



Contents lists available at ScienceDirect

The American Journal of Surgery

journal homepage: www.americanjournalofsurgery.com

The impact of the repeal of Michigan's universal helmet law on traumatic brain injury: A statewide analysis

Rachel N. Saunders^{a,*}, Nicholas S. Adams^b, Alistair J. Chapman^c, Alan T. Davis^d, Tracy J. Koehler^d, Luke T. Durling^c, Gaby A. Iskander^c, John A. Giroto^e

^a Spectrum Health/Michigan State University General Surgery Residency, 221 Michigan NE, Suite 402, Grand Rapids, MI 49503, United States

^b Spectrum Health/Michigan State University Plastic Surgery Residency, 221 Michigan NE, Suite 402, Grand Rapids, MI 49503, United States

^c Spectrum Health Hospital, Acute Care Surgery, Michigan State University College of Human Medicine, 221 Michigan NE, Suite 402, Grand Rapids, MI 49503, United States

^d Grand Rapids Medical Education Partners, 945 Ottawa Ave NE, Grand Rapids, MI 49503, United States

^e Spectrum Health Helen DeVos Children's Hospital, Pediatric Plastic and Craniofacial Surgery, Michigan State University College of Human Medicine, 426 Michigan St NE, Suite 304, Grand Rapids, MI 49503, United States

ARTICLE INFO

Article history:

Received 7 July 2017

Received in revised form

23 September 2017

Accepted 26 September 2017

Keywords:

Helmet

Helmet law

Mortality

Motorcycle

Traumatic brain injury

ABSTRACT

Background: In April of 2012, Michigan repealed its 35-year-old universal motorcycle helmet law in favor of a partial helmet law, which permits motorcyclists older than 21 years old with sufficient insurance and experience to drive un-helmeted. We evaluated the clinical impact of the repeal.

Methods: The Michigan Trauma Quality Improvement Program's trauma database was queried for motorcycle crash patients between 1/1/09–4/12/12 and between 4/13/12–12/31/14.

Results: There were 1970 patients in the pre-repeal analysis and 2673 patients in the post-repeal analysis. Following the repeal, patients were more likely to be un-helmeted ($p < 0.001$) and to have a traumatic brain injury ($p < 0.001$). Patients were also more likely to require neurosurgical interventions (relative risk 1.4, $p = 0.011$).

Conclusion: Following the repeal of the universal helmet law, there has been a significant increase in traumatic brain injuries and neurosurgical interventions. This analysis highlights another detrimental impact of the repeal of the universal helmet law.

Summary sentences: Following the repeal of the universal helmet law, there has been a significant increase in traumatic brain injuries and neurosurgical interventions. This analysis highlights another detrimental impact of the repeal of the universal helmet law.

© 2017 Elsevier Inc. All rights reserved.

1. Introduction

Motorcycle helmet laws have been in evolution for over 50 years. In 1966, Congress passed the National Highway Safety Act mandating that all states enact universal motorcycle helmet laws in order to receive federal highway funding. All but three states complied. The federal mandate was repealed in 1976, and universal helmet laws were repealed or weakened in half of participating states. The details of partial helmet laws vary depending on the state, but generally limit those who can ride unhelmeted at least by age. Currently, 19 states have universal helmet laws; 28 states have

partial helmet laws; and 3 states have no motorcycle helmet laws. These changes have prompted trauma surgeons around the country to assess the impact of motorcycle helmet legislation.

It is well established that weakened helmet laws result in decreased helmet use.^{1–5} Helmet use has been repeatedly demonstrated to decrease the incidence of traumatic brain injury (TBI) in motorcycle trauma patients.^{1–3,5,6} Further, universal helmet laws have been shown to effectively decrease the incidence of head injury and, in some studies, reduce head injury related death rates.^{4,5,7,8}

Despite the evidence that universal helmet legislation decreases TBI and mortality, Michigan repealed its 35-year-old universal motorcycle helmet law in April of 2012 in favor of a partial helmet law. Michigan's partial helmet law allows motorcyclists to be un-helmeted if they are at least 21 years old, have at least \$20,000 in

* Corresponding author.

E-mail address: rachel.saunders@spectrumhealth.org (R.N. Saunders).

first-party medical benefits, and have held a motorcycle endorsement for at least two years or have passed an approved motorcycle safety course. This is the first multi-year statewide study evaluating the impact of Michigan's motorcycle helmet legislative change on TBI.

2. Methods

2.1. We conducted a retrospective review of the Michigan trauma quality improvement

Program's (MTQIP) trauma database to investigate the impact of motorcycle helmet legislation on patient outcomes. This database captures clinical information from trauma patients admitted to 29 Michigan level one and level two trauma centers. After receiving approval from the Spectrum Health Institutional Review Board, the database was evaluated for the time periods 1/1/09–4/12/12 and 4/13/12–12/31/14. This represents an approximately three-year time period before and after repeal of the universal helmet law.

Motorcycle trauma patients were selected using the International Classification of Disease ninth edition Clinical Modification (ICD-9 CM) External Cause of Injury Codes (E-Codes) (E810–E819 and E820–E825, series 0.2 and 0.3). Data collected included age, sex, helmet status, blood alcohol content (BAC), injury severity scale (ISS), TBI, Glasgow coma scale (GCS), maximum abbreviated injury scale head/neck (AIS-HN), neurosurgical procedures, insurance status, and hospital mortality. Specific injuries were identified using ICD-9 CM diagnosis codes for traumatic brain injuries (800.0–801.9, 803.0–804.9, 850.0–854.1, 950.1–950.3, 959.01, and 995.55). GCS was used to determine TBI severity and categorized as mild or none (GCS 13–15) and moderate to severe (GCS 3–12). TBI severity was also classified by the AIS-HN with a score of 0–1 pertaining to mild or no TBI and a score of 2–6 equating moderate (2) to un-survivable (6) based on AIS 2005. Neurosurgical procedures were identified using ICD-9 CM procedure codes (01.00–01.60 and 02.00–02.99). Primary payor insurance types were grouped and analyzed. Patients with Medicare or Medicaid were classified as Government Insurance. Those with commercial health insurance or no-fault auto insurance as their primary payor were classified as commercial insurance. The Michigan State Police provided on-scene motorcycle fatality data.

