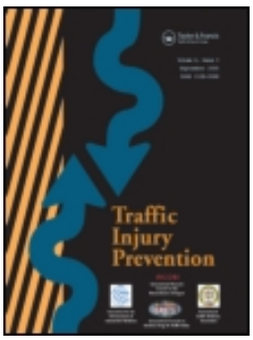

Traffic Injury Prevention

ISSN: 1538-9588 (Print) 1538-957X (Online) Journal homepage: https://www.tandfonline.com/loi/gcpi20

Using Enforcement and Adjudication Data to Assess the Impact of a Primary Safety Belt Law

Julia F. Costich & Svetla S. Slavova

To cite this article: Julia F. Costich & Svetla S. Slavova (2015) Using Enforcement and Adjudication Data to Assess the Impact of a Primary Safety Belt Law, Traffic Injury Prevention, 16:7, 664-668, DOI: 10.1080/15389588.2014.999857

To link to this article: https://doi.org/10.1080/15389588.2014.999857

Accepted author version posted online: 08 Jan 2015.
Published online: 24 Jun 2015.

Traffic Injury Prevention (2015) **00**, 664–668

ISSN: 1538-9588 print / 1538-957X online
DOI: 10.1080/15389588.2014.999857

Taylor & Francis
Taylor & Francis Group

Using Enforcement and Adjudication Data to Assess the Impact of a Primary Safety Belt Law

JULIA F. COSTICH[1,2] and SVETLA S. SLAVOVA[2,3]

[1]*Department of Health Management & Policy, University of Kentucky, Lexington, Kentucky*
[2]*Kentucky Injury Prevention & Research Center, College of Public Health, University of Kentucky, Lexington, Kentucky*
[3]*Department of Biostatistics, University of Kentucky, Lexington, Kentucky*

Received 10 September 2014, Accepted 15 December 2014

Background: Identification of effective implementation strategies for motor vehicle injury prevention law is an important priority for research in public health law and policy. Extensive literature in related fields demonstrates the relationship between enforcement activities and achievement of safety objectives.

Purpose: We conducted this study to determine the role of enforcement and adjudication in the implementation of a primary safety belt law, including the level and sustainability of safety belt–related conviction rates, using newly available data from the state judicial administrative authority. A secondary goal was to assess the contribution of the administrative data set to the analysis of the primary safety belt law.

Methods: The analysis used an interrupted time series design to evaluate the longitudinal effect of the primary safety belt law implementation in 2007 on safety belt infractions and convictions in Kentucky, 2003–2012.

Segmented regression analysis was used to estimate changes in the level and trend of safety belt nonuse conviction rate after the full implementation of the law, while controlling for the baseline level and trend. The association between the safety belt–related conviction rates and other expected outcomes of the law's implementation was studied.

Results: Safety belt citations doubled and convictions nearly tripled during the decade studied, most dramatically in the first year. Increases were sustained throughout the study period.

There was a strong positive linear association between the safety belt nonuse conviction rate and the observed safety belt use in the state, as well as a strong negative association between the safety belt nonuse conviction rate and the number of nonrestrained motor vehicle crash fatalities.

Discussion: Our analysis demonstrates that Kentucky's public safety and judicial systems took the new law seriously and enforced it effectively and that the increased level of enforcement persisted for at least 5 years after implementation. We also find that data from judicial system administrative agency reports make an important contribution to public policy analysis. In the face of persistent antiregulatory forces and public-sector budget cuts, it is critically important to document the relationship between enforcement activities and the achievement of legislative goals.

