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Traffic stops do not prevent traffic deaths

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Abstract

OBJECTIVES: Amid growing calls for police reform, it is imperative to reassess whether police actions designed to improve public safety are associated with injury prevention. This study aims to examine the relationship between the police traffic stops (PTSs) and motor vehicle crash (MVC) deaths at the state level. We hypothesize that increased PTSs would be associated with reduced MVC deaths.

METHODS: We retrospectively analyzed PTSs and MVC deaths at the state level from 2004 to 2016. Police traffic stops data were from 33 state patrols from the Stanford Open Policing Project. The MVC deaths data were collected from the National Highway Traffic Safety Administration. The vehicle miles traveled data were from the Federal Highway Administration Office of Highway Policy Information. All data were adjusted per 100 million vehicle miles traveled (100MVMT) and were analyzed as state-level time series cross-sectional data. The dependent variable was MVC deaths per 100MVMT, and the independent variable was number of PTSs per 100MVMT. We performed panel data analysis accounting for random and fixed state effects and changes over time.

RESULTS: Thirty-three state patrols with 235 combined years were analyzed, with a total of 161,153,248 PTSs. The PTS rate varied by state and year. Nebraska had the highest PTS rate (3,637/100MVMT in 2004), while Arizona had the lowest (0.17/100MVMT in 2009). Motor

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AUTHORSHIP

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DISCLOSURE

C.W.T.is a consultant for Zimmer Biomet, Sig Medical, Atricure, and Medtronic. V.P.H.'s husband is a consultant for Zimmer Biomet, Sig Medical, Atricure, and Medtronic. The other authors declare no conflicts of interest.

This study was considered exempt of institutional review board approval because the data are deidentified.

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vehicle crash deaths varied by state and year, with the highest death rate occurring in South Carolina in 2005 (2.2/100MVMT) and the lowest in Rhode Island in 2015 (0.57/100MVMT). After accounting for year and state-level variability, no association was found between PTS and the MVC death rates.

CONCLUSION: State patrol traffic stops are not associated with reduced MVC deaths. Strategies to reduce death from MVC should consider alternative strategies, such as motor vehicle modifications, community-based safety initiatives, improved access to health care, or prioritizing trauma system.

LEVEL OF EVIDENCE: Retrospective epidemiological study, level IV.

Keywords

Police traffic stops; motor vehicle related deaths; injury prevention

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In the United States, high motor vehicle use,[1] motor vehicle crashes (MVCs), and crash-related deaths are common. In 2018, morethan33,000 fatal MVCs occurred inthe United States, killing 36,560 people.[2] Motor vehicle crash fatalities are a leading cause of death, accounting for 17.4% of all injury-related deaths between 2012 and 2015.[3] Also, MVCs impose a significant economic burden, and in 2010, the economic cost of these crashes including loss of productivity and medical costs totaled US $242 billion (or 1.6% of the US Gross Domestic Product) and rose to US $836 billion when adjusted for quality of life valuations.[4]

While MVCs are costly, they are preventable. Thus, prevention of MVCs and their related injuries and deaths constitute a significant health policy focus. Seat belt laws, increased penalties for traffic violations, reduced legal alcohol blood content, roadway improvements, and law enforcement traffic stops are the common strategies to decrease MVC.[5–11] Many developed countries rely heavily on police traffic stops (PTSs [http://links.lww.com/TA/B968]) to reduce MVCs and improve road safety. Single county studies and smaller analyses support the assumption that PTSs effectively increase the adherence to traffic laws and reduce MVCs and MVC-related injuries.[11–16] A study using municipal-level PTS data from 300 towns in Massachusetts between 2001 and 2003 showed that an increase in traffic citations was associated with fewer MVCs and crash-related injuries.[15] Another study indicated a negative relationship between fatality rate and policing budget and the number of highway officers. In this study, the number of active hours spent by highway officers was the best negative predictor of fatality rate.[17]

Although PTS is the highly preferred alternative to reduce traffic collisions and improve roadway safety, the public, academics, and news media have scrutinized PTSs for racial disparities[16,18,19] and revenue generation.[20,21] A recent study using 21 state patrol agenciesand 35 municipal police departments showed that higher percentage of Black drivers were stopped than White drivers before dusk,[19] suggesting racial bias. Furthermore, PTSs have been criticized as subject to revenue generating, with some data suggesting when higher and short-run revenue was necessary, officers shift their limited time to targeting White drivers in areas where there was a large White-to-Black income ratio.[21] Together, these reports suggest conflicting conclusions that PTSs are associated with roadway safety but may also be susceptible to bias unrelated to traffic safety. To date, there is no nationwide analysis of the association of PTSs to MVC deaths. Therefore, the role of PTSs in reducing MVC traumatic deaths is unclear, and it is critical to determine the effect to ascertain their role in health policy.

