implemented in Connecticut.[12] Rudisill et al[13] reported that bans forbidding calling while driving were associated with 40% fewer self-reported handheld calls, but that bans forbidding texting appeared to have had far less effect on texting while driving (aRR = 0.92, 95% CI = 0.84, 1.01). Further analysis found that the bans forbidding calling examined by Rudisill et al[13] were mainly comprehensive handheld bans, while bans forbidding texting were mainly texting-only bans. A Canadian study found that a comprehensive handheld ban reduced overall and handheld cellphone use and increased hands-free use as a substitution to handheld use.[51]

We found comprehensive handheld bans allowing primary enforcement were associated with fewer driver fatalities. Previous research has reported that primary enforcement increases the effectiveness of seatbelt laws, relative to secondary enforcement.[30] Secondary enforcement could be a barrier for enforcement.[52] However, we found that comprehensive handheld bans without primary enforcement for all banned activities might be associated with modestly fewer driver fatalities. Due to the relatively limited number of fatalities subject to comprehensive handheld bans without primary enforcement for all banned activities, more research is needed to confirm the findings on comprehensive handheld bans and mode of enforcement.

Future research is needed to clarify why comprehensive handheld bans are associated with fewer driver fatalities, but calling-only or texting-only bans are not. Self-report surveys could examine (1) drivers' awareness of cellphone bans, including details like primary versus secondary enforcement, which specific phone use activities are proscribed, and loopholes that interfere with enforcement and (2) driver's beliefs and experiences about the extent of law enforcement. This would guide efforts to design more beneficial laws and enhance the effectiveness of existing laws.

Strengths and Limitations

A strength is that multiple sensitivity analyses suggest that the estimate is robust for cellphone bans across alternative statistical models. Moreover, we examined not only driver fatalities, but also non-driver and total fatalities. One limitation of this study is that we could not directly examine cellphone-related driver fatalities because cellphone use by crash-involved drivers is often difficult to detect[53] and, until recently, was not routinely reported in crash investigations. We examined driver deaths and the findings may not be generalizable to other outcomes such as injuries, hospitalizations, and health care costs. We believe that we have considered the primary confounders; however, it remains possible that unobserved, unknown, or hard-to-measure confounders may bias effect estimates. Last, we did not have a measure of enforcement such as the number of cellphone-related citations. Such

measures would help clarify the direct and indirect effects of cellphone laws on traffic fatalities.

In conclusion, comprehensive handheld bans were associated with fewer driver fatalities. As of January 2020, 18 states have comprehensively banned almost all handheld cellphone use while driving.

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