Keywords: motor vehicle safety, safety belt legislation, enforcement, public policy

Introduction

Identification of effective implementation strategies for motor vehicle injury prevention law is an important priority for research in public health law and policy. Implementation of safety-related laws often includes public awareness campaigns and targeted education initiatives as well as statutory enforcement. Safety belt laws are an appropriate focus for detailed analysis because of the disproportionate contribution of motor vehicle–related trauma to injury morbidity and mortality and the strong evidence base for safety belts' effectiveness in reducing motor vehicle–related injury (Centers for Disease Control and Prevention [CDC] 2011; Shults et al. 2004), as well as the broad social acceptance enjoyed by safety belt laws (Debinski et al. 2014). A 2013 Kentucky report found that occupants of vehicles that sustained crashes who were wearing safety belts were 98% less likely to be killed in motor vehicle crashes and 91% less likely to be seriously injured than unbelted vehicle occupants (Kentucky Transportation Center 2013a, table 31). Other state-specific studies have found associations between primary safety belt laws and reductions in motor vehicle crash–related morbidity and mortality (Carter et al. 2014; Chaudhary et al. 2010; Houston and Richardson 2002; NHTSA 2013; Nichols and Ledingham 2008; Tison and Williams 2010). As a recent NHTSA guide states,

Associate Editor Matthew Reed oversaw the review of this article.
Address correspondence to Julia F. Costich, Kentucky Injury Prevention & Research Center, College of Public Health, University of Kentucky, 333 Waller Ave., Ste. 206, Lexington, KY 40504. E-mail: julia.costich@uky.edu

> The most effective strategy for achieving and maintaining high belt use is highly publicized high-visibility enforcement of strong occupant restraint use laws. The effectiveness of high visibility enforcement has been documented repeatedly in the United States and abroad. The strategy's three components—laws, enforcement, and publicity—cannot be separated: effectiveness decreases if any one is weak or lacking. (Goodwin et al. 2013; section 2, p. 6)

In their seminal assessment of injury prevention law, Christoffel and Teret (1993) pointed out that public health law cannot be evaluated accurately when enforcement and compliance are lacking: "Variation in enforcement has a very significant effect on evaluation findings and the meaning and value of these findings. To take an extreme example, a law that is known to be unenforced—like jaywalking ordinances in many cities—is tantamount to no law at all, and an evaluation of effectiveness in reducing injury would be a misleading exercise" (p. 182). Approaches to the implementation of public health laws are inevitably influenced by policy considerations and political divisions (Polinsky and Shavell 2007). Controversy can arise when laws are perceived as infringing on the individual's ability to act in his or her own interests (Jacobson et al. 2007). Thus, for example, motorcycle helmet laws have pitted libertarians against safety advocates (Homer and French 2009). Implementation shortfalls have been further exacerbated by cuts in public health funding and staffing since 2008 that have reduced the complement of public health and safety staff available to execute enforcement duties (Costich and Patton 2013; Miller and Hendrie 2013; National Association of County & City Health Officials 2012; U.S. Department of Justice 2011).

The following analysis takes advantage of a natural experiment, an approach often used in public health law analysis because the field does not lend itself to controlled trials or randomization (Wagenaar and Komro 2013). Kentucky enacted a primary safety belt law (codified as Ky. Rev. Stat. 189.125(6)) in 2006, and full enforcement took effect in 2007. A 2013 statewide survey found only 85% of drivers and passengers used safety belts, suggesting that state and local police continue to find many opportunities for citations (Kentucky Transportation Center 2013b). We also make use of a newly available data set from the Kentucky Administrative Office of the Courts that sets out the number of citations and convictions by court and offense. We used data from 4 years before and 6 years after full implementation of the primary safety belt law to assess the level and sustainability of enforcement of the law by answering the following questions:

1. Were more drivers cited for safety belt law infractions after the full implementation of the primary enforcement law?
2. Were more of the drivers cited for safety belt law infractions actually convicted of those infractions?
3. Were changes in the expected direction of citations and convictions maintained after the initial enhanced enforcement took effect?

A secondary goal of the study was to determine whether there was an association between the enforcement of the law and 2 expected outcomes of the law's implementation: (1) increased safety belt use by occupants and (2) decrease in motor vehicle–related fatalities.

