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Original article

# The association between handheld phone bans and the prevalence of handheld phone conversations among young drivers in the United States

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ABSTRACT

*Purpose:* Fourteen US states and the District of Columbia have banned handheld phone use for all drivers. We examined whether such legislation was associated with reduced handheld phone conversations among drivers aged younger than 25 years.
*Methods:* Data from the 2008 to 2013 National Occupant Protection Use Survey were merged with states' legislation. The outcome was roadside-observed handheld phone conversation at stop signs or lights. Logistic regression was used.
*Results:* A total of 32,784 young drivers were observed. Relative to drivers who were observed in states without a universal handheld phone ban, the adjusted odds ratio of phone conversation was 0.42 (95% confidence interval, 0.33–0.53) for drivers who were observed in states with bans. The relative reduction in phone conversation was 46% (23%, 61%) for laws that were effective less than 1 year, 55% (32%, 70%) for 1–2 years, 63% (51%, 72%) for 2 years or more, relative to no laws.
*Conclusions:* Universal handheld phone bans may be effective at reducing handheld phone use among young drivers.



## Introduction

Traffic crashes are the leading cause of death among persons aged 15–24 years in the United States, accounting for about one-quarter (6510 fatalities) of all deaths for this demographic group during 2013 [1]. Distracted driving is a prevalent traffic safety hazard [2–4]; for example, a 2014 national survey reported that approximately 56% of drivers aged 16–18 years and 72% of drivers aged 19–24 years talked on a cell phone while driving in the past month [4]. Handheld phone use while driving is distracting because it requires that attention be diverted away from the roadway when dialing a number, receiving a call, or holding a phone to the ear. In addition, when auditory and speech demands are high, driving performance is further degraded by cognitive distraction [5–9].

To mitigate this risk, 14 states and the District of Columbia have enacted a handheld phone ban for all drivers (universal handheld phone ban) as of August 2016 [10]. In general, it prohibits drivers from engaging a call using at least one hand on a public highway, but it allows hands-free calling by using headphones, ear buds, Bluetooth, or speaker phone. Few studies have examined the effectiveness of such laws in reducing driver handheld phone use [11–14]. These studies are consistent in findings that universal handheld phone bans are associated with reduced handheld phone use. However, there are unique challenges in enforcing handheld phone laws. Handheld phone conversation is prohibited, but dialing a number on a speaker phone (hands-free use) is generally allowed. It is difficult for police officers to distinguish whether dialing is handheld or hands-free use. It is challenging for police to detect drivers holding a phone to their ear and citations of handheld

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phone use are low [15]. It would be interesting to examine whether the ban has long-term effectiveness without high-level enforcement. In addition, the monetary amount of fine may be important to drivers violating traffic laws; for example, increasing a fine from $5 to $100 was associated with 11% increase in seat belt use [16]. The objective of this study was to determine the relationship between a state's handheld phone ban, including specific provisions of these bans around fines and its long-term effectiveness, and the prevalence of handheld phone use among a nationally representative sample of young drivers.

## Materials and methods

### *Data sources*

The primary data source was the 2008–2013 National Occupant Protection Use Survey (NOPUS) [17]. NOPUS is a national observational survey examining driver electronic device use, seat belt use, and child restraint use at randomly selected traffic stop signs and stoplights in the United States [18]. Observers collect data on the stopped passenger vehicles including casual assessment of the driver's age and race. The survey is conducted in June each year with observations collected between 7 AM and 6 PM. The sampling design involves two-stage sampling with stratified probability proportional to size [18]. In each year, approximately 50 primary sampling units and 1200 observational sites are selected [18].

A dataset of each state's distracted driving legislation spanning from January 1, 2008 through December 31, 2013 was compiled from several sources including web searches [19], the Insurance Institute for Highway Safety [10], and the Governor's Highway Safety Association [20]. Each piece of legislation was subsequently retrieved from the respective states' legislative archives and verified independently by two individuals. The dataset contained information on effective dates and amount of fines. In this article, the focus was on legislation applicable to all ages of drivers, hereafter called universal handheld phone bans.

