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Modeling the Impact of Rescinding Michigan's Primary and Secondary Seat Belt Laws on Death and Injury from Passenger Vehicle Crashes

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Abstract

Background: Seat belts are the most effective method of decreasing fatal and nonfatal motor vehicle crash injury. Advocacy groups have recently been successful in enacting repeals of mandatory motorcycle helmet laws in several states. In some states, this has prompted renewed efforts aimed at repealing mandatory seat belt laws.

Purpose: To evaluate and quantify the potential impact of rescinding seat belt laws on annual crash-related fatalities, nonfatal injuries, and associated economic costs, using Michigan as a model, to inform the national debate.

Methods: Proportional injury rates were calculated utilizing police-reported statewide passenger vehicle crash data from 1999 and 2002, where belt use rates approximate estimates associated with repeal of primary and secondary seat belt laws. Proportional rates were applied to the most recent year of crash data (2011) to estimate changes in statewide fatalities and nonfatal injuries. National cost estimates were applied to injury data to calculate associated economic costs.

Results: Full repeal of the seat belt law is estimated to result in an additional 163 fatalities, 13,722 nonfatal injuries, and an associated societal cost of \$1.6 billion annually. Repeal of the primary seat belt law only is estimated to result in an additional 95 fatalities, 9156 nonfatal injuries, and an associated societal cost of \$1.0 billion annually.

Conclusions: This analysis suggests that repealing the either the primary or full seat belt law would have a substantial and negative impact on public health, increasing motor vehicle crash related fatality, nonfatal injury, and associated economic costs.

Keywords

motor vehicle crash; injury prevention; seat belt law

Introduction

Motor vehicle crashes (MVCs) are the leading cause of death for Americans under 44 years old, responsible for 32,885 fatalities and 2.2 million injuries in 2010 (NHTSA 2010; WISQARS Centers for Disease Control and Prevention 2012). The annual crash-related economic impact is estimated at \$230.6 billion (Blincoe et al. 2002). Seat belts are the most effective means of decreasing crash-related injury (Beck et al. 2007; Dinh-Zarr et al. 2001; Kahane 2000). Despite the public health benefit, 51 percent of passenger vehicle occupants involved in fatal crashes are unrestrained at the time of the crash (NHTSA 2010). Safety belt laws are designed to increase belt use and thereby reduce the incidence of death and injury. Primary seat belt laws allow police to stop and ticket motorists solely for an observed violation, whereas secondary laws require motorists to be stopped for another traffic violation to receive a seat belt violation. Primary seat belt laws are associated with higher belt usage rates, lower incidence of crash-related injuries, and lower overall fatality rates (Beck et al. 2007; Cohen and Einav 2003; Dinh-Zarr et al. 2001; Farmer and Williams 2005; Rivara et al. 1999; Shults et al. 2004; Task Force on Community Preventive Services 2001).

Since the mandate requiring state motorcycle helmet laws to receive federal highway funding ended in 1975, 31 states have repealed mandatory helmet laws, decreasing helmet use and increasing associated fatalities and serious injuries (Bledsoe et al. 2006; Ho and Haydel 2004; Hotz et al. 2002; Houston and Richardson 2007; Mertz and Weiss 2008). Successful helmet law repeal efforts have prompted legislators and activist groups to advocate for the repeal of seat belt laws in several states, including Michigan, citing concern for personal liberties (Kimball 2011; Miller 2011; National Motorists Association 2010). Michigan first adopted a secondary seat belt law in 1985, increasing belt use to 58.4 percent from 19.8 percent (Datta et al. 2012; State of Michigan 2013). This was followed by a primary seat belt law implementation in 2000, increasing belt use consistently to Michigan's current rate of 95 percent (Datta et al. 2012; State of Michigan 2013). The purpose of this brief report is to model the potential impact of rescinding Michigan seat belt laws, specifically characterizing the changes in fatalities, nonfatal injuries, and associated economic costs to inform the wider national debate regarding seat belt law repeal efforts.

