Annals of Epidemiology 28 (2018) 730–735

Contents lists available at ScienceDirect

Annals of Epidemiology

journal homepage: www.annalsofepidemiology.org

Original article

Cell phone use while driving laws and motor vehicle driver fatalities: differences in population subgroups and location

Toni M. Rudisill, PhD [a], Haitao Chu, MD, PhD [b], Motao Zhu, MD, PhD [c,d,*]

[a] Injury Control Research Center, West Virginia University, Morgantown
[b] School of Public Health, University of Minnesota Twin Cities, Minneapolis
[c] The Center for Injury Research and Policy, The Research Institute at Nationwide Children's Hospital, Columbus, OH
[d] Division of Epidemiology, Department of Pediatrics, College of Medicine, College of Public Health Ohio State University, Columbus

ARTICLE INFO

Article history:
Received 9 August 2017
Accepted 26 July 2018
Available online 31 July 2018

Keywords:
Automobile driving
Cell phones
Epidemiology
Fatal outcome
Legislation

ABSTRACT

Purpose: Research suggests that cell phone use while driving laws are associated with lower driver fatalities. This study seeks to determine whether this relationship is modified by driver age (16–24, 25–39, 40–59, ≥60), sex (male, female), race/ethnicity (white non-Hispanic, white Hispanic, black non-Hispanic, other), or rurality (rural, urban).
Methods: Fatality Analysis Reporting System data were merged with state legislation (2000–2014). The exposure was the type of legislation in effect. The outcome was non–alcohol-related driver fatalities by state-quarter-year. Incident rate ratios were estimated using generalized Poisson mixed regression for overdispersed count data with robust standard errors.
Results: Amongst 190,544 drivers, compared to periods without bans, universal hand-held calling bans were associated with 10% (adjusted incident rate ratio = 0.90, 95% confidence interval 0.84, 0.96) lower non–alcohol-related driver fatalities overall and up to 13% lower fatalities across all age groups and sexes but not for race/ethnicity or rurality. When comparing state-quarter-years with bans to those without, universal texting bans were not associated with lower fatalities overall or for any demographic group.
Conclusions: The relationships between cell phone laws and non–alcohol-related driver fatalities are modified by driver demographics, particularly for universal hand-held bans. Universal hand-held calling bans may benefit more types of drivers compared to texting bans.

Introduction

Cell phones have been agathokakological for traffic safety. Although these technologies can be used positively, such as to hasten emergency services postcollision, they can also be used to facilitate injury while driving. Research shows that distracted driving collisions are increasing and that cell phone use is a significant contributor of these events [1]. In 2014 alone, 3179 people were killed and 431,000 were injured in distracted driving collisions in the United States (US) [2]. It is well established that cell phone use can negatively impact driving ability by cognitively, manually, or visually impeding driver attention [3–8]. A 2014 national survey determined that ~90% of drivers feel that cell phone use while driving is a significant threat to safety, yet a fair portion of these drivers still engage in such behaviors [9].

As of June 2017, 48 states have enacted at least one cell phone use while driving law [10]. Of these states, 14 regulate hand-held calling while driving for all licensed drivers; these bans typically prohibit drivers from physically holding a mobile device and conversing but permit hands-free technology [10]. Forty-six states have ratified texting while driving bans for all drivers, which typically bar drivers from manually answering or composing text messages [10]. However, texting bans characteristically do not prohibit hand-held cell phone conversations.

Various studies have investigated the relationship between these laws and outcomes such as observed and self-reported driver behavior and fatal collision rates [11]. To the authors' knowledge, 11 studies have investigated the relationship between cell phone use while driving laws and fatal collisions; of these studies, five have investigated universal texting bans (UTBs) and 10 have evaluated

Conflict of interests: All authors report no conflicts of interest.

* Corresponding author. The Center for Injury Research and Policy, The Research Institute at Nationwide Children's Hospital, 700 Children's Drive, RB3-WB5217, Columbus, OH 43205. Tel.: +1 614 355 6687; fax: +1 614 355 5897.
E-mail address: motao.zhu@nationwidechildrens.org (M. Zhu).

https://doi.org/10.1016/j.annepidem.2018.07.015
1047-2797/

universal hand-held calling bans (UHBs) [12–22]. The term "universal" indicates that the legislation applies to all licensed drivers. One study found that UTB with primary enforcement, meaning the driver could be pulled over for that specific offense, were associated with 8% lower single vehicle, single-occupant crashes [12]. Rocco and Sampaio determined that primary enforced UTBs were associated with 3% lower total fatalities [21]. Other research concluded that UTB were not associated with significant reductions in total fatal crashes or total fatalities [13,15]. Ferdinand et al investigated the relationship between UTB, total fatalities, and driver fatalities in specific age groups and conceded that total fatalities were 5% lower in 15–21 year olds only and driver fatalities were 7% lower only among those older than equal to 65 years when these bans were in effect [16]. The findings concerning UHB reveal that their presence was associated with up to 13% lower total fatal crashes, total fatalities, and driver fatalities [13–22]. In specific age groups, Lim and Chi determined that UHBs were associated with 11% lower non–alcohol-related fatal crashes among drivers younger than 21 years [18]. Ferdinand et al concluded that among 22–64 year old, total fatal crashes were 4% lower and total fatalities were 6% lower when UHB were effective [16]. Another study found that among 18–54 year old age groups, UHBs were associated with 7%–9% lower driver fatalities [19].