Methods

Kentucky citation and conviction data were made available by the Administrative Office of the Courts (AOC). Citation data count the number of times law enforcement officers provided motorists with written notice of their noncompliance with the safety belt law, and convictions are judicial findings that the law was violated and a fine must be paid. Data were extracted from AOC reports for the years 2003–2012. We chose to focus on cases rather than charges because the variation between case and charge metrics for these 2 types of infractions was minimal and because the case data reflect the number of incidents when the specific infraction was charged and are thus more closely measure changes in enforcement of the law over a time period.

We used an interrupted time series design to evaluate the longitudinal effect of the primary safety belt law's implementation ("intervention"). The rate of conviction was calculated as number of convictions per 1,000 citations. Because the outcome "conviction rate" is continuous and calculated annually (i.e., at evenly spaced intervals), segmented regression modeling (Gillings et al. 1981; Wagner et al. 2002) was appropriate for testing whether the change in the conviction rate occurring after the intervention was statistically significant and estimating the change in the conviction rate before and after full implementation of the law. In order to further specify the appropriate statistical model, the Durbin-Watson statistic for the regression model was calculated (value of 3.0791), indicating no autocorrelation (P value for hypothesis of negative autocorrelation of .19, P value for hypothesis of positive autocorrelation of .81). The graph of the conviction rate by year suggested that there was an immediate change in the rate in 2007 when the full implementation of the law was enacted rather than a lagged effect. Therefore, there was no need for correction for either lagged effect or autocorrelation, and the following model was chosen for assessing the changes in the rate of conviction for safety belt citation before and after the full implementation of the primary safety belt law ("intervention") :

$$\begin{aligned}\text{Rate}_t &= \beta_0 + \beta_1 * \text{Time}_t + \beta_2 * \text{Intervention}_t \\ &\quad + \beta_3 * \text{Time after intervention}_t + e_t,\end{aligned}$$

where Rate_t is the safety belt nonuse conviction rate in year t; β_0 is the baseline rate; β_1 is the change in the rate each year before the intervention; Time_t is a continuous variable measuring the number of years before and after the intervention and ranging from -3 to 6 for the period 2003–2012; β_2 is an estimate for the immediate change (jump or drop) in the rate after the intervention; Intervention_t is 0 for years before 2007 and 1 for years from 2007 forward; β_3 is the estimated change in the slope after the introduction of the law, compared with the slope in the period before the intervention; and $\text{Time after intervention}_t$ measures the number of years passed after the intervention and

Table 1. Safety belt use citations, convictions, and conviction rate per 1,000 citations, 2003–2012

Year	Number of safety belt citations[a]	Number of safety belt convictions[a]	Conviction rate per 1,000 safety belt citations
2003	53,253	29,784	559
2004	52,535	27,956	532
2005	50,760	26,422	521
2006	36,040	18,329	509
2007	92,339	67,092	727
2008	97,135	72,542	747
2009	100,194	75,816	757
2010	93,103	70,905	762
2011	103,283	81,846	792
2012	110,577	87,366	790

[a]Source: Kentucky Administrative Office of the Courts.

has a value of 0 for year 2007 or earlier. Segmented regression models fit a least-squares regression line in each segment assuming a linear relationship between the independent variable and the outcome within each segment. We used proc autoreg in SAS 9.3 (SAS Institute, Inc., Cary, NC) to estimate changes in the level and trend of the rates after the intervention.

We assessed the linear association between the safety belt nonuse conviction rate per 1,000 safety belt citations and the percentage of safety belt use among all front seat drivers and passengers in Kentucky using data from the annual observational survey conducted across a large number of sites in Kentucky (Kentucky Transportation Center 2013b). We also examined the association between the conviction rate and the number of occupants killed in motor vehicle crashes who were not wearing safety belts at the time of the crash, using Kentucky State Police traffic collision data (2012). The Pearson correlation coefficient was used as a measure of association strength.