Methods

Seat belt use rates associated with changes in seat belt law were reviewed to estimate full and primary law repeal effects on Michigan's current seat belt rate (95%; Datta et al. 2012). After the 1986 repeal of the Nebraska seat belt law, observed belt use decreased by 30 percent, from 45 percent in 1985 to an average of 32 percent over the 6 subsequent years

until a secondary enforcement law was enacted in 1992 (NHTSA 2001; NOOH 2012). In addition, New Hampshire is the only current state without a mandatory seat belt law and has an observed seat belt use rate of 72 percent (NHTSA 2011). Thus, we estimated that a full seat belt law repeal for adults (over 18 years old) would likely decrease belt use to between 67 percent (a 30% decrease) and 72 percent (the current New Hampshire rate). The conservative estimate (72%) was used for this analysis. An isolated primary seat belt law repeal (i.e., changing a primary law to allow only secondary enforcement) was estimated to decrease the Michigan rate to 83 percent based on prior literature demonstrating primary seat belt law implementation in secondary law states increases use by an average of 12 percentage points (Nichols et al. 2010). Furthermore, current average belt use in the 17 states with secondary enforcement is 82 percent and current belt use in Ohio, a secondary enforcement state with similar geography and demographics to Michigan, is 83 percent (NHTSA 2012), suggesting that the estimate of 82 percent would be an accurate reflection of potential belt use changes associated with a reversion to secondary enforcement.

Police report censuses of passenger car crashes from when Michigan's belt use was last 72 percent (1999) or 83 percent (2002) and for the most recent year (2011) were used in all analyses. The KABCO scale (National Safety Council 1990), an on-scene police officer-reported injury severity scale, was used to classify fatal and nonfatal injuries (K: killed, A: incapacitating injury, B: nonincapacitating injury, C: possible injury, O: uninjured). Expected numbers of fatal and nonfatal injuries were obtained by applying proportional injury severity rates (e.g., Number of K injuries/Total KABCO injuries) from 1999 and 2002 to observed 2011 data. This approach assumes that seat belt use decreases the percentage of fatal and severe nonfatal injuries but would not affect the overall number of crashes. Multinomial confidence intervals were calculated on the K, A, B, C, and O rates using established procedures (Quesenberry and Hurst 1964). The increases in statewide deaths and injuries were obtained from the difference between 2011 estimates and observed data.

National Safety Council unintentional MVC injury cost estimates for 2010 (K = \$4.36 million; A = \$220,300; B = \$56,200; C = \$26,700; O = \$2,400) were then applied to the crash data, estimating the increased societal cost associated with a potential seat belt law repeal. The National Safety Council annually reports comprehensive economic cost estimates for the *expenses incurred* or *income not received* due to a fatal or nonfatal motor vehicle crash injury stratified using the KABCO scale (National Safety Council 2012). These comprehensive cost estimates include wage and productivity losses, medical expenses (including hospital care, as well as ambulance and helicopter transport costs), administrative expenses (i.e., private and public health insurance costs, police and legal costs), motor vehicle damage, employer's uninsured costs (i.e., employer productivity costs), and quality of life (National Safety Council 2011, 2012).

Results

Observed passenger vehicle occupant fatalities and injuries (1999, 2002, 2011) and calculated KABCO proportional rates (1999, 2002) are presented in Table 1. Adjusted 2011 data reflect the application of 1999 and 2002 KABCO proportional injury calculated rates to 2011 data, estimating the number of fatalities and nonfatal injuries expected if seat belt use

rates reverted to 72 and 83 percent, respectively. The increase in expected fatalities and injuries associated with a full repeal and partial repeal and associated societal cost estimates are presented in Table 2. A complete repeal is estimated to result in an additional 163 fatalities and 13,722 nonfatal injuries, representing an additional injury-related cost of \$1.6 billion annually in Michigan alone. Repeal of the primary seat belt law repeal is estimated to result in an additional 95 fatalities, 9156 nonfatal injuries, and \$1.0 billion annually in this one state.