The purpose of this study was to examine the association between PTSs and MVC deaths using a nationwide analysis. We hypothesized that increased PTSs would be associated with reduced MVC deaths. A secondary purpose of this study was to evaluate the association between PTSs and MVC deaths in different racial subgroups of the population and different PTSs outcomes with the hypothesis that PTSs effectiveness may vary in racial subgroups or by PTSs outcome.

PATIENTS AND METHODS

Data Sources

The PTS datawere collected from the Stanford Open Policing Project (SOPP). The SOPP is an academic endeavor to collect policing data. The data were collected using public records requests from all 50 states. Because data from each jurisdiction were provided in idiosyncratic formats with varying levels of specificity, SOPP used a variety of automated and manual procedures to homogenize the data. Although the data at the state level are incomplete, this database contains more than 200 million traffic stops carried out by dozens of state patrol agencies and municipal police departments over a decade across the country.[22]

The definition and determination of race were categorized by the state reporting agency and was validated by SOPP to adjust for data entry errors at the state level.[19] These data also provide the outcome of the PTS, categorized aswarning, citation, or arrest. A citation is defined as “an order issued by a law enforcement that releases a person on a promise to appear in court or pay a fine” and is used by states to divert low risk offenders from criminal detention.[23] Awarning is a PTS that did not result in a citation or arrest. The standardized data and code to analyze the records are available at https://openpolicing.stanford.edu.

The outcome of interest was MVC death. The MVC deaths data were collected using the Fatality and Injury Reporting System Tool available through the National Highway Traffic Safety Administration (NHTSA).[24] The methodology used to categorize MVCs and other data definitions have been previously described.[25] For the purposes of this analysis, we hypothesized that the effect of PTSs may be limited to interstate highways, as state patrols may concentrate their attention on these roads. Therefore, fatalities were categorized as occurring on interstates or noninterstate roads using definitions provided by the NHTSA. The race of an MVC death was also collected from Fatality and Injury Reporting System Tool to perform subgroup analyses of PTSs and race. To account for the variability between states in terms of road mileage and traffic, we obtained motor vehicle miles traveled data for each state year from the Federal Highway Administration Office of Highway Policy Information.[26]

Study Population

Although SOPP provided data on some urban municipalities, we chose to perform a state-level analysis using state patrol PTS data from the available 33 states (Fig. 1). We believe that applying a state-level analysis would potentially correct for differences in local municipality PTS reporting. Furthermore, 83% of all PTSs are conducted by state police officers,[27] suggesting that this analysis would account for the vast majority of PTS activity. The analysis was limited to 33 state patrol PTSs occurring between 2007 and 2016, with variation in reporting years accounted for in the data analysis. Again, this analysis was limited by data available through SOPP, which in turn was limited by state reporting. The PTSs, MVC deaths, and vehicle miles traveled data were provided in particular formats with varying levels of specificity; therefore, we used a variety of automated and manual procedures to create a final data set. All data were adjusted per 100 million vehicle miles traveled (100MVMT).

Outcome Variable

The primary outcome of this study was yearly statewide MVC death rate per 100MVMT.

Statistical Analysis

Demographic characteristics are summarized as absolute frequencies and rates per 100MVMT. The data were analyzed as unbalanced state-level time series cross-sectional data. The purpose of this analysis is to account for time-dependent and state-dependent confounding with the assumption that outcomes vary between states and over time.

We used PROC PANEL procedures in SAS 9.4 to analyze the data with “states” as the cross section and “year” as the period within the cross section. The data were treated as unbalanced panel because not all the cross sections (states) had PTS data of the same period (year). To account for the unbalanced panel, we used the Wansbeek and Kapteyn method for estimating variance components.[28]

We used a two-way random-effects model to analyze the relationship between PTSs and MVC deaths. A two-way model depends on both the cross section and the period to which the observation belongs. We fit the following two-way random effects model to the data:

$$\text{MVCDeaths}_{it} = \text{Intercept} + \beta\,\text{PTS}_{it} + v_i + e_t + \varepsilon_{it}$$

where MVCDeaths_{it} represents the MVC deaths (total or interstate) and βPTS_{it} represents PTSs (total or stratified by race and outcome). Furthermore, v_i represents the cross-sectional effect, e_t is time series (year) effects, and ε_{it} is error variance (other unmeasured confounders) components (i = 1–33 states; t = 2004–2016 years).