Although these studies are informative, several gaps in the literature persist. First, several states have added this legislation within the past 5 years so the extant literature needs revised. With the exception of one study [17], others did not adjust for the increasing number of cell phones in the population and no studies controlled for police population; both of these factors may confound the relationship between cell phone laws and driver fatalities. Also, it is unclear whether the relationship between these laws and driver fatal collisions are modified by other demographic factors. Traffic safety research suggests that certain laws may be more effective in some populations than others. It is well established in the literature that males tend to exhibit more risk taking behaviors, such as speeding, maintaining safe following distances, or driving too fast for conditions, compared to female drivers [23]. Drivers in rural areas are known to engage in riskier behaviors, such as speeding or seat belt nonuse, compared to urban drivers [24,25]. Age is also a well-known modifier of driver behavior and crash outcomes [23,26,27]. Previous traffic safety studies have also documented racial and ethnic differences in red light running, stop sign violations, driving while intoxicated, seat belt nonuse, and speeding [28–31]. However, it is unknown whether cell phone use while driving laws are associated with lower driver fatalities across different demographic groups of drivers. If differences exist, this information could be useful for future public health interventions regarding cell phone use while driving.

Therefore, the purpose of this study was to investigate whether disparities in the association between driver fatalities and cell phone use while driving laws exist for those of different ages, sex, race/ethnicity, and rurality. Considering previous traffic safety research, it was hypothesized that differences would exist between these groups.

Materials and methods

Data sources

The primary data source was the Fatality Analysis Reporting System (FARS). FARS is a publically available database maintained by the National Highway Traffic Safety Administration and is a compilation of all fatal traffic collisions that occur on US roadways. All 50 states and the District of Columbia report collisions to the National Highway Traffic Safety Administration when at least one individual involved in the crash dies within 30 days of the incident. Trained analysts abstract the data from the reported files, which detail the circumstances surrounding the crash, vehicles, and individuals involved. FARS has been described in more detail elsewhere [32,33].

The 2000–2014 FARS data were collected and merged with states' cell phone use while driving legislation in 2017. This data set was constructed by the authors, which was generated via internet searches [34], the Insurance Institute for Highway Safety [10], and the Governor's Highway Safety Association [35]. The laws were researched in each state's legislative archives, read and coded. Information was collected regarding effective dates, who was affected, what was permitted/prohibited, etc. Coding was completed by two individuals for accuracy.

Other data were collected. Population estimates on July 1 of each year were retrieved from the US Census Bureau [36]. The number of cellphone subscriptions by state-year was obtained from the Federal Communications Commission's Local Telephone Competition reports [37]. Information pertaining to traffic safety laws, such as speed limits, seat belt laws, alcohol laws, etc., was obtained from two sources. Dr. Scott Masten, formerly of the California Department of Transportation, provided a data set of extant traffic laws, which were coded through 2008 [38]. The data set was expanded by the authors through 2014 using data from the Insurance Institute of Highway Safety [39]. The quarterly unemployment rate and consumer price index were obtained from the US Bureau of Labor Statistics [40]. Annual gasoline prices were gathered from the Energy Information Administration [41]. The quarterly per capita income was garnered from the Bureau of Economic Analysis [42]. The number of full time police officers was obtained from the US Federal Bureau of Investigation [43].

Study population

The study population was limited to drivers of passenger vehicles older than equal to 16 years of age, who were killed in a non–alcohol-related collision that occurred between January 1, 2000 and December 31, 2014. Nonalcohol collisions were defined as any collision where the investigating officer reported that alcohol was not consumed by the driver. This analysis was limited to drivers because cell phone laws only restrict drivers' behavior.

Variables

The main exposure was the presence of a UTB and/or UHB. These laws were binary coded (present or absent) by state-quarter-year. The primary outcome was driver fatality counts by state-quarter-year. The District of Columbia was included as a state. Drivers were categorized into demographic subgroups as shown in Table 1. Location was categorized as urban or rural, which was based on the roadway function class where the collision occurred. Yearly population estimates for each state were linearly interpolated into state-quarter-year. Cell phone coverage by state-year was calculated by taking the number of residents with cell phone subscriptions per 1000 of the states' population. Yearly per capita income by state was converted to quarter-year via linear interpolation. These values were then adjusted by the 2014 consumer price index to correct for inflation. The yearly gas price by state was converted to dollars per gallon and then adjusted by the 2014 consumer price index to correct for inflation. The maximum speed limit was obtained for each state by quarter-year and was binary coded as greater than or equal to 70 miles per hour. Administrative license suspension (i.e. the automatic suspension of a license for testing above a set blood alcohol concentration) was obtained for each state-quarter-year and binary coded as present/absent. The minimum state per se