Limitations

Our analysis and results must be considered in the context of several limitations. The modeling used in this analysis relies on belt use estimates from prior years and from states other than Michigan to theoretically derive belt use estimates for Michigan after a seat belt law repeal, which potentially limits the accuracy of our modeling. In addition, the Nebraska seat belt repeal occurred prior to the implementation of a national public health campaign (“Click It or Ticket”) that has been successful at increasing belt use nationwide, contributing to a culture of belt use that was likely not present when Nebraska’s law was repealed and may not currently be present in New Hampshire, where a belt use law has never been in place. However, recent Michigan safety law changes demonstrate that regardless of previously effective law enforcement and public health campaigns, safety device use would likely decline significantly after a seat belt law repeal. The recent 2012 helmet law repeal in Michigan decreased motorcycle helmet use among crash-involved riders by 24 percent (from 97.8 to 74.3%), despite an established culture of helmet use bolstered by a helmet law and public health advocacy demonstrating the increased risks of riding without a helmet (Rupp and Flannagan 2013). In addition, Michigan seat belt use rates after the 1985 mandatory seat belt law implementation were significantly lower (58.4%) than the full repeal estimates used in this analysis. Finally, Michigan belt use rates increased 13.5 percent (to 83.5%) when a primary enforcement law was adopted (Michigan Office of Highway Safety 2012). Taken together, this suggests that the conservative estimates used for our analysis are likely reasonable measures for belt use changes associated with a full and partial repeal.

Our analysis also excluded missing KABCO data. Although this potentially underestimates repeal effects, missing data most likely result from uninjured or lower level injury crashes rather than fatal or severe injuries, and current state policy is based on data with the same rate of missing cases. Finally, our model does not account for improvements in vehicle crashworthiness or emergency medical services response time from prior years (1999, 2002) to the current model year (2011). The wider availability of frontal air bags in vehicles is likely to have the greatest impact among vehicle improvements; however, they require occupant seat belt use to be effectively engaged and provide their maximal benefit, underscoring the need for high levels of seat belt use. The overall impact of these changes to our analysis is likely minimal but should be noted with interpretation of the data.

Discussion

This analysis builds on prior literature demonstrating the success of seat belts as an injury prevention measure and presents a novel method to estimate the impact of repeal efforts as

they are considered in states other than Michigan. Since 1975, seat belts are estimated to have saved 280,000 lives and prior research suggests that seat belts reduce the risk of passenger vehicle death and severe injury by as much as 45 and 50 percent respectively (Dinh-Zarr 2001; Evans 1986; NHTSA 2010). Increasing and maintaining high seat belt use rates are essential to achieve this injury benefit. Seat belt laws, increased enforcement of the laws, and increased fines are effective public health measures to increase seat belt use and decrease death and injury in motor vehicle crashes (Dinh-Zarr et al. 2001). Consistent with this prior literature, we have demonstrated that repealing seat belt laws would have substantial and negative impacts on MVC injury prevention with increased numbers of fatalities, nonfatal injuries, and injury-associated economic costs.

The impact of a seat belt law repeal is not likely to affect all subpopulations equally. Primary seat belt laws are most effective among those who are least likely to wear seat belts: adolescents, less-educated, lower-income, male, and rural occupants (Beck et al. 2007). They are also effective in increasing seat belt use among drinking drivers, a subgroup that has low baseline seat belt use and accounts for 31 percent of all occupant fatalities (Beck et al. 2007; Hingson and Winter 2003; Lange and Voas 1998; NHTSA 2012). In addition, high school students have previously been noted to be 12 percent less likely to drive belted and 15 percent less likely to ride belted in states with secondary enforcement (Garcia-Espana et al. 2012). Unbelted adults are less likely to ensure that child passengers are belted; one study reported that up to 40 percent of youth are unbelted when adult drivers are unbelted (Centers for Disease Control and Prevention 1993; Russell et al. 1994; Williams et al. 2003). Importantly, parental seat belt use is predictive of subsequent teen driver belt use, with the highest teen use observed in teens whose parents currently wear seat belts and were told by their parents to wear seat belts (Shin et al. 1999). Mandatory seat belt laws have been a critical component of efforts to increase belt use among vulnerable populations, and seat belt repeal would likely have a disproportionately negative impact among these subpopulations.

