Economic Impact of Motorcycle Helmets: From Impact to Discharge

Brian J. Eastridge, MD, Shahid Shafi, MD, MPH, Joseph P. Minei, MD, Daniel Culica, MD, PhD, Charles McConnel, PhD, and Larry Gentilello, MD

Background: The economic impact of helmet use remains controversial. Previous studies of injured motorcyclists suggest a marginal inpatient hospital cost difference between helmeted and unhelmeted riders. The purpose of this study was to expand the economic analysis of motorcycle helmet utilization to the point of injury by including motorcycle crash patients who do not require hospital admission.

Methods: Prehospital motorcycle crash data were collected from the National Highway Transportation Safety Administration (NHTSA) General Estimates System (GES) database from 1994 to 2002 with respect to helmet use, injury severity, and transport to a hospital. A focused literature search yielded the hospital admission rates of helmeted and unhelmeted motorcyclists evaluated in the emergency department. The National Trauma Data Bank (NTDB) was queried from 1994 to

2002 to collect data including helmet use and hospital charges for injured motorcyclists. Cost analysis was performed by linkage of the queried databases and data from the literature. Statistical comparisons between groups were performed using an independent samples *t* test and χ^2 analysis.

Results: The NHTSA GES database yielded 5,328 sample patients. 1,854 patients (34.8%) were unhelmeted and 3,474 (65.2%) were helmeted. Transport to a hospital was required of 78.6% of unhelmeted and 73.3% of helmeted patients ($p < 0.01$). Of motorcyclists evaluated in the emergency department, 39.9% of unhelmeted and 32.8% of helmeted patients required hospital admission. NTDB analysis of injured motorcyclists from the concomitant interval yielded 9,033 patients in whom helmet use data were available and 5,343 patients for whom associated

hospital cost data were available. Unhelmeted motorcyclists incurred charges of $39,390 + $1,436 per injury, whereas helmeted motorcyclists incurred charges of $36,334 + $1,232 per injury. Mathematical extrapolation derived a charge of $12,353 per unhelmeted and $8,735 per helmeted motorcyclist for every crash with a difference of $3,618 between helmeted and unhelmeted riders involved in a motorcycle crash.

Conclusions: With a current estimate of 197,608 motorcycle crashes/year in which 69,163 riders were unhelmeted, the differential healthcare economic burden between unhelmeted and helmeted motorcyclists is approximately $250,231, 734 per year and underscores the need for improved legislation to improve motorcycle helmet utilization.

Key Words: Motorcycle, Helmet, Injury, Cost, Trauma.

J Trauma. 2006;60:978–984.

T he debate over the use of motorcycle helmets while riding has been a longstanding and emotionally charged issue. Historically, Congress enacted legislation in 1966 that withheld Federal Department of Transportation funds from states without mandatory motorcycle helmet laws. Subsequent to lobbying efforts by a number of influential and well funded biker's rights organizations such as A Brotherhood Against Totalitarian Enactments (ABATE) and the American Motorcyclist Association (AMA), Congress was pressured into repealing this legislation under the auspices

that the law violated the motorcycle rider's personal rights and freedoms. In the years that followed the 1975 ruling, 50% of individual states enacted measures that either partially or fully rescinded their helmet laws. Since that era, increased motorcycle crash deaths and the economic burden of increased cost of care have fueled the debate over the mandatory helmet laws, pitting societal costs against personal freedoms.

Although motorcycles constitute only a very small percentage of the motor vehicles in the United States, motorcycle crashes are responsible for a disproportionate share of injury and death associated with motor vehicular crashes.[1–10] According to National Highway Transportation Safety Administration (NHTSA), 80% of motorcycle crashes result in injury or death of the rider(s).[11] With motorcycle ridership ever increasing, evidence is accumulating that the injury related medical costs of nonhelmeted riders are much more substantial than those of helmeted riders.[6–20] Antihelmet law lobbyists argue that such studies look at inpatient hospital data and although they may present statistically significant differences, these differences are not practically different with respect to costs. Truly, many of these studies demonstrate only a marginal difference in inpatient hospital cost between helmeted and nonhelmeted riders. Previous studies

to determine whether unhelmeted motorcyclists incur greater health care costs compared the hospital charges of helmeted and unhelmeted motorcyclists admitted to the hospital after a crash related injury. Such analyses may underestimate the potential cost savings associated with helmet use because all patients included in these studies will have met the threshold condition of having sustained a serious injury, regardless of helmet use. Helmeted cyclists involved in a crash may be more likely to be discharged from the scene, averting health care costs altogether. Additionally, the proportion of both groups that require transport to the hospital may favor a cost advantage for the helmeted cyclists who would be more likely to be treated and discharged, averting the costs of inpatient hospitalization.