Results

As shown in Table 1, safety belt citations doubled and convictions nearly tripled during the decade studied. Most dramatically, in the first year of full primary safety belt law enforcement (2007), citations increased from 36,040 in 2006 to 92,339, a 156% increase, and convictions increased from 18,329 in 2006 to 67,092 in 2007, a 266% increase. The rate of convictions per 1,000 safety belt citations jumped 43%, from 509/1,000 in 2006 to 727/1,000 in 2007. The number of citations and convictions continued to rise, although more modestly, for the duration of the study period. The conviction rate may have plateaued at about 790/1,000 but is still very high in historical terms.

Figure 1 shows a decreasing trend in conviction rate for safety belt offenses before the implementation of the law, an immediate jump in the rate following the 2007 implementation, and a continued gradually increasing rise in subsequent years. The segmented regression analysis confirmed the statistical significance of the immediate jump in the conviction rate in 2007. The intercept measuring the level of the conviction rate just before the intervention in 2006—that is, at time = 0—was estimated as 505.6 convictions per 1,000 citations. The estimated coefficient for the variable Time_t was −16.4, showing a significant annual decrease of about 16/1,000 in the annual rate before the intervention, 2003–2006 (P value of .0018). The coefficient for the variable Intervention_t was estimated as 240.4, showing that the level of the conviction rate increased immediately after the intervention in 2007 by 240 convictions per 1,000 citations, a significant increase ($P < .0001$). Maintenance of the trend after the intervention is measured by the coefficient for the variable Time after intervention_t and is estimated as an annual increase of 29.5 convictions per 1,000 citations, a significant annual increase ($P = .0002$).

During the same period, the observed percentage of safety belt use among front seat drivers and passengers increased from 66% in 2003 to 84% in 2012, although between 2003 and 2006 the total increased by only one percentage point (Figure 1). Coinciding with the increased number of safety belt citations issued after the implementation of the law and the jump in conviction rate, the observed usage of safety belts increased from 67% in 2006 to 73% in 2007. There was another big increase in observed safety belt usage from 73% in 2008 to 80% in 2009, followed by an average annual increase of 2%. There was a strong positive linear association between the observed safety belt use and the safety belt nonuse conviction rate (estimated Pearson correlation coefficient of 0.91, $P = 0.0002$).

The state's motor vehicle fatalities dropped by 24% during the same period, from 928 in 2003 to 746 in 2012 (Table 2). As set out in Figure 2, there was little change during this period in the number of occupants killed who were restrained at the time of the crash, and the number of people killed who were listed as "restraint not applicable" (e.g., pedestrians) was relatively stable. Whereas in 2003, 509 people were killed not wearing restraints (54.8% of all 2003 fatalities), by 2012 this number had fallen to 322 (43.2% of 746 fatalities; Table 2).

There was also a statistically significant negative linear association between the safety belt use conviction rate and the number of occupants killed who were not wearing safety belts

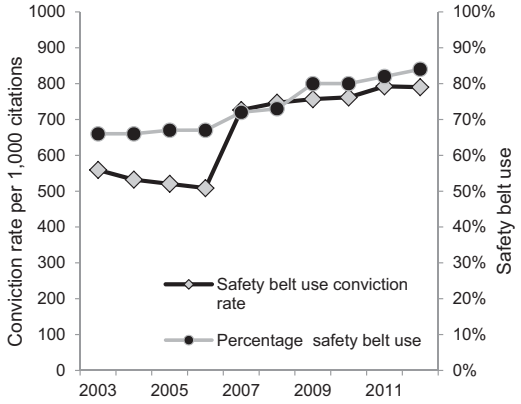

Fig. 1. (a) Safety belt use conviction rate per 1,000 citations and (b) observed percentage of safety belt use by drivers and front seat passengers, Kentucky, 2003–2012. (a) Source: Kentucky Administrative Office of the Courts. (b) Source: Kentucky Transportation Center (2013b).

