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DOT HS 810 856 A Brief Statistical Summary October 2007

Bodily Injury Locations in Fatally Injured Motorcycle Riders

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Summary
A study of linked death certificate information reveals that among fatally injured motorcycle riders, there is a direct correlation between a head injury and helmet use. In fact, while about 35 percent of the helmeted motorcyclists had a head injury, about 51 percent of the unhelmeted motorcyclists had a head injury.

Introduction
The objective of this research note is to report the bodily location of injuries to fatally injured motorcycle riders (motorcyclists). Injury location is recorded on the death certificate by the coroner/medical examiner and is captured in mortality databases under what are known as axis codes. While the severity of the injuries is not recorded, the location of injuries is recorded. Of particular interest in this note is injury to the head and its relationship with helmet use.

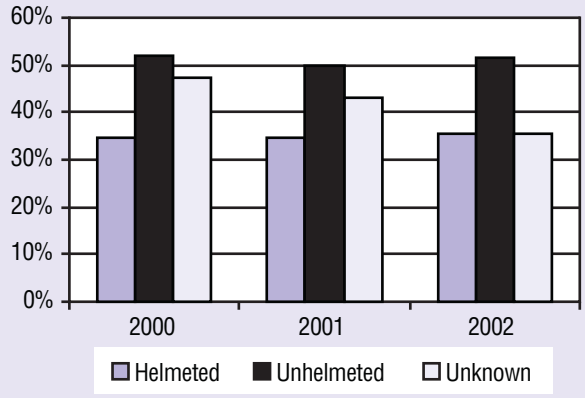
Data and Methodology
The note uses underlying cause of mortality data from the National Center for Health Statistics (NCHS) that have been linked to NHTSA's Fatality Analysis Reporting System (FARS). The NCHS Multiple Cause of Death (MCoD) data set includes data on all recorded deaths that occur in the United States. Using this linked data, this note presents information for 2000, 2001, and 2002 on 8,539 motorcyclists who were fatally injured. While a total of 9,364 motorcyclists were fatally injured from 2000 to 2002, the death certificate information was available only for 8,539 of those motorcyclists. In the linked data, each record includes information from the decedent's death certificate about the underlying cause of death, multiple conditions that contributed to the death, as well as demographic data on the decedent. The underlying cause of death may be internal morbid bodily conditions or external conditions such as injuries, poisoning, etc. coded using the International Classification of Diseases, Tenth Revision (ICD-10). Two sets of codes on conditions considered contributing causes of death are included for each data record in the MCoD files. The original death certificate coding is preserved in the entity-axis codes, while the record-axis codes have been edited by NCHS to eliminate contradictions and to define the condition most precisely within the limitations of ICD-10 coding and the available medical information on the death certificate. Record-axis codes are used by NCHS for the published MCoD statistics. The ordering of codes within each record is not the same as it appeared on the death certificate, and this should not be considered relevant information. Record-axis codes represent the most meaningful codes for the reported condition and have been used in this analysis.

In this analysis, injuries to the head include (1) superficial injury of head; (2) open wound of head; (3) fracture of skull and facial bones; (4) dislocation, sprain, and strain of joints and ligaments of head; (5) injury of cranial nerves; (6) injury of eye and obit; (7) intracranial injury; (8) crushing injury of head; (9) traumatic amputation of part of head; and (10) other head injuries.

Another common code used in the record axis codes is *Injuries Involving Multiple Body Regions* that could potentially include an injury to the head. However, since this code cannot be parsed into individual body location, only the head injuries mentioned above are included.

Results
Figure 1 depicts the proportion of fatally injured motorcycle riders with a coded injury of the head by their helmet use from 2000 to 2002. About 51 percent of the unhelmeted riders suffered a head injury as compared to about 35 percent of the helmeted riders.

Figure 1: Head Injury by Helmet Use Among Fatally Injured Motorcycle Riders



The proportions depicted in Figure 1 are likely to under-state the actual number of motorcyclist fatalities with head injuries as *Injuries Involving Multiple Body Regions* is likely to include head injuries. Table 1 depicts the number and proportion of fatally injured with a head injury (not including those with *Injuries in Multiple Body Regions*) by their helmet use.

Table 1: **Head Injury by Helmet Use Among Fatally Injured Motorcyclists, 2000-2002**

Helmet Use	Head Injury		Total
	Yes	No	
Yes	1,545 [35%]	2,867 [65%]	4,412 [100%]
No	1,955 [51%]	1,874 [49%]	3,829 [100%]
Unknown	126 [42%]	172 [58%]	298 [100%]
Total	**3,626 [42%]**	**4,913 [57%]**	**8,539 [100%]**

Source: NCSA FARS 2000-2002, CDC Multiple Cause of Death Linked Files

As shown in Table 1, a significant relationship was observed between helmet use and injury to the head among fatally injured motorcycle operators.