To check the appropriateness of random-effects specification in our models, we used the Hausman test. The null hypothesis under this test is that there is no correlation between the variance component (cross-sectional variance *states* and time series variance *year*) and the predictor variable (PTS).[28] A p value of <0.05 from the Hausman test suggests that the fixed-effects model is more appropriate. The fixed-effects model does not assume that state effects are uncorrelated. We fit the following two-way fixed effects model to the data:

$$\text{MVCDeaths}_{it} = \text{Intercept} + \beta\,\text{PTS}_{it} + \gamma_i + \alpha_t + \varepsilon_{it}$$

where MVCDeaths_{it}, βPTS_{it}, and ε_{it} are defined as previously, but γ_i and α_t are the nonrandom cross-sectional (states) and time series (year) components.

The MVC death rate was classified into four categories as total MVC death rate per 100MVMT, interstate MVC death rate per 100MVMT, White MVC death rate per 100MVMT, and Black MVC death rate per 100MVMT. The PTS rate was stratified into six categories based on driver's race and outcome after PTSs. The classification of PTS rate was as follows: all PTSs per 100MVMT, White PTSs per 100MVMT, Black PTSs per 100MVMT, warning after PTSs per 100MVMT, citation after PTSs per 100MVMT, and arrest after PTSs per 100MVMT.

All the statistical analysis was conducted in SAS 9.4.[29] All tests were two-tailed, and p value of <0.05 was considered significant. This study was institutional review board exempt.

RESULTS

A total of 33 states reported data on state patrol PTSs with 235 combined years. Thirty-two states (96.7%) reported driver's race, and 27 (81.8%) reported on the outcome after the PTSs including warnings, citations, or arrests. The analysis included a total of 161.2 million PTSs from 2004 to 2016. The PTS rate varied by state and year. Nebraska had the highest PTS rate (3,637/100MVMT in 2004), while Arizona had the lowest (0.17/100MVMT in 2009).

During the study period, 190,880 MVC deaths were reported in the NHTSA database, including 23,084 (12.1%) interstate MVC deaths. Motor vehicle crash deaths varied by state and year, with the highest death rate occurring in South Carolina in 2005 (2.2/100MVMT) and the lowest in Rhode Island in 2015 (0.57/100MVMT).

Using a random-effects model, there was no significant association between increased PTS and total MVC death rate when adjusted for million vehicle miles traveled (MVMT) (coefficient, −0.00002; p = 0.4238), nor was there an association of PTS and interstate MVC death rate when adjusted for MVMT (coefficient, −0.000006; p = 0.3848) (Table 1 and Fig. 2).

In a subgroup analysis of 29 states with race categorized, there were 160.7 million total stops, including 95.8 million White PTSs (58.8%), 23.8 million Black PTSs (14.5%), and 41.3 million stops with other or missing race (26.4%). Among 190,226 total MVC deaths in these state years, there were 115,527 MVC deaths among Whites (60.7%), 24,522 among Blacks (12.9%), and 50,177 deaths with other or missing race (26.4%).Using a random-effects model, there was no significant association between White PTSs and White MVC death rate when adjusted for MVMT (p = 0.1168) (Table 2) or between Black PTSs per 100MVMT and Black MVC death rate when adjusted for MVMT (coefficient, −0.00002; p = 0.6219) (Table 3).

In a subgroup analysis of 130.5 million PTSs that occurred in 27 states (189 state years) with PTSs outcomes recorded, PTSs resulted in 38.7 million warnings (29.2%), 53.0 million citations issued (40.8%), 2.0 million arrests made (1.5%), and 37.8 million had other or no applicable outcomes (29.1%). The highest warning rate was issued in Illinois in 2016 (1190.9/100MVMT); the highest citation rate was in North Carolina in 2010 (1096.7/100MVMT); and the highest arrest rate was in Arizona in 2016 (271/100MVMT). Using a fixed-effects model, there was no significant association between increased PTS warnings and total MVC death rate when adjusted for MVMT (coefficient, −0.00001; $p = 0.8693$), nor was there an association of PTS warnings and interstate MVC death rate when adjusted for MVMT (coefficient, −0.000006; $p = 0.7267$) (Table 4). There was also no association between citations after PTS and total MVC death rate (random-effects model, $p = 0.7078$) or in an interstate-level analysis (random-effects model, $p = 0.4470$) (Table 5). Arrests after PTSs were also not associated with total MVC deaths (random-effects model, $p = 0.6904$) and interstate MVC death rate per 100MVMT (fixed-effects model, $p = 0.2419$) (Table 6).