In conclusion, despite the limitations inherent in modeling the potential effects of a primary or secondary seat belt law repeal, repealing either would likely have a substantial and negative impact on the public health, directly increasing motor vehicle crash-related death, nonfatal injuries, and economic costs as well as disproportionately impacting vulnerable populations.

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References

- Beck LF, Shults RA, Mack KA, Ryan GW. Associations between sociodemographics and safety belt use in states with and without primary enforcement laws. *Am J Public Health*. 2007;97: 1619–1624. [PubMed: 1766699]
- Bledsoe BE, Wesley AK, Eckstein M, Dunn TM, O’Keefe MF. Helicopter scene transport of trauma patients with nonlife-threatening injuries: a meta-analysis. *J Trauma*. 2006;60:1257–1265. [PubMed: 16766969]
- Blincoe LJ, Spicer R, Luchter S, et al. *The Economic Impact of Motor Vehicle Crashes, 2000*. Washington, DC: US Department of Transportation; 2002.
- Centers for Disease Control and Prevention. Impact of adult safety-belt use on restraint use among children. *MMWR Morb Mortal Wkly Rep*. 1993;42:275–278. [PubMed: 8459798]
- Cohen A, Einav L. The effects of mandatory seat belt laws on driving behavior and traffic fatalities. *Rev Econ Stat*. 2003;85:828–843.
- Datta TK, Savolainen PT, Gates T, Russo BJ. *Annual Direct Observation Survey of Safety Belt Use*. Office of Highway Safety Planning; 2012.
- Dinh-Zarr TB, Sleet DA, Shults RA, et al. Reviews of evidence regarding interventions to increase the use of safety belts. *Am J Prev Med*. 2001;21(4):48–65.
- Evans L. The effectiveness of safety belts in preventing fatalities. *Accid Anal Prev*. 1986;18:229–241. [PubMed: 3730097]
- Farmer CM, Williams AF. Effect on fatality risk of changing from secondary to primary seat belt enforcement. *J Safety Res*. 2005;36(2):189–194. [PubMed: 15878597]
- Garcia-Espana JF, Winston FK, Durbin DR. Safety belt laws and disparities in safety belt use among US high-school drivers. *Am J Public Health*. 2012;102:1128–1134. [PubMed: 22515851]
- Hingson R, Winter M. Epidemiology and consequences of drinking and driving. *Alcohol Res Health*. 2003;27:63–78. [PubMed: 15301401]
- Ho EL, Haydel MJ. Louisiana motorcycle fatalities linked to statewide helmet law repeal. *J La State Med Soc*. 2004;156(3):151–152, 154–155, 157. [PubMed: 15233389]
- Hotz GA, Cohn SM, Popkin C, et al. The impact of a repealed motorcycle helmet law in Miami–Dade County. *J Trauma*. 2002;52:469–474. [PubMed: 11901321]
- Houston DJ, Richardson LE Jr. Motorcycle safety and the repeal of universal helmet laws. *Am J Public Health*. 2007;97: 2063–2069. [PubMed: 17901447]
- Kahane CJ. *Fatality Reduction by Safety Belts for Front-Seat Occupants of Cars and Light Trucks: Updated and Expanded Estimates Based on 1986–99 FARS Data*. Washington D.C.: NHTSA; 2000. Report No. DOT HS 809 199.
- Kimball J. House votes to repeal primary seat-belt law. *Minnesota Post*. 2011 Available at: <http://www.minnpost.com/political-agenda/2011/05/house-votes-repeal-primary-seat-belt-law>. Accessed May 18, 2011.
- Lange JE, Voas RB. Nighttime observations of safety belt use: an evaluation of California’s primary law. *Am J Public Health*. 1998;88:1718–1720. [PubMed: 9807546]
- Mertz KJ, Weiss HB. Changes in motorcycle-related head injury deaths, hospitalizations, and hospital charges following repeal of Pennsylvania’s mandatory motorcycle helmet law. *Am J Public Health*. 2008;98:1464–1467. [PubMed: 18556613]
- Michigan Office of Highway Safety. *Seatbelt history in the US and Michigan*. 2012 Available at: <http://www.michigan.gov>. Accessed March 1, 2013.
- Miller K. Lawmaker wants to repeal “primary offence” seat belt law. *Banger Daily News*. 2011 Available at: <http://bangordailynews.com/2011/01/20/politics/lawmaker-seeks-seat-belt-law-change-to-make-it-illegal-for-police-to-stop-motorists-for-not-buckling-up/>. Accessed January 20, 2011.
- National Motorists Association. *NMA Position on Seat Belt Laws*. 2010 Available at: <http://www.motorists.org/seat-belt-laws/position>. Accessed October 26, 2012.
- National Safety Council. *Manual on Classification of Motor Vehicle Traffic Accidents*. 5th ed. Itasca, IL: National Safety Council; 1990. ANSI D-16.11–1989.

