# STATE-LEVEL HELMET USE LAWS, HELMET USE, AND HEAD INJURIES IN EMS PATIENTS INVOLVED IN MOTORCYCLE COLLISIONS

Morgan K. Anderson[1], Alyssa M. Green[1], Lori L. Boland[1-2]

[1]Clincial and Research Services, ImageTrend LLC; [2]Allina Health Emergency Medical Service

## BACKGROUND

Motorcycle helmets save lives, reduce serious injuries, and reduce healthcare and other economic costs.[1-3] Currently, 18 states have laws that require helmet use by motorcyclists ≥ 21 years of age.

## OBJECTIVE

Compare helmet use and head trauma in emergency medical services (EMS) patients involved in motorcycle collisions (MCC) in states with and without helmet use laws.

## METHODS

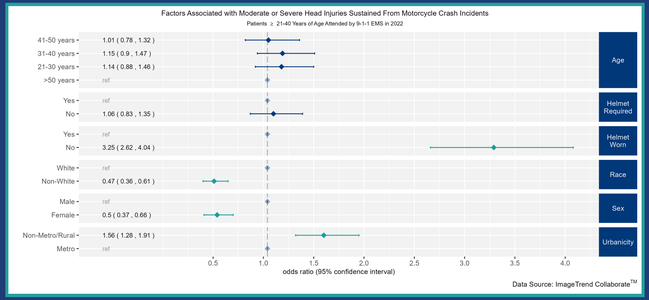
- ImageTrend Collaborate national dataset
- 9-1-1 responses occurring in 2022
- Patient was a motorcyclist in a transport collision (ICD-10 V20-V29) and ≥ 21 years of age.

### MEASURES

- Patient demographics
- Urbanicity (metro, non-metro/rural)[4]
- Helmet use
- Presence of state helmet use law (yes/no)
- Patient disposition
- Glasgow Coma Scale score (GCS)
- EMS-documented head injury identified using provider impressions and chief complaint anatomical location
- Moderate or severe head injury (GCS ≤ 12)

### ANALYSIS

- Chi-square tests for proportion comparisons
- Multivariable logistic regression (95% CI) used to describe associations of measures to moderate or severe head injury




**Unhelmeted motorcyclists were over 3 times more likely to have a moderate or severe head injury than those wearing a helmet in collisions attended by EMS.**

**Table 1. Motorcycle Collision Incidents Attended by Emergency Medical Services, 2022**

| Variables | Total | States with Helmet Laws | States without Helmet Laws | Percent Difference |
|---|---|---|---|---|
| **N Motorcycle Incidents** | 17,762 | 5,989 | 11,773 | |
| **Patient Age** | | | | |
| **21-30 years** | 4,568(25.7%) | 1,616(27.0%) | 2,952(25.1%) | -7.0%* |
| **31-40 years** | 4,029(22.7%) | 1,451(24.2%) | 2,578(21.9%) | -9.5%* |
| **41-50 years** | 3,260(18.4%) | 1,082(18.1%) | 2,178(18.5%) | +2.2% |
| **>50 years** | 5,905(33.3%) | 1,840(30.7%) | 4,065(34.5%) | +12.4%* |
| **Patient Sex** | | | | |
| **Male** | 14,701(83.0%) | 5,108(85.5%) | 9,593(81.8%) | - 4.3%* |
| **Female** | 3,002(17.0%) | 865(14.5%) | 2,137(18.2%) | +25.5%* |
| **Unknown** | 59 | 16 | 43 | |
| **Race** | | | | |
| **White** | 10,341(71.6%) | 3,125(65.9%) | 7,216(74.4%) | +12.9%* |
| **Black or African American** | 1,591(11.1%) | 680(14.3%) | 911(9.4%) | - 34.3%* |
| **Hispanic** | 1,788(12.4%) | 640(13.5%) | 1,148(11.8%) | - 12.6%* |
| **Other or Multiple Races** | 722(5.0%) | 299(6.3%) | 423(4.4%) | - 30.2%* |
| **Unknown** | 3,320 | 1,245 | 2,075 | |
| **Urbanicity[a]** | | | | |
| **Metro** | 14,628(83.5%) | 5,239(88.3%) | 9,389(81.0%) | - 8.3%* |
| **NonMetro/Rural** | 2,898(16.5%) | **692(11.7%)** | **2,206 (19.0%)** | +64.1%* |
| **Unknown** | 236 | 58 | 178 | |
| **Documentation of Helmet Worn[b]** | | | | |
| **Yes** | 6,413(47.2%) | 2,975(76.2%) | 4,208(43.4%) | - 43.0%* |
| **No** | 7,183(52.8%) | **928(23.8%)** | **5,485(56.6%)** | +137.8%* |
| **Unknown** | 4,166 | 2,086 | 2,080 | |
| **Total Glasgow Coma Score** | | | | |
| **Mild (13-15)** | 14,348 (87.8%) | 4,838(88.9%) | 9,510(87.2%) | - 1.9% |
| **Moderate (9-12)** | 801(4.9%) | 227(4.2%) | 574(5.3%) | +26.2%* |
| **Severe (3-8)** | 1,198(7.3%) | 380(7.0%) | 818(7.5%) | +7.1% |
| **Unknown** | 1,415 | 544 | 871 | |
| **Documented Head Injury[c]** | | | | |
| **Yes** | 2,739(15.4%) | **488(8.2%)** | **2,251(19.1%)** | +132.9%* |
| **Moderate/Severe Head Injury[d]** | | | | |
| **Yes** | 628(3.9%) | **118(2.2%)** | **510(4.8%)** | +118.2%* |
| **Patient Disposition** | | | | |
| **Treated and Transported** | 12,781(71.0%) | 4,217(69.1%) | 8,564(72.0%) | +4.2%* |
| **NotTransported[e]** | 2,747(15.5%) | 812(13.6%) | 1,935(16.4%) | +20.6%* |
| **Transferred Care** | 1,871(10.4%) | 836(13.7%) | 1,035(8.7%) | - 36.5%* |
| **Dead** | 363(2.0%) | 124(2.0%) | 239(2.0%) | 0.0% |
| **Trauma Team Activated** | | | | |
| **Yes** | 4,527(25.5%) | 1,878(31.4%) | 2,649(22.5%) | -28.3%* |