DISCUSSION

This study contradicts previously published studies and demonstrates no association of PTSs and MVC-related fatalities, suggesting that, in aggregate, PTSs are not an effective method of trauma-related death prevention. This is the first nationwide assessment of PTSs effectiveness and differs considerably in scope relative to previous studies, which primarily examined individual municipalities.[16,17] This study examined the broader effects of PTSs on MVC deaths, whereas much of the literature has focused on the effects of PTSs on specific adverse indications such as alcohol-impaired driving.[30]

We have several hypotheses why there is no association between PTSs and MVC road deaths. One potential explanation reducing the effectiveness of PTSs is the increasing prevalence of countermeasures such as speed trap reporting.[31,32] Several mapping software applications allow reporting of speed traps, which altered drivers to their presence before they encounter them on the roadway. This may have the effect of only transiently curbing, dangerous driving behavior temporarily, potentially leading to unsafe behaviors elsewhere. Other PTSs countermeasures such as radar detectors can also be used to identify law enforcement speed checks before being detected by law enforcement, which may limit the effectiveness of PTSs in curbing dangerous motor vehicle use. Another explanation is that risky behavior has already been reduced by law enforcement. Data from NHTSA suggest that nationwide traffic deaths in 2019 were the lowest since 2014.[33] This decrease may be due to vigilant law enforcement activity, which has been performed to improve roadway safety. Lastly, there may be no association of PTSs and MVC death because most MVC deaths occur on rural roads with limited police presence. In this study, more than 85% of MVC death occurredonnoninterstateroads.Despiteincreasinglawenforcement budgets, policing of the United States' more than 4.18 million miles is logistically complex. As such, in many areas, the threat of citation is likely low and therefore not an effective means to curb dangerous roadway behaviors.

This study also examines the relationship of race to PTSs effectiveness. In that analysis, we found that there was no difference in the effect of PTSs among the White and Black motorists. Previous studies have found significant racial disparities in policing such that Black drivers are more likely than White drivers to be pulled over, searched, and required less suspicion to justify the search.[22] That report criticized law enforcement as operating under racially “biased” assumptions and has coincided with growing calls for police reforms regarding race-biased enforcement.[18,22,34] This study doesnot include ananalysis of PTS rates by race but supports that the effect of PTSs to reduce MVS related death is not seen among Black or White motorists.

This study alsodemonstratedthat the outcome ofthe PTSs (warning, citation, or arrest) was not associated with MVC death. Several countries in Europe have taken a more severe approach to motor vehicle citations, whereby fines are proportionally higher than in the United States. For example, in the Finnish “day fine” system, fines for minor offenses are calculated based on an offender’s net income and can lead to citations for more than US $200,000.[35] Other European countries, such as Denmark and Switzerland, alter the fine based on the location of the infraction, with urban tickets associated with larger fines.[36] An analysis of drivers in Florida suggests that increasing fines were more effective, as they were associated with lower rates of violation “recidivism.”[37] Our analysis suggests that the outcomewas not associated with safety. The lack of association of citations with safety suggests that this system needs a reform, and we advocate for a data-driven approach to motor vehicle safety enforcement with an emphasis on factors that can improve injury prevention. Another study supported a finding citing that PTSs’ reprioritization can reduce adverse crash outcomes and disparities.[16] We believethatfuturestudy into PTS prioritiesis appropriate, as itprovides a better understanding of which PTS reasons are associated with improvements in roadway safety.