Information on each state's number of cell phone subscriptions from each year was compiled from the Federal Communications Commission's Local Telephone Competition reports [21,22]. Population estimates were obtained from the US Census Bureau [23]. Cell phone subscriptions and population estimates were used to estimate the number of cell phone subscriptions per 100 residents each year as a measure of the ownership of cell phones in the state's general public.

### *Study population*

The study population included participants who were drivers in the 2008–2013 NOPUS survey and judged less than 25 years of age by roadside observers. NOPUS has three categories (<25 years, 25–69 years, and ≥70 years) in driver's age, and we chose those aged younger than 25 years given their high cell phone use. Because of the methodology of the NOPUS survey (not all states are sampled), this yielded a sample of drivers spanning 35 states (see Web Appendix: Table A1.) Of 35 states, 9 implemented universal handheld phone bans by 2013.

### *Variables*

The dependent variable of interest, handheld cell phone use, was recorded at four levels in NOPUS: holding phones to their ears, speaking with visible headsets, visibly manipulating handheld devices, and no observed electronic device use. Each driver was assessed for about 10 seconds before the observer assigned him or her to one of the four categories [17]. For this analysis, driver behavior was dichotomized into handheld phone conversation (holding phones to their ears) or not (the latter three categories). The category of visibly manipulating handheld devices might include a small proportion of manual phone number dialing, but dialing is typically less than the 10-second observation duration. We suspect that visibly manipulating handheld devices might be more aligned with texting than dialing.

The primary predictor variable was whether a universal handheld phone ban was in effect for the state of the observed driver. Additional factors for secondary analysis included amount of fine and the length of time since legislation enacted. States' universal handheld phone bans in effect at the time of the NOPUS survey were categorized into presence or absence. Nine states implemented such a ban by 2013. A table listing each state in the analysis and the characteristics of handheld phone bans appears in the Appendix (Table A1). As fines are typically listed as a range in legislation, the minimum was taken, and further categorized into less than $100 or $100 or more without accounting for administrative court fees.

Additional independent variables were the driver's sex, race (White, African American, and other), the rurality of the observational site (urban, suburban, and rural), the driver's seat belt use (yes or no), vehicle type (passenger car, pick-up truck, van, or sports utility vehicle), and the state's number of cell phone subscriptions per 100 residents.

### *Data analysis*

Logistic regression was fitted to estimate the odds ratio (OR) of driver handheld phone conversation accounting for the survey's complex sample design (i.e. clustering, strata, etc.). The NOPUS data provide 56 replicate weights for 2011–2013 data, 62 replicate weights for 2010 data, but no replicate weights for the 2008–2009 data. To combine 2008–2013 data, we created pseudo strata and clusters from primary sampling units and used the Taylor Series approximation method to compute standard errors for all descriptive estimates and the model parameter estimates [24]. To verify our pseudo strata method, we applied pseudo strata and replicate weights method to 2011–2013. Both methods produced the same point estimates and confidence limits for OR for handheld phone ban when rounding to two decimal places.

To determine whether handheld phone ban and provisions were associated with driver handheld phone conversation, an adjusted OR (aOR) was calculated for presence versus absence of a universal ban. The aOR was estimated by comparing drivers in nine states with ban with drivers in 26 states without bans and by comparing drivers before and after the ban in six states where a ban was implemented in 2008–2013. We further estimated the aOR according to minimal state fines (<$100 vs. ≥$100) and length since implementation (<1 year, 1–2 years, ≥2 years). Separate models were estimated for each provision and adjusted for sex, race, seat belt use, vehicle type, rurality of the observation site, and the number of cell phone subscriptions per 100 residents. In sensitivity analysis of categorizing handheld phone conversation, we left out two categories (speaking with visible headsets and visibly manipulating handheld devices) and kept "holding phones to their ears" and "no observed electronic device use" to estimate the OR in comparison of handheld phone ban with no ban. All analyses were run in SAS version 9.4 (SAS Institute Inc., Cary, NC, USA) using the complex sample procedures. Confidence limits were based on a 95% interval, all hypothesis tests were two-sided with $\alpha = 0.05$.

## Results

Of the 380,645 passenger vehicle occupants observed in 2008–2013 NOPUS, a total of 266,461 were drivers, and 32,784