To more clearly demonstrate the economic advantages of motorcycle helmet utilization, our goal was to evaluate the direct medical costs of motorcycle associated injury from "impact to discharge." No attempt was made to include the medical costs incurred posthospital discharge or indirect costs such as lost wages, disability, or intangible losses. We had two hypotheses in this present study. Our first hypothesis was that inpatient charges underestimate the medical cost disparity between the medical care of the helmeted and unhelmeted motorcyclist. Our secondary hypothesis was that in addition to decreased inpatient costs, the primary economic advantage of motorcycle helmets was a decreased utilization of the acute healthcare system after collision.

METHODS
Prehospital Data

Prehospital data to estimate the proportion of motorcycle drivers who required transport to an emergency department for further evaluation, as well as data on motorcycle helmet use, were obtained from the General Estimates System (GES) database developed by the National Center for Statistics and Analysis (NCSA), a branch of the NHTSA. GES data come from a nationally representative sample of police-reported motor vehicle crashes of all severity. This system was created to identify traffic safety problem areas, provide a foundation for regulatory and consumer initiatives, and form the basis for cost and benefit analyses of traffic safety programs. The information is used to estimate how many motor vehicle crashes of different kinds take place and what happens when they occur. For a crash to be eligible for the GES sample, a police accident report (PAR) must be completed. These PAR documents are compiled from 60 areas that representatively reflect the geography, roadway mileage, population, and traffic density of the United States.

During the period of this analysis (1994 to 2002), PARs were submitted for 585,300 motor vehicle crash incidents. The inclusion criteria for the current study consisted of all patients for whom crash data indicated motorcycle crash as the mechanism of injury and for whom the status of helmet utilization and scene disposition was known. Exclusion criteria consisted of lack of information on mechanism. These

basic parameters identified our prehospital study population of 5,328 subjects. This patient population was stratified based upon motorcycle helmet use with patients being divided into helmet use (n = 3,474, 65.2%) and nonuse (n = 1,854, 34.8%) categories.

These two prehospital sample groups were compared with respect to their requirement for transport to a hospital for emergency department evaluation. The primary data points of interest in this phase of the analysis were the prevalence of helmet use and the association between motorcycle helmet use and injuries requiring transport to the hospital for acute medical care.

Hospital Data

Hospital admission rates from the emergency department were obtained from an intensive literature review specific to the admission rates of injured motorcyclists.[1] Inpatient hospitalization data in this study were derived from the National Trauma Data Bank (NTDB). The NTDB is a perpetual registry project sponsored by the American College of Surgeons that collects injury data from participating trauma centers around the United States. The mission of the NTDB is to maintain this database as an injury information repository to "improve the care of the injured patient through systematic efforts in prevention, care, and rehabilitation."

During the period of this analysis (1994 to 2002), the medical records of 474,024 patients admitted to 140 trauma centers were recorded in the database. The inclusion criteria for the current study consisted of all patients for whom crash data indicated motorcycle crash as the mechanism of injury and for whom the status of helmet utilization was known. In the NTDB, there were 10,730 patients during the study period with motorcycle crash documented as mechanism of injury of which 84% were included in this analysis. Excluded from the analysis were 1,697 patients in whom there was a lack of information on helmet use or age was less than 16 years. The inclusion criteria identified our hospital study population of 9,033 patients. This patient population was stratified based upon motorcycle helmet use with patients being divided into helmet use (n = 6,119, 67.7%) and nonuse (n = 2,914, 32.3%) categories.

These two hospital sample groups were compared with regard to their total hospital charges and injury severity. Hospital charges were utilized as a surrogate for hospital costs. Injury severity was measured using abbreviated injury scale (AIS) scores and injury severity score (ISS). The primary data points of interest in this phase of the study were the comparison of motorcycle helmet use with respect to injury severity and acute inpatient hospital cost.

In both the GES- and NTDB-derived analyses, continuous variables were represented by the means + SEM and were compared using an independent samples t test. Categorical variables were represented as percentages and compared by using a Pearson χ^2 methodology. SPSS for Windows was

used for data management and statistical analysis (SPSS Graduate Pack for Windows 12.0, SPSS Inc., Chicago, IL, 2003). A $p < 0.05$ was considered significant for all statistical analyses.