One important finding of this study is that state-level PTS data are incomplete and therefore difficult to study. The SOPP attempted to collect PTS data from all 50states, but only a subset was available for analysis here. Furthermore, specific data from the stops, such as driver race or PTSs outcome, are not universally reported. As value-based spending becomes increasingly important, so too is transparency in law enforcement activity. Only with increased transparency can thevalue of specific policing activities be demonstrated and therefore justified. Physicians are held to a high standard of “risk-adjusted” outcomes, and we believe that PTSs could also be evaluated in this way. For example,if communities could identifyroadwayswithelevatedriskof MVC, police could use real-time feedback to determine if specific policing activities were improving safety in those areas. This would require significant changes to public reporting of law enforcement activity and infrastructure changes that facilitate data sharing between federal and local authorities. We advocate for transparent policing records to determine best practices for community health.

This study has several limitations, which reduce its impact and generalizability. First, this is a retrospective database study, and unmeasuredconfoundersmayhavebiasedthefindingsandconclusions of the study. We have attempted to reduce confounding factors through complex statistical corrections, which are designed to account for differences between states and over time but are limited by possible bias that exists at several levels. Second, the study does not account for non-PTS law enforcement mechanisms, such as red-light cameras, which have been shown to reduce MVC fatalities.[38] Theoretically, the statistical modeling techniques, which account for clustering within states, should correct for this, but bias can occur at this level, nonetheless. Similarly, we do not account for motor vehicle type or age. We believe that the difference in vehicle type should also be accounted for in the random effects model, but bias may exist at this level. Third, we have onlyexamined a state patrol PTS data. Although state patrols account for 83% of all PTSs, they do not represent all lawenforcement measures.[27] We have attempted to correct for this by only evaluating interstate-related MVC fatalities (where state patrols may have greater impact), but non–state patrol PTSs may have a confounding effect of the relationships studied in this analysis. Fourth, the conclusion regarding association of PTSs and MVC fatality can only accurately predict a relationship if the relationship exists within the study cohort. It is possible that vastly more (or fewer) PTSs would lead to an effect. Fifth, greater law enforcement is not synonymous with stricter regulations, as PTSs are a measure of enforcement not regulation. Road safety regulations are not the subject of this analysis and may confound the conclusions of this study. Sixth, we strongly caution against the conclusion that all law enforcement of motor vehicle infractions is ineffective. This analysis included only state patrol data, and it is possible (or even likely) that certain subgroups of PTSs are beneficial, such as stops for intoxicated driving. Lastly, although we have citedthestudiesaddressing racialdisparitiesinPTSs, this studydoesnotintendtobringattentiontoracialprofilingintraffic stops. The subgroup analysis by race is performed to identify if the PTSs effectiveness varies among racial subgroups. While there may exist a racial bias in PTSs, there may be other significant confounders in the relationship of PTSs to MVC deaths based on race, such as socioeconomic status that is currently not available in the data set that we used.

CONCLUSION

This study suggests that, inaggregate, PTSsby state patrol do not reduce MVC-related fatalities. Given the magnitude of public health crisis related to injuries and deaths sustained by MVCs, directing scarce resources to effective strategies such as rural and urban infrastructural changes, motor vehicle modifications with advanced lifesaving technology, community-based safety initiatives, improved access to health care, or prioritizing trauma system and improved trauma care is imperative. We suggest strong consideration of resource allocation to improved MVC safety mechanisms that may enhance injury prevention strategies. The futurestudies shouldalsoconsider understanding the root causes of MVCs to design effective measures.

DISCUSSION

The issue of responsible policing is a timely one. Each year, 11% of the general population will have contact with the police through a traffic stop. Sarode et al. should be commended for asking if we can provide our law enforcement colleagues with objective health outcomes data. One needs to be careful though, not to assume that we as the healthcare community understand the full intentions behind law enforcement policies. As the authors point out, injury prevention may not be the only driving force behind traffic stops. While revenue generation is perhaps a less palatable rationale, traffic stops may also assist with the interdiction of other crimes: for example, a stop may lead to the recovery of an illegal weapon thus preventing firearm-related injury while not affecting fatalities from motor vehicle collisions (MVC). This “Broken Windows Policing” style was initially meant to create a sense of pride and build rapport within communities by addressing minor infractions which in turn reduced more severe ones. This, unfortunately, can and has been misapplied to marginalized communities. The recommendation from law enforcement experts is to work with each individual community to develop policies that address the most pressing issues. Overarching generalizations about, shall we call it, “Broken Tail-lights Policing” are likely to not be applicable across a variety of communities.

As with everything, 2020 data are going to look very different. Some agencies placed a temporary halt on traffic stops for all but the most severe infractions during the initial stages of COVID-19 pandemic. However, fewer cars on the street also resulted in faster traffic speeds. Once the data has been released, it would be interesting to repeat this analysis as an interrupted time series analysis.