Data were analyzed using STATA v14.1 (StataCorp, College Station, TX). Descriptive statistics were calculated. Quantitative data are expressed as the mean \pm SD, whereas nominal data are expressed as a percentage. Comparisons between groups for quantitative variables were performed using the *t*-test. Nominal variables were evaluated using the chi-square test. The difference in rates of on-scene mortalities between the pre- and post-repeal time periods was performed using the binomial test. Relative risk (RR) and 95% confidence intervals (95% CI) were calculated for nominal variables. A multivariate logistic regression analysis was performed, with mortality as the dependent variable, and helmet law status (pre- vs. post-repeal), intoxication, age, gender, TBI and ISS as the independent variables. In addition, a multiple regression analysis and a logistic regression analysis were performed, with ISS and TBI, respectively, as the dependent variables, and helmet law status, intoxication, age and gender as the independent variables. Statistical significance was assessed at $p < 0.05$.

3. Results

A total of 4643 motorcycle crash patients were identified between January 1, 2009 and December 31, 2014. Eighty-seven percent were male and the average age was 43.7 ± 14.8 years.

One thousand nine hundred seventy motorcycle trauma patients were included from 1/1/09–4/12/12 (before the repeal) and 2673 patients were included from 4/13/12–12/31/14 (after the repeal). Demographic and clinical data for both groups are listed in Table 1. There were no differences in age, sex, ISS, or mean BAC between the two groups.

3.1. Pre-law vs. post-law data

The proportion of un-helmeted motorcycle trauma patients presenting to Michigan trauma centers after the universal helmet law repeal increased from 20% (174/858) to 44% (1143/2597; $p < 0.001$). TBI, neurosurgical procedures, and mortality data are depicted in Table 2. Following the repeal, the number of patients with TBI classified as moderate to severe based on GCS trended towards significance (RR: 1.2, 95% CI: 1.0–1.4; $p = 0.051$). When using AIS-HN to classify head injuries, we found a significant increase in moderate to un-survivable (AIS-HN 2–6) head injuries following the repeal (RR: 1.1, 95% CI: 1.0–1.2; $p = 0.025$).

Primary payor source was analyzed for patients presenting before and after the helmet law repeal. Patients were less likely to have commercial insurance (891/1156, 77% vs. 1883/2509, 75%, $p = 0.184$) and more likely to be uninsured (77/1156, 7% vs. 242/2509, 10%, $p = 0.003$) following the repeal. There was no difference in the proportion of patients with government insurance as their primary payor (129/1156, 11% vs. 321/2509, 13%, $p = 0.16$).

3.2. Helmeted vs. un-helmeted data

During the pre-repeal and the post-repeal time intervals, helmeted motorcycle patients were compared to un-helmeted motorcycle patients. There were no differences in age and sex, but un-helmeted patients were found to have higher mean BAC and ISS than the helmeted motorcyclists (Table 1). TBI, neurosurgical procedures, and mortality data are depicted in Table 2. Based on GCS, un-helmeted riders were much more likely to sustain moderate and severe TBI (RR: 1.7, 95% CI: 1.5–2.0; $p < 0.001$). Un-helmeted patients were also found to have a lower mean GCS ($p < 0.001$) and higher mean AIS-HN ($p < 0.001$).

We evaluated the primary payor source for helmeted and un-helmeted motorcyclists presenting to a Michigan trauma centers. Helmeted motorcyclists were more likely to have commercial insurance (1620/2050, 79% vs. 841/1213, 69%, $p < 0.001$). Un-helmeted motorcyclists were more likely to have government

Table 1
Demographic data comparing patients before and after universal helmet law repeal and helmeted and un-helmeted.

	Universal Helmet Law n = 1970	Partial Helmet Law n = 2673	p-value
Age (y)	43.6 \pm 14.6	43.7 \pm 14.9	0.785
Sex (% male)	1701 (86%) (n = 1969)	2348 (88%)	0.143
BAC – Any alcohol ^a	136 \pm 96 (n = 422)	131 \pm 103 (n = 733)	0.436
BAC – Intoxicated ^b	182 \pm 77 (n = 291)	192 \pm 82 (n = 461)	0.118
ISS	15.3 \pm 11.3	14.7 \pm 10.6	0.062
	Helmeted Patients (n = 2138)	Unhelmeted Patients (n = 1317)	p-value
Age (y)	43.9 \pm 15.2	43.6 \pm 14.3	0.602
Sex (% male)	1861 (87%)	1167 (89%)	0.174
BAC – Any alcohol ^a	111 \pm 94 (n = 414)	149 \pm 103 (n = 493)	<0.001
BAC – Intoxicated ^b	178 \pm 73 (n = 232)	199 \pm 80 (n = 348)	0.002
ISS	14.3 \pm 9.8	15.2 \pm 11.7	0.010

BAC: blood alcohol content; ISS: injury severity score.

^a Any blood alcohol concentration measured > 0 mg/dL.

^b Blood alcohol concentration > 79 mg/dL.

Download English Version:

<https://daneshyari.com/en/article/8830737>

Download Persian Version:

<https://daneshyari.com/article/8830737>

[Daneshyari.com](https://daneshyari.com)