Table 2. Restraint use in fatal motor vehicle crashes, Kentucky, 2003–2012

Year	Number of MVC fatalities, all occupants	Fatally injured occupants who used restraint		Fatally injured occupants who did not use restraint		Fatalities, restraint not applicable[a]	
2003	928	256	27.6%	509	54.8%	163	17.6%
2004	964	288	29.9%	519	53.8%	157	16.3%
2005	985	283	28.7%	511	51.9%	191	19.4%
2006	913	252	27.6%	477	52.2%	184	20.2%
2007	864	274	31.7%	388	44.9%	202	23.4%
2008	826	229	27.7%	381	46.1%	216	26.2%
2009	791	273	34.5%	356	45.0%	162	20.5%
2010	769	249	32.4%	319	41.5%	201	26.1%
2011	721	243	33.7%	310	43.0%	168	23.3%
2012	746	237	31.8%	322	43.2%	187	25.1%

Source: Traffic Collisions in Kentucky Annual Reports (years 2003 to 2012). Available at: http://www.kentuckystatepolice.org/data.html
[a]The category "not applicable" includes occupants in vehicles that normally do not contain safety restraints, occupants where safety restraint usage was not indicated, occupants not in an appropriate position, and pedestrians and pedalcyclists.

at the time of collision (Pearson correlation coefficient $r = -0.97$; $P < .0001$). Figure 2 shows that the increase in the safety belt use conviction rate coincided with a decrease in the number of unrestrained MVC fatalities.

Discussion

Public safety advocates are painfully aware that their work is not done when the long, difficult task of promoting legislation finally comes to fruition. Effective enforcement and adjudication are equally important if safety-related laws are to have more than symbolic status. Our analysis uses a novel data source to demonstrate that Kentucky's public safety and judicial systems took the new law seriously and enforced it effectively and that the increased level of enforcement has persisted during the 5 years since implementation.

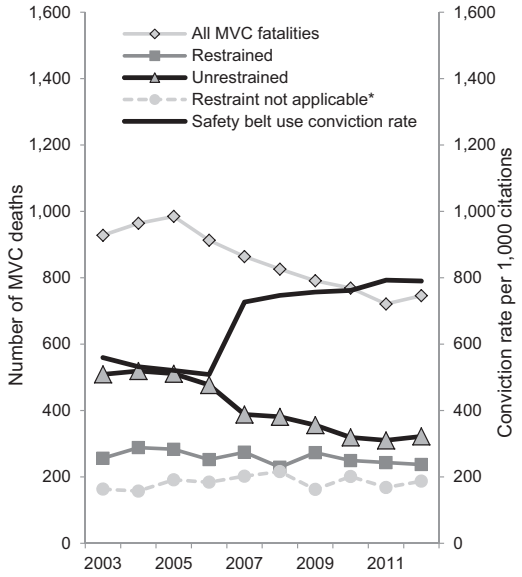

Fig. 2. (a) Safety belt use conviction rate per 1,000 citations and (b) number of motor vehicle collision fatalities, Kentucky, 2003–2012. (a) Source: Kentucky Administrative Office of the Courts. (b) Source: Traffic Collisions in Kentucky Annual Reports (years 2003 to 2012). Available from http://www.kentuckystatepolice.org/data.html. *The "not applicable" category includes occupants in vehicles that normally do not contain safety restraints, occupants where safety restraint usage was not indicated, occupants not in an appropriate position, and pedestrians and pedalcyclists.

The results from Kentucky showed that an increase in the conviction rate was associated with increased use of safety belts by front row occupants of vehicles that crashed. There was also a strong association between implementation of the law and a decline in related fatalities. Our finding of a decrease in citation volume before the law was implemented was similar to a trend observed in Florida, where citation volume dropped immediately before the implementation of a Click It or Ticket campaign associated with a new primary safety belt law (Nichols et al. 2012).