With 83% of all traffic stops being conducted by state police officers, only 12% of MVC deaths occur on interstate roads. With this discrepancy, the suggested lack of correlation between traffic stops and MVC deaths should be questioned. Perhaps this article could stand as a call to collaborate with our law enforcement colleagues to collect specific data prospectively evaluating potential healthcare implications of such policing practices.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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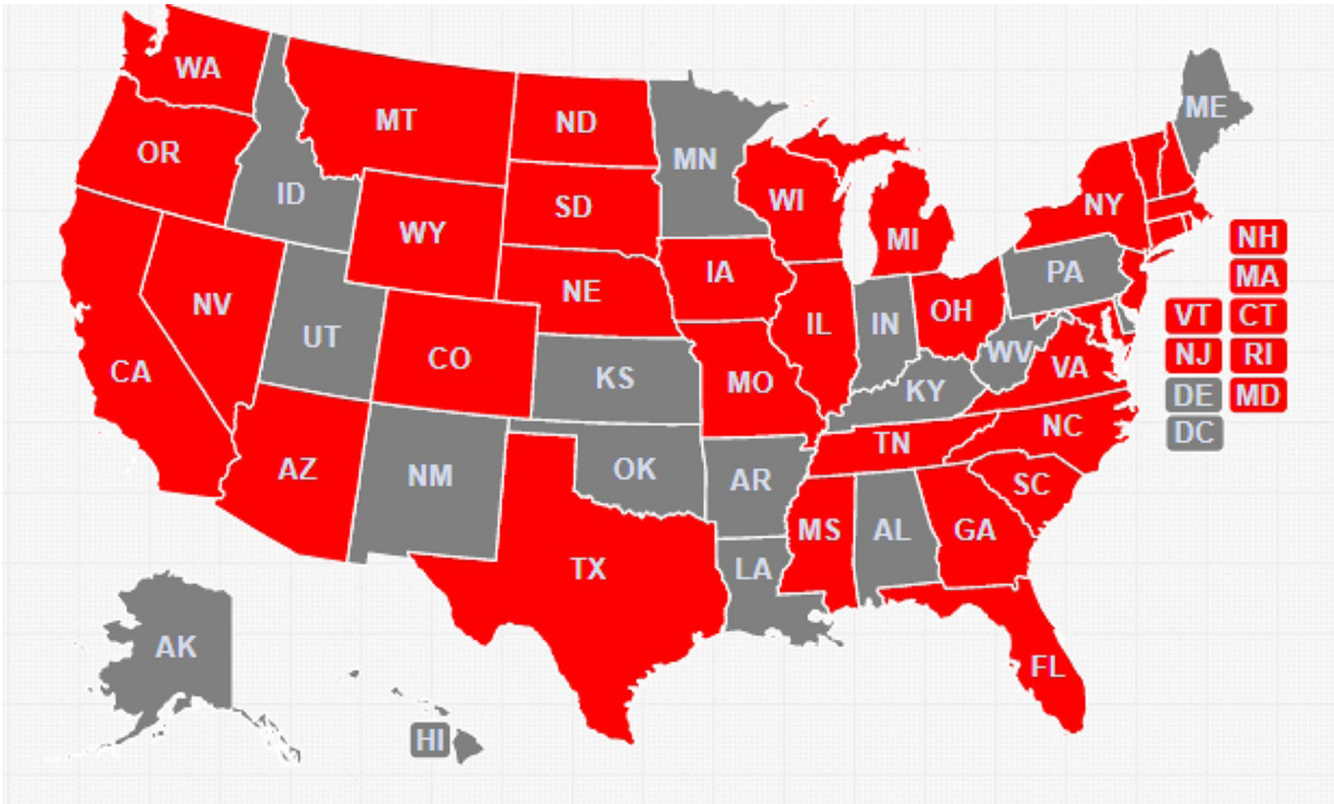

Figure 1.
Geographic coverage of compiled state patrol data. We analyzed 33 state patrol agencies data (red) on >161 million PTSs between 2004 and 2016. *This graph is created using simplemaps.