Cost Analysis

Motorcycle crash numbers were obtained from Centers for Disease Control, National Center for Injury Prevention and Control, Web-based Injury Statistics Query and Reporting System (WISQARSTM). Linking this data to the NHTSA GES data, we were then able to derive the number of helmeted and unhelmeted riders involved in crashes and subsequently the number of these respective patient populations who required transportation to the hospital for emergency department evaluation. The number of hospital admissions within each group was calculated from specific motorcycle injury emergency room admission rates derived from a single study in the medical literature.[1] At this point, admission data were linked to the NTDB database to develop total charges for helmeted and unhelmeted riders. All charges were normatively cost adjusted to the 2002 dollar using the medical care component index. The charge per crash rider was computed by dividing total charge by the total number of riders in that group. The Δcharge was the difference between the unhelmeted and helmeted cost per crash rider. Total charge was finally derived by multiplying Δcharge by the number of unhelmeted motorcyclists. (Fig. 1). The cost analysis algorithm is respectively depicted in tabular format in Table 3.

Table 1 Prehospital Course and Injury Severity of Patients Involved in Nonfatal Motorcycle Collisions

|	n	Helmeted	Nonhelmeted	p Value
Require transport to emergency room	4,005	2,547 (73.3)	1,458 (78.6)	0.01
Discharge from scene	1,323	927 (26.7)	396 (21.4)	0.01
Total live patients	5,328			
Death at scene	297	135 (3.6)	162 (8.3)	0.001

Data were abstracted from NHTSA GES and are presented n (%).

RESULTS

There were no basic demographic differences between the helmeted and nonhelmeted motorcyclists. Based upon the GES, of motorcycle riders involved in collisions, injury acuity requiring transport to the hospital for emergency department evaluation was required of 78.6% of nonhelmeted riders as compared with 73.3% of helmeted motorcyclists ($p < 0.01$; Table 1). Subsequent to motorcycle collisions, nonhelmeted motorcyclists were at significantly increased risk of death (8.3% vs. 3.6%; $p < 0.001$) when compared with helmeted riders (Table 1).

Of motorcycle riders hospitalized due to injuries associated with motorcycle collision, basic demographic characteristics were similar. Of note, there were no significant differences in the rates of neck, thorax, abdomen, or spine injuries between the helmeted and nonhelmeted groups. As expected, unhelmeted

Cost Analysis of Motorcyclists Involved in Collision in the U.S.
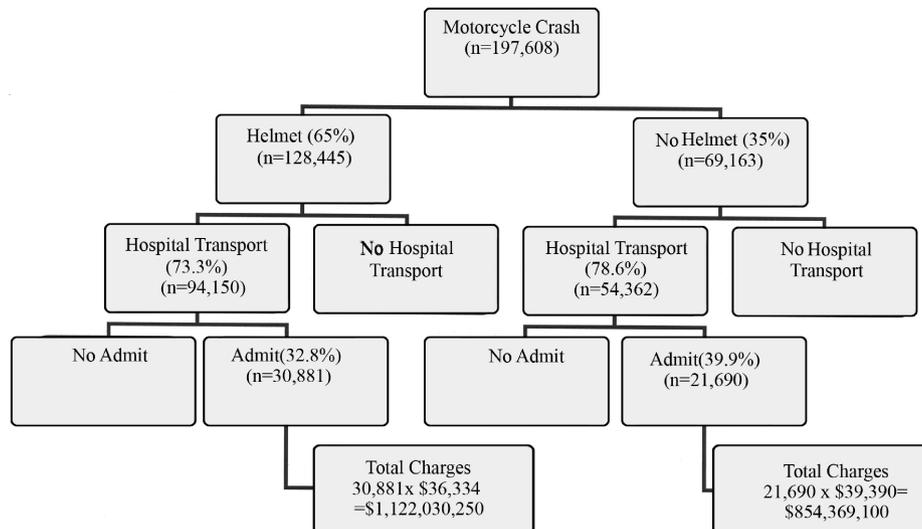
Helmet
$1,122,030,250/128,445 = $8,735 / crash rider
Δ Charge= $12,353 - $8,735 = $3,618

No Helmet
$854,369,100/69,163 = $12,353/crash rider

Therefore, if all unhelmeted riders were to wear helmets:
69,163 (unhelmeted riders) x $3,618 (Δ charge) = $250,231,734 / year

Fig. 1. *Cost analysis of motorcyclists involved in collision in the United States.*

Table 2 Injury Pattern and Inpatient Hospital Clinical Outcomes of Patients Involved in Motorcycle Collisions (n = 9033)