The decline in motor vehicle fatalities, though very large, was not as steep following the safety belt law's implementation as the increase in citations, suggesting that multiple factors are contributing to reduced loss of life on Kentucky's highways. Similarly, a study of California's implementation of primary safety belt legislation almost a decade earlier showed no direct impact on fatalities (Houston and Richardson 2002). However, Kentucky's population is overrepresented in categories most likely to benefit from primary enforcement, including individuals with lower incomes and educational attainment (Beck et al. 2007). In addition, many studies point to the contribution of safety belt use to motor vehicle fatality reduction, as summarized in the *Guide to Community Preventive Services* (CDC 2014), which has endorsed primary safety belt laws since 2000.

Limitations

There are 2 important limitations to our findings: our reliance on administrative data collected for purposes other than the current inquiry and the fact that motor vehicle fatality rates were declining rapidly during the study period. The AOC data set is not machine readable and thus does not lend itself to regional or county-specific analysis. It lacks data elements that would support linkage with the more detailed records available from state police files, the state trauma registry, and data sets maintained by the NHTSA, to name but a few potential re-

sources. Such linkages would allow us to identify the specific relationships, rather than general associations, between enforcement and adjudication actions, subsequent infractions, and crash or injury outcomes.

Our analysis accounted for the secular trend of decline in motor vehicle fatalities, but this approach may not have given appropriate weight to factors such as improvements in automotive and highway engineering, better emergency medical and trauma services, and changing social norms regarding safety belt use (Goodwin et al. 2013).

Further research is needed to explain the strong correlation between the safety belt conviction rate and the observed percentage of occupants using safety belts and assess the relationship between strong enforcement and high safety belt usage.

Public policy evaluation requires a multifaceted, multidisciplinary approach if it is to encompass all of the factors that contribute to achieving a policy's intended objectives. In this case, adding data on enforcement and adjudication of a primary safety belt law to an assessment based on fatality reduction alone demonstrates the value of consistent, sustained focus on the well-supported intervention of safety belt use. The value of the administrative agency reports would be further enhanced by system upgrades allowing for the generation of machine-readable data.

In the face of persistent antiregulatory forces and public-sector budget cuts, it is critically important to document the relationship between enforcement activities and the achievement of legislative goals.

Acknowledgment

Jason Cloyd and Kat Delaney of the Kentucky Administrative Office of the Courts graciously assisted in the acquisition and transmission of enforcement and adjudication data.

References

Beck LF, Shults RA, Mack KA, Ryan GW. Associations between sociodemographics and seat belt use in states with and without primary seat belt laws. *Am J Public Health.* 2007;97:1619–1624.

Carter PM, Flannagan CAC, Bingham CR, Cunningham RM, Rupp JD. Modeling the impact of rescinding Michigan's primary and secondary seat belt laws on death and injury from passenger vehicle crashes. *Traffic Inj Prev.* 2014;15:701–703.

Centers for Disease Control and Prevention (CDC). Motor vehicle–related injury prevention. In: *The Guide to Community Preventive Services*. 2014. Available at: http://www.thecommunityguide.org/mvoi/safetybelts/index.html. Accessed December 11, 2014.

Centers for Disease Control and Prevention (CDC). Vital signs: nonfatal motor vehicle occupant injuries and seat belt use among adults—United States. *Morb Mortal Wkly Rep.* 2011;59:1681–1686.

Chaudhary NK, Tison J, Casanova T. The effects of Maine's change to primary seat belt law on seat belt use and public perception and awareness. *Traffic Inj Prev*. 2010;11(2):165–172.

Christoffel T, Teret SP. *Protecting the Public: Legal Issues in Injury Prevention*. New York, NY: Oxford University Press; 1993.

Costich JF, Patton DJ. Enforcement: linking policy and impact in public health. *Jurimetrics.* 2013;53:293–305.

Debinski B, Clegg Smith K, Gielen A. Public opinion on motor vehicle–related injury prevention policies: a systematic review of a decade of research. *Traffic Inj Prev.* 2014;15;243–251.

Gillings D, Makuc D, Siegel E. Analysis of interrupted time series mortality trends: an example to evaluate regionalized perinatal care. *Am J Public Health.* 1981;71:38–46.