- National Safety Council. Technical appendix. In: Injury Facts. 2011:197–203.
- National Safety Council. Estimating the Costs of Unintentional Injuries. 2012 Available at: http://www.nsc.org/news_resources/injury_and_death_statistics/Pages/EstimatingtheCostsofUnintentionalInjuries.aspx. Accessed October 26, 2012.
- Nebraska Office of Highway Safety (NOOH). Nebraska Seatbelt Use Rates 1985–2012. 2012 Accessed at: <http://www.transportation.nebraska.gov>. Accessed September 1, 2012.
- NHTSA. Fifth/Sixth Report to Congress Effectiveness of Occupant Protection Systems and Their Use. NHTSA; 2001. Report No. DOT HS 809 442.
- NHTSA. Traffic Safety Facts 2010 Data. 2010 Available at: <http://www.nhtsa.gov/>. Accessed June 1, 2012.
- NHTSA. Seat Belt Use in 2010—Use Rates in the States and Territories. 2011 Available at: <http://www-nrd.nhtsa.dot.gov/Pubs/811493.pdf>. Accessed July 1, 2011.
- NHTSA. Traffic Safety Facts 2010 Data: Alcohol-Impaired Driving. 2012.
- Nichols JL, Tippetts SA, Fell JC, et al. Strategies to Increase Seat Belt Use: An Analysis of Levels of Fines and the Type of Law. NHTSA; 2010 Available at: <http://www-nrd.nhtsa.dot.gov/Pubs/811606.pdf>. Accessed June 1, 2012.
- Quesenberry CP, Hurst DC. Large sample simultaneous confidence intervals for multinomial proportions. *Technometrics*. 1964;6(2):191–195.
- Rivara FP, Thompson DC, Cummings P. Effectiveness of primary and secondary enforced seat belt laws. *Am J Prev Med*. 1999;16:30–39.
- Rupp J, Flannagan CAC. 2012 Preliminary Motorcycle Helmet Use Repeal Results. University of Michigan Transportation Research Institute; 2013.
- Russell J, Kresnow MJ, Brackbill R. The effect of adult belt laws and other factors on restraint use for children under age 11. *Accid Anal Prev*. 1994;26:287–295. [PubMed: 8011041]
- Shin D, Hong LX, Waldron I. Possible causes of socioeconomic and ethnic differences in seat belt use among high school students. *Accid Anal Prev*. 1999;31:485–496. [PubMed: 10440546]
- 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. [PubMed: 15003594]
- State of Michigan. Seat belt history in the US and Michigan. 2013 Available at: http://www.michigan.gov/documents/msp/Seat_belt_timeline_03_web_386202_7.pdf. Accessed October 1, 2013.
- Task Force on Community Preventive Services. Recommendations to reduce injuries to motor vehicle occupants: increasing child safety seat use, increasing safety belt use and reducing alcohol-impaired driving. *Am J Prev Med*. 2001;21(4 suppl):16–22. [PubMed: 11691558]
- Williams AF, McCart AT, Geary L. Seatbelt use by high school students. *Inj Prev*. 2003;9(1):25–28. [PubMed: 12642554]
- WISQARS Centers for Disease Control and Prevention. 10 Leading Causes of Death, US 2010, All Races, Both Sexes. 2012 Available at: <http://www.cdc.gov>. Accessed October 26, 2012.