[a]USDA RUCC (Rural Urban Continuum Codes) https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx
[b]NEMSIS eInjury.07 (Use of Occupant Safety Equipment)
[c]Head injury from anatomical and provider primary or secondary impression
[d]Patient had a documented head injury and a GCS ≤ 12
[e] Not transported dispositions include: Patient refused, treated and released, patient evaluated and no care provided
*Chi-square p-value <0.05

## RESULTS

- 17,762 motorcycle collisions occurred in 2022
- 11,733 (66%) motorcycle collisions occurred in states without helmet use laws
- States without helmet use laws had higher proportions of:
  - Unhelmeted patients
  - EMS-documented head injuries
  - Moderate or severe head injuries
  - Non-metro/rural areas
- Multivariate model including age, sex, race, urbanicity, helmet use, and presence of state law:
  - Protective factors for moderate/severe head injury were:
    - Female sex (OR=0.50, 95% CI, 0.37-0.66)
    - Nonwhite race (OR=0.47, 95%CI 0.36-0.61)
- Increased risk for moderate/severe head injury were:
  - Not wearing a helmet (OR=3.25, 95%CI 2.62-4.04)
  - Nonmetro/rural (OR=1.56, 95%CI 1.28-1.91; referent: metro)

## LIMITATIONS

- Convenience sample of all EMS Incidents in the United States
- Severity measured by patient death could not be assessed as not all are attended by EMS or deaths would be pronounced at hospital
- Some information may have been in patient narrative which would not be captured in this analysis

## CONCLUSION

These national EMS data indicate the prevalence of helmet use among motorcycle crash victims attended to by EMS is markedly higher in states with laws requiring helmet use. Independent of state law, MCC victims not wearing helmets are significantly more likely to have moderate or severe head trauma documented by EMS.

1. National Highway Traffic Safety Administration. Lives and costs saved by motorcycle helmets, 2017 (Traffic Safety Facts. Report No. DOT HS 812 867). U.S. Department of Transportation, Washington, DC; 2019. Available at https://crashstats.nhtsa.dot.gov-/Api/Public/ViewPublication/812867external icon. Accessed 4 April 2023.
2. Liu BC, Ivers R, Norton R, et. al. Helmets for preventing injury in motorcycle riders. Cochrane Database Systematic Reviews. 2008;(1):CD004333. https://doi.org/10.1002/14651858.CD004333.pub3external icon
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.
4. United States Department of Agriculture. 2020. Rural-Urban Continuum Codes. [Accessed 6/10/2023]. https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx

Use your phone to scan and read the full abstract.

IMAGETREND®