	Total (n)	Helmeted	Nonhelmeted	p Value
Face injury	1,851	19.6% (952)	39.2% (899)	0.001
Neck injury	74	1.0% (47)	1.2% (27)	0.418
Thorax injury	2,208	31.2% (1513)	30.3% (695)	0.442
Abdomen injury	1,196	17.2% (834)	15.8% (362)	0.134
Spine injury	1,325	18.7% (910)	18.1% (415)	0.494
Brain injury (all)	2,731	30.7% (1,490)	54.1% (1,241)	0.001
Brain injury (AIS >3)	1,436	14.1% (685)	32.7% (751)	0.001
Length of stay (days)	8,897	6.51 ± 0.12 (6,012)	7.11 ± 0.19 (2,885)	0.007
Hospital charges ($)	5,343	36,334 ± 1,232 (3,783)	39,390 ± 1,436 (1,560)	0.05
Mortality	469	4.3% (264)	7.0% (205)	0.001

Data derived from NTDB, Continuous data are presented as means ± SEM. Categorical data are presented as % (n).

motorcyclists sustained a substantially higher rate of facial injuries (39.2%) and brain injuries (54.1%) compared with helmeted riders, who had rates of facial injury and brain injury of 19.6% and 30.7% respectively ($p < 0.001$; Table 2). When the data were further substratified, 32.7% of nonhelmeted riders and 14.1% of helmeted riders sustained severe brain injury (AIS >3; $p < 0.001$). Hospital charges were significantly lower at $36,334 + 1,232 for helmeted riders (n = 3,783) compared with $39,390 + 1,436 for nonhelmeted riders (n = 1,560; $p < 0.05$; Table 2). Mathematical analysis estimated medical costs incurred as a result of unhelmeted motorcycle riding were $250,231,734 per year (Table 3).

DISCUSSION

In our present study, estimate of $250,231,734 was substantially greater than most other estimates in the literature. The main economic advantages of the helmeted rider are a result of the following: 1) fewer injuries requiring transport to emergency department; 2) fewer inpatient admissions from the emergency department; 3) decreased inpatient hospital cost; 4) lower rate of traumatic brain injury; and 5) lower rate of maxillofacial injury.

Our study suggests that nonhelmeted motorcyclists incur a greater rate of injury as well as higher acuity injury after being involved in a motorcycle collision. As such, more unhelmeted riders require transport to a hospital for emergency evaluation. Prior reports in the literature note that there is a significant differential hospital admission rate comparing helmeted (32.8%) and unhelmeted (39.9%) riders.[1] Delving deeper into our analysis, it is also apparent that motorcycle riders have substantial rates of injury to all body regions, likely secondary to the relatively unprotected mechanism of injury. Intuitively, an unprotected brain would be at more risk than the helmet protected brain. Our current study substantiates this finding in congruity with the findings of other authors in the literature that unhelmeted motorcyclists have nearly twice the rate of severe traumatic brain injury (AIS >3) as helmeted motorcyclists.[4–5,14–15,21–29] The difference between this study and that of previous authors is our concerted effort to look at prehospital events with the expectation that helmeted motorcyclists would be less likely to have injury requiring transport to the hospital and an even lesser likelihood of having injuries necessitating inpatient care. Prior publications by the Crash Outcome Data Evaluation System (CODES) Project sponsored by NHTSA substantiate our hypothesis.[30]

We suggest that our current analysis has significant advantages over previous studies in the literature in that it is based on two large databases, the NHTSA GES and the NTDB, whereas

Table 3 Cost Analysis Algorithm for 197,608 Motorcycle Crash Riders

Data Element	With Helmet	No Helmet	Data Source
Riders in crashes (%)	65	35	NHTSA GES
Riders in crashes (n)	128,445	69,163	Derived
Crash riders requiring hospital transport (%)	73.3	78.6	NHTSA GES
Crash riders requiring hospital transport (n)	94,150	54,362	Derived
Crash rider transports requiring admission (%)	32.8	39.9	Literature Prospective Study[1]
Crash rider transports requiring admission (n)	30,881	21,690	Derived
Hospital charges per admission	$32,598	$36,163	NTDB
Total hospital charges	$1,006,658,840	$784,375,470	Derived
Charge/crash rider	$7,837	$11,340	Derived