Baseline fatalities and injuries for passenger vehicle occupants when observed belt use in Michigan was last at 72 percent (1999), 83 percent (2002) and in 2011. Baseline fatalities and injuries for 2011 are adjusted to reflect the KABCO proportional rates for 1999 (72% observed belt use rate) and 2002 (83% belt use rate) applied to the most recent year of state crash data

Table 1.

	Police Reported Injury Severity [†]					
	Fatalities	Incapacitating Injury	Non-incapacitating Injury	Possible/Minor Injury	Property Damage (No Injury)	
1999 Data						
Baseline	840	7,961	19,251	61,692	456,899	
Proportional Rate (95% CI)	0.15% (0.14–0.17)	1.46% (1.41–1.51)	3.52% (3.45–3.60)	11.29% (11.15–11.42)	83.58% (83.43–83.74)	
2002 Data						
Baseline	706	6,395	16,102	55,441	435,053	
Proportional Rate (95% CI)	0.14% (0.12–0.15)	1.24% (1.20–1.29)	3.13% (3.06–3.21)	10.79% (10.66–10.93)	84.69% (84.54–84.84)	
2011 Data						
Baseline	480	3,502	11,439	39,372	363,534	
1999 Proportional Rates applied to 2011 Data (95% CI)	643 (578–715)	6,092 (5,887–6,305)	14,732 (14,414–15,057)	47,211 (46,662–47,765)	349,649 (349,000–350,292)	
2002 Proportional Rates applied to 2011 Data (95% CI)	575 (512–645)	5,208 (5,012–5,411)	13,113 (12,803–13,430)	45,148 (44,593–45,709)	354,284 (353,634–354,928)	

[†] K: Killed, A: Incapacitating injury, B: Non-incapacitating injury, C: Possible injury, and O: uninjured, (property damage only).

Predicted increase in fatalities, nonfatal injuries, and societal costs associated with rescinding all currently existing belt use laws (i.e., full repeal) or reverting to secondary enforcement (i.e., primary repeal)

Table 2.

Police-reported injury severity [†]	Estimated injury increase, n (95% confidence interval)	National Safety Council ^{††} cost estimate per injury (\$, 000s)	Estimated cost increase (\$, 000s), (95% confidence interval)
Full primary and secondary law repeal			
Fatalities	163 (98–235)	4360	709,908 (427,632–1,023,743)
Incapacitating injuries	2590 (2385–2803)	220.3	570,638 (525,413–617,416)
Nonincapacitating injury	3293 (2975–3618)	56.2	185,074 (167,208–203,318)
Possible/minor injury	7839 (7290–8393)	26.7	209,294 (194,646–224,094)
Property damage only	–13,885 (–14,533 to –13,242)	2.4	–33,324 (–34,879 to –31,780)
Total cost			1,641,591
Primary law repeal only (i.e., secondary enforcement)			
Fatalities	95 (32–165)	4360	413,887 (139,808–721,560)
Incapacitating injuries	1706 (1510–1909)	220.3	375,775 (332,683–420,527)
Nonincapacitating injury	1674 (1364–1991)	56.2	94,056 (76,653–111,866)
Possible/minor injury	5776 (5221–6337)	26.7	154,223 (139,409–169,198)
Property damage only	–9250 (–9900 to –8606)	2.4	–22,201 (–23,761 to –20,654)
Total cost			1,015,740

[†] K: Killed, A: Incapacitating injury, B: Non-incapacitating injury, C: Possible injury, and O: uninjured.

^{††} NSC: 2010 National Safety Council Cost Estimates.