Goodwin A, Kirley B, Sandt L, et al. *Countermeasures That Work: A Highway Safety Countermeasures Guide for State Highway Safety Offices*. 7th ed. Washington, DC: US Department of Transportation, NHTSA; 2013. DOT HS 811 727.

Homer J, French M. Motorcycle helmet laws in the United States from 1990 to 2005: politics and public health. *Am J Public Health.* 2009;99:415–423.

Houston DJ, Richardson LE. Traffic safety and the switch to a primary seat belt law: the California experience. *Am J Public Health.* 2002;97:2063–2069.

Jacobson P, Hoffman R, Lopez W. Regulating public health: principles and application of administrative law. In: Goodman R, Hoffman R, Lopez W, Matthews E, Rothstein M, eds. *Law in Public Health Practice*. Oxford: Oxford University Press; 2007:69–88.

Kentucky Revised Statutes § 189.125(6). Available at: http://www.lrc.ky.gov/Statutes/statute.aspx?id=40597. Accessed May 20, 2015.

Kentucky State Police. *Collision Report Analysis for Safer Highways (CRASH)*. Available at: http://crashinformationky.org/KCAP/Public/Home.aspx. Accessed May 20, 2015.

Kentucky Transportation Center. *Analysis of Traffic Crash Data in Kentucky, 2008–2012*. Lexington, KY: Author; 2013a.

Kentucky Transportation Center. *2013 Safety Belt Usage Survey in Kentucky*. Lexington, KY: Author; 2013b.

Miller TR, Hendrie D. Cost-effectiveness and cost–benefit analysis of public health laws. In: Wagenaar AC, Burris S, eds. *Public Health Law Research: Theory and Methods*. San Francisco, CA: Jossey-Bass; 2013:347–378.

National Association of County & City Health Officials. *Local Health Department Job Losses and Program Cuts: Report of the January 2012 Survey*. 2012. Available at: http://www.naccho.org/topics/infrastructure/lhdbudget/. Accessed September 6, 2014.

NHTSA. Impact of implementing a primary seat belt enforcement law in Florida: a case study. *Ann Emerg Med.* 2013;62(2):182–183.

Nichols JL, Chaffe R, Solomon MG. *Impact of Implementing a Primary Enforcement Seat Belt Law in Florida: A Case Study*. Washington, DC: NHTSA; 2012. DOT HS 811 656.

Nichols JL, Ledingham KA. *The Impact of Legislation, Enforcement, and Sanctions on Safety Belt Use*. Washington, DC: Transportation Research Board; 2008. NCHRP Report 601.

Polinsky AM, Shavell S. A theory of public enforcement of law. In: Polinsky AM, Shavell S, eds. *Handbook of Law and Economics*. New York, NY: Elsevier; 2007:403–454.

Shults RA, Elder RW, Sleet DA, Thompson RS, Nichols JL. Primary enforcement seat belt laws are effective even in the face of rising belt use rates. *Accid Anal Prev.* 2004;36:491–493.

Tison J, Williams AF. *Analyzing the First Years of the Click It or Ticket Mobilizations*. Washington, DC: NHTSA; 2010. DOT HS 811 232. Available at: http://www.nhtsa.gov/staticfiles/nti/pdf/811232.pdf.

US Department of Justice. *The Impact of the Economic Downturn on American Police Agencies*. 2011. Available at: http://www.cops.usdoj.gov/files/RIC/Publications/e101113406_Economic%20Impact.pdf. Accessed September 6, 2014.

Wagenaar AC, Komro KA. Natural experiments: research design elements for optimal causal inference without randomization. In: Wagenaar AC, Burris S, eds. *Public Health Law Research: Theory and Methods*. San Francisco, CA: Jossey-Bass; 2013:307–324.

Wagner AK, Soumerai SB, Zhang F, Ross-Degnan D. Segmented regression analysis of interrupted time series studies in medication use research. *J Clin Pharm Ther.* 2002;27(4):299–309.