Table 2 depicts the distribution of the number of coded record axis codes pertaining to external injuries for the fatally injured motorcycle operators, by their helmet use.

Table 2: **Number of External Injury Codes for Fatally Injured Motorcyclists by Their Helmet Use, 2000-2002**

Num of Codes	Helmeted		Unhelmeted		Total**	
	Num	%	Num	%	Num	%
0*	28	1%	37	1%	65	1%
1	2,796	63%	2,371	62%	5,349	63%
2	922	21%	870	23%	1,869	22%
3	361	8%	315	8%	698	8%
4	147	3%	112	3%	269	3%
5	76	2%	63	2%	141	2%
6	48	1%	39	1%	89	1%
7	18	0%	9	0%	29	0%
8	7	0%	7	0%	15	0%
9	6	0%	3	0%	9	0%
10	3	0%	3	0%	6	0%
Total	**4,412**	**100%**	**3,829**	**100%**	**8,539**	**100%**

Source: NCSA FARS 2000-2002, CDC Multiple Cause of Death Linked Files
*No coded injury
**Columns do not add to total due to unknown helmet use

As seen in Table 2, about 92 percent (63%+22%+8%) of the fatally injured motorcyclists had at the most three injury-related record axis codes. Table 3 presents a more detailed breakdown of the injury locations for the 5,349 motorcyclists who had only one coded injury, by the helmet use of the fatally injured motorcyclist. About 19 percent of the injuries to the helmeted motorcyclist were to the head while 36 percent of the injuries to the un-helmeted motorcyclist were to the head.

Table 3: **Injury Locations in Fatally Injured Motorcyclists When Only One Injury-Related Record Axis Was Coded, 2000-2002**

Injury	Helmeted		Unhelmeted		Total*	
	Num	%	Num	%	Num	%
Multiple Locations	1,580	57%	1,036	44%	2,713	51%
Head	518	19%	864	36%	1,428	27%
Neck	79	3%	38	2%	124	2%
Thorax	174	6%	83	4%	268	5%
Shoulder/Arms	2	0%	0	0%	2	0%
Abdomen/ Lumbar/ Spine	73	3%	47	2%	125	2%
Hip/Legs	9	0%	6	0%	15	0%
Unspecified	361	13%	297	13%	674	13%
Total	**2,796**	**100%**	**2,371**	**100%**	**5,349**	**100%**

Source: NCSA FARS 2000-2002, CDC Multiple Cause of Death Linked Files
*Columns do not add to total due to unknown helmet use

Overall, when only one injury was coded, *Injury in Multiple Locations* was observed for about half of the fatally injured motorcyclist. Injury to the head was observed in about 27 percent of the fatalities.

Table 4 depicts injuries to fatally injured motorcyclists with at least two injuries.

Table 4: **Injury Locations in Fatally Injured Motorcyclists With Two Injury-Related Record Axis, 2000-2002**

1st Code+ 2nd Code	Helmeted		Unhelmeted		Total*	
	Num	%	Num	%	Num	%
Head+Head	180	20%	295	34%	495	26.5%
Head+Thorax	139	15%	102	12%	251	13.4%
Head+Neck	118	13%	83	10%	206	11.0%
Multiple+Unspecified	90	10%	50	6%	146	7.8%
Thorax+Abdomen	85	9%	39	4%	130	7.0%
Head+Abdomen	49	5%	54	6%	108	5.8%
Head+Unspecified	32	3%	69	8%	106	5.7%
Head+Multiple	40	4%	55	6%	98	5.2%
Thorax+Thorax	29	3%	20	2%	52	2.8%
Thorax+Unspecified	19	2%	15	2%	36	1.9%
Neck+Thorax	22	2%	10	1%	32	1.7%
Other	133	14%	78	9%	209	11.2%
Total	**922**	**100%**	**870**	**100%**	**1,869**	**100%**

Source: NCSA FARS 2000-2002, CDC Multiple Cause of Death Linked Files
*Columns do not add to total due to unknown helmet use

About 34 percent of the unhelmeted motorcyclists had two injury codes, both related to head injuries, as compared to 20 percent of helmeted motorcyclists with two injury related record axis codes.

Conclusions

Analysis of linked death certificate information points to a significant correlation between helmet use and injuries to the head among fatally injured motorcycle riders. Slightly more than half of the unhelmeted motorcyclists had one or more injuries to their head as compared to slightly less than a third of the helmeted motorcyclists.

References

NCHS, *Underlying Cause of Mortality Data*, National Center for Health Statistics, Centers for Disease Control

U.S. Department of Transportation
National Highway Traffic Safety Administration

Published by NHTSA's National Center for Statistics and Analysis 1200 New Jersey Avenue SE., Washington, DC 20590