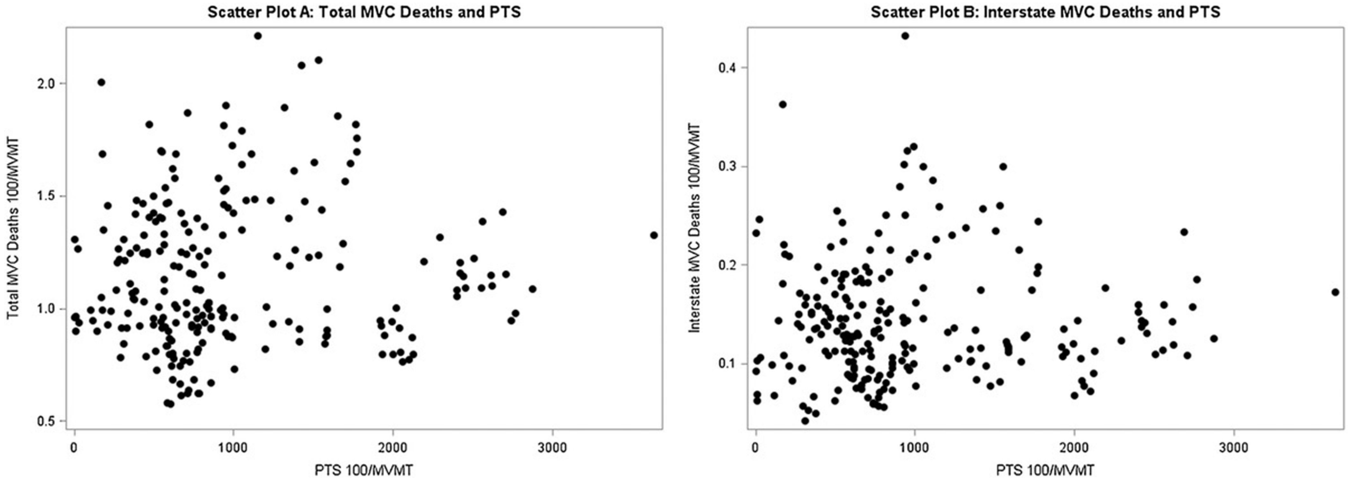

Figure 2.
Scatterplot for total and interstate MVC deaths per 100MVMT and PTSs per 100MVMT.

TABLE 1.

Predictor Variable — All PTSs per 100MVMT

Model 1: Random-effects model for total MVC deaths		
Hausman test for random effects, *p* value = 0.8397		
	Estimate	***p***
PTSs per 100MVMT	−0.00002	0.4238
Model 2: Random-effects model for interstate MVC deaths		
Hausman test for random effects, *p* value = 0.6849		
	Estimate	***p***
PTSs per 100MVMT	−0.000006	0.3848

TABLE 2.

Predictor Variable — White PTSs per 100MVMT

Model 1: Random-effects model for White MVC deaths		
Hausman test for random effects, *p* value = 0.4478		
	Estimate	***p***
White PTSs per 100MVMT	0.000077	0.1168

TABLE 3.

Predictor variable — Black PTSs per 100MVMT

Model 1: Fixed-effects model for Black MVC deaths		
Hausman test for random effects, *p* value = 0.0516		
	Estimate	***p***
Black PTSs per 100MVMT	−0.00002	0.6219

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TABLE 4.

Predictor Variable — Warning per 100MVMT After PTSs

Model 1: Fixed-effects model for total MVC deaths		
	Estimate	***p***
Warning per 100MVMT after PTSs	−0.00001	0.8693
Model 2: Fixed-effects model for interstate MVC deaths		
	Estimate	***p***
Warning per 100MVMT after PTSs	−0.000006	0.7267

TABLE 5.

Predictor Variable — Citations per 100MVMT After PTSs

Model 1: Random-effects model for total MVC deaths		
Hausman test for random effects, *p* value = 0.7125		
	Estimate	***p***
Citations per 100MVMT after PTSs	0.000021	0.7078
Model 2: Random-effects model for interstate MVC deaths		
Hausman test for random effects, *p* value = 0.7506		
	Estimate	***p***
Citations per 100MVMT after PTSs	−0.00001	0.4470

TABLE 6.

Predictor Variable — Arrests per 100MVMT After PTSs

Model 1: Random-effects model for total MVC deaths		
Hausman test for random effects, *p* value = 0.6031		
	Estimate	***p***
Arrests per 100MVMT after PTSs	0.000142	0.6904
Model 2: Fixed-effects model for interstate MVC deaths		
	Estimate	***p***
Arrests per 100MVMT after PTSs	−0.00013	0.2419