

Title: Impact of Helmet Law Repeal on Motorcycle Crash Incidents Attended by EMS in Missouri

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Background: Previous research has shown motorcycle helmets save lives, reduce serious injuries, and reduce costs associated with healthcare, lost productivity, and other economic costs.¹⁻³ The state of Missouri repealed its universal helmet use law for motorcyclists aged 26 and older with valid health insurance on August 28, 2020. The aim of this study was to compare characteristics of motorcycle crashes (MCC) attended by emergency medical services (EMS) in Missouri before and after the repeal of the helmet use law.

Methods: Inclusion criteria for this study were 9-1-1 EMS responses involving a MCC injury where the patient was either a driver or passenger on a motorcycle and was at least 26 years of age. MCC injuries were identified using injury cause ICD-10 Codes V20-V29. Occupant safety equipment use, provider impressions, chief complaint anatomical location, and patient care narratives were used to categorize helmet use and head injuries. Incidents were ascertained for two time periods: March 1, 2020 through August 27, 2020 (before helmet law repeal) and March 1, 2021 through August 27, 2021 (after helmet law repeal). Patient demographics, urbanicity, helmet use, head injury, patient acuity, Glasgow Coma Score (GCS) and trauma team activations were examined. Categorical variables were compared for the two time periods with chi-square tests used to assess differences in proportions.

Results: There were 682 MCC (7% of all motor vehicle incidents) before the helmet law repeal and 1,031 MCCs (8% of all motor vehicle) that occurred after the helmet law repeal. Of note, the number of incidents increased in 2021 due to the COVID-19 shelter in place order, leading to less travel, being lifted from the prior year. The age, sex, and race distributions of MCC patients did not differ by time period. After the repeal, there was a 53% decrease in the proportion of MCC patients that were helmeted (77.3% vs 36.2%, $p < .xxx$). In addition, the prevalence of documented head injuries, patients with critical injuries, patients with GCS < 8 , and trauma team activations increased by 50%, 64%, 64%, and 20%, respectively (all $p < 0.xxx$) after the law was repealed. There was no significant difference in the proportion of MCC incidents that resulted in patient deaths reported by EMS before and after the law repeal (2.5% vs 2.2%, $p = 0.363$), but not all roadway deaths are attended by EMS.

Conclusion: Based on these results, the repeal of the mandatory helmet law in Missouri has been associated with an increase in head injuries, injury severity, and subsequent trauma team activations among MCC patients attended to by EMS. Longer term monitoring is necessary to track the impacts of helmet use in MCCs on EMS resources and costs. There was also a decrease in helmet use documentation by EMS providers after the helmet law was repealed, which may be an indicator in the perception that helmet use documentation is no longer relevant; This has not been well studied, but additional research should be performed to see if these results are similar in other states where helmet use laws are changed. Additionally, training for providers on the importance of documenting safety equipment used by patients by may also be necessary, especially when laws change related to incidents seen by EMS.

Tables and References

| Variables | Prior to Helmet Law Repeal ^a (2020) | After Helmet Law Repeal ^a (2021) | Total |
|---|--|---|---------------|
| N All Injury Incidents | 35,048 | 44,711 | 79,759 |
| N All Transport Incidents | 9,236 | 12,701* | 21,937 |
| N Motorcycle Incidents | 682 | 1,031* | 1,713 |
| Patient Age | | | |
| 26-35 years | 204 (29.9%) | 303 (29.4%) | 507 (29.6%) |
| 36-45 years | 160 (23.5%) | 244 (23.7%) | 404 (23.6%) |
| 46-55 years | 133 (19.5%) | 235 (22.8%) | 368 (21.5%) |
| >55 years | 185 (27.1%) | 249 (24.2%) | 434 (25.3%) |
| Patient Sex | | | |
| Male | 577 (84.6%) | 897 (87.0%) | 1,474 (86.1%) |
| Female | 103 (15.1%) | 133 (12.9%) | 236 (13.8%) |
| Unknown | 2 (0.3%) | 1 (0.1%) | 3 (0.1%) |
| Race | | | |
| White | 558 (82.0%) | 823 (79.8%) | 1,382 (79.8%) |
| Black or African American | 82 (12.0%) | 101 (9.8%) | 183 (10.6%) |
| Hispanic | 6 (0.9%) | 14 (1.4%) | 20 (1.2%) |
| Other or Multiple Races | 5 (0.7%) | 7 (0.7%) | 12 (0.7%) |
| Unknown | 30 (4.4%) | 86 (8.3%)* | 116 (7.7%) |
| Urbanicity^b | | | |
| Metro | 476 (69.8%) | 674 (65.4%)* | 1,150 (67.1%) |
| Non-Metro | 102 (15.0%) | 179 (17.4%) | 281 (16.4%) |
| Rural | 26 (3.8%) | 31 (3.0%) | 57 (3.3%) |
| Unknown | 78 (11.4%) | 147 (14.1%) | 225 (13.1%) |
| Helmet Worn | | | |
| Yes | 527 (77.3%) | 518 (36.2%)* | 1,045 (61.0%) |
| No | 94 (13.8%) | 373 (50.2%)* | 467 (27.3%) |
| Unknown | 61 (8.9%) | 140 (13.6%)* | 201 (11.8%) |
| Documented Head Injury | | | |
| No | 576 (84.5%) | 791 (76.7%)* | 1,367 (79.8%) |
| Yes | 106 (15.5%) | 240 (23.3%)* | 346 (20.2%) |
| Patient Disposition | | | |
| Treated and Transported | 497 (72.9%) | 792 (76.8%)* | 1,289 (75.3%) |
| Refused Evaluation, Care, or Transport | 122 (17.9%) | 139 (13.5%)* | 261 (15.2%) |
| No Treatment Required | 19 (2.8%) | 17 (1.7%) | 36 (2.1%) |
| Transferred | 19 (2.8%) | 46 (4.5%)* | 65 (3.8%) |
| Dead | 17 (2.5%) | 23 (2.2%)* | 40 (2.3%) |
| Treated and Released (Per protocol) | 8 (1.2%) | 15 (1.5%) | 23 (1.3%) |
| Patient Acuity^c | | | |
| Critical | 46 (6.7%) | 113(11.0%)* | 159 (9.3%) |
| Emergent | 138 (20.2%) | 240 (22.5%)* | 394 (21.6%) |
| Lower Acuity | 154 (22.6%) | 232 (23.3%)* | 370 (23.0%) |
| Dead | 17 (2.5%) | 23 (2.2%)* | 40 (2.3%) |
| Patient refused evaluation and care | 75 (11.0%) | 89 (8.6%)* | 164 (9.6%) |
| Unknown | 252 (37.0%) | 333 (32.3%)* | 585 (34.2%) |
| Total Glasgow Coma Score^d | | | |
| Mild | 598 (87.7%) | 851 (82.5%) | 1,449 (84.6%) |
| Moderate | 17 (2.5%) | 22 (2.1%) | 39 (2.3%) |
| Severe | 40 (5.9%) | 100 (9.7%)* | 140 (8.2%) |
| Unknown | 27 (4.0%) | 58 (5.6%) | 85 (5.0%) |
| Trauma Team Activated | | | |
| Yes | 135 (19.8%) | 245 (23.8%)* | 380 (22.2%) |
| No | 528 (77.4%) | 743 (72.31%)* | 1,271 (74.2%) |
| Unknown | 19 (2.8%) | 43 (4.2%)* | 62 (3.6%) |

^a Missouri repealed a Helmet Use Requirement Law that went into effect on August 28th, 2020. The use of a helmet was not required pending the individual was 26 years or older and had valid insurance. This analysis compared data before and after the repeal during the Spring/Summer (Mar 1st – Aug 27th) timeframes

^b Metro area includes counties located within a metropolitan area that has over 250,000 residents. Non-Metro area includes urban counties with at least 2,500 residents, that may or may not be adjacent to a metropolitan area. Rural denotes counties that are completely rural or urban with less than 2,500 people in an urban area.

^c Final Patient acuity was used as primary source, if this was missing, the initial patient acuity was used

^d Final Patient Total Glasgow Coma score was used as primary source, if this was missing, the initial patient Total Glasgow Coma score was used

*Chi-square p-value <0.05

| Variables | BEFORE % w Helmet | AFTER % w helmet |
|---------------------------|----------------------|---------------------|
| Patient Age | | |
| 26-35 years | 148 (72.6%) | 154 (50.8%) |
| 36-45 years | 120 (75.0%) | 113 (46.3%) |
| 46-55 years | 100 (75.2%) | 109 (46.4%) |
| >55 years | 159 (86.0%) | 142 (57.0%) |
| Patient Gender | | |
| Male | 452 (78.3%) | 451 (50.3%) |
| Female | 73 (70.9%) | 66 (49.6%) |
| Race | | |
| White | 441 (78.9%) | 400 (48.6%) |
| Black or African American | 58 (70.7%) | 60 (59.4%) |
| Hispanic | 3 (50.0%) | 8 (57.1%) |
| Other | 5 (100.0%) | 3 (42.9%) |
| Race/Multiple | | |
| Unknown | 20 (66.7%) | 47 (54.7%) |
| Urbanicity | | |
| Metro | 375 (78.8%) | 349 (51.8%) |
| Non-Metro | 77 (75.5%) | 84 (46.9%) |
| Rural | 21 (80.8%) | 13 (41.9%) |
| Unknown | 54 (69.2%) | 72 (49.0%) |

^aSpring/Summer (Mar 1st – Aug 27th)

References:

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3. Patel, P. B., Staley, C. A., Runner, R., Mehta, S., & Schenker, M. L. (2019). Unhelmeted motorcycle riders have increased injury burden: a need to revisit universal helmet laws. Journal of surgical research, 242, 177-182.