most prior studies analyzed data from a single state, locality, or medical institution. As such, the sample populations within this study maintain the diversity to be representative of the population as a whole. However, as with other database studies, our analysis has a number of potential limitations. The WISQARS database is a Centers for Disease Control and Prevention (CDC)-based secondary data set. Secondary data sets are at risk for selection bias and reporting bias among others. On the other hand, the data for the GES comes from a nationally representative sample of police-reported motor vehicle crashes. It was created to identify traffic safety problem areas, provide a basis for regulatory and consumer initiatives, and support cost-benefit analyses of traffic safety programs. The information is used to estimate how many motor vehicle crashes occur and the associated events. Sources suggest that about half of the motorcycle crashes in the country are not reported to the police, regardless of the presence or absence of injury. By restricting attention to police-reported crashes, there exists an inherent bias to under report injury utilizing this database. As with other authors, our analysis suffers from the necessity to utilize hospital charges as a surrogate for cost.[5,7,9] True cost data would be preferable, but because this is a comparative study, it is of lesser consequence. In fact, inpatient charges represent only 60% of actual charges with an additional 40% being charged by physicians, emergency rooms, and emergency medical service agencies. It is likely, in most of these analyses that hospital charges probably vastly underestimate the true cost of acute medical care when these other additional costs are taken into account. In fact, this underestimate inherently introduces bias against our findings by limiting the charge difference between helmeted and unhelmeted riders. Another potential source of bias is missing data points within the databases. Although there were a number of missing data points, with the very large size of each of these databases, we based our analysis on the assumption that missing data would be equally distributed within the helmeted and unhelmeted rider samples. We suggest that although there exist a number of limitations in our study which may be additive, the collective lack of sensitivity of the model still likely errs on the side of gross underestimation of the economic liability of unhelmeted motorcyclists.

Our study links the critical prehospital events with the acute inpatient care to derive the economic impact of motorcycle helmet use. Future studies are needed to combine rehabilitation costs and other postdischarge costs to this data. Because traumatic brain injuries are disproportionately inflicted upon unhelmeted motorcycle riders, it is probable that this expansion of the analysis will further potentiate the cost disparity between helmeted and unhelmeted riders involved in motorcycle collisions. In addition, our study did not evaluate long-term medical costs, and probably only represents the "tip of the iceberg" when long term care and rehabilitation costs are taken into account. Further study is necessary to analyze the rehabilitation costs of motorcycle related injury to derive a more complete picture of the economics of motorcycle crash related injury.

In the last three years of this analysis (2000 to 2002), there was an average of 197,608 nonfatal motorcycle crashes per year in the United States, 35% of who were estimated to have been unhelmeted. Given the cost differential noted in the present study, the estimated additional medical costs incurred as a result of unhelmeted motorcycle riding is $250,231,734/year. Nearly half of motorcycle crash victims do not have private health insurance coverage.[13] Most uninsured patients are unable to pay their bill. Practically, this indicates that the government must compensate for nearly half the medical costs of injured motorcyclists through state and local taxes, Medicaid, or other government programs funded by taxpayers. Our economic analysis in our study highlights the need for ongoing legislative efforts to once again mandate motorcycle helmet use.

REFERENCES

1. Kelly P, Sanson T, Strange G, Orsay. A prospective study of the impact of helmet usage on motorcycle trauma. *Ann Emerg Med.* 1991;20:852–856.
2. McSwain, Norman E Jr., Belles Anita. Motorcycle helmets—medical costs and the law. *J Trauma.* 1990;30:1189–1199.
3. Offner Patrick J, Rivara Frederick P, Maier Ronald V. The impact of motorcycle helmet use. *J Trauma.* 1992;32:636–642.
4. McSwain Norman E Jr., Petrucelli Elaine. Medical consequences of motorcycle helmet nonusage. *J Trauma.* 1984;24:233–236.
5. Kraus JF, Peek C, McArthur DL, Williams A. The effect of the 1992 California motorcycle helmet use law on motorcycle crash fatalities and injuries. *JAMA.* 1994;272:1506–1511.
6. Max W, Stark B, Root S. Putting a lid on injury costs: the economic impact of the California Motorcycle Helmet Law. *J Trauma.* 1998; 45:550–556.
7. Rowland J, Rivara F, Salzberg P, Soderberg R, Maier R, Koepsell T. Motorcycle helmet use and injury outcome and hospitalization costs from crashes in Washington state. *Am J Pub Health.* 1996;86:41–45.
8. Johnson S, Walker J, Utter D. Research Note, Revised. Crash Outcome Data Evaluation System (CODES) project safety belt and helmet analyses. Washington DC: National Highway Traffic Safety; February 1996.
9. Muelleman RL, Mlinek EJ, Collicott PE. Motorcycle crash injuries and costs: effect of a reenacted comprehensive helmet use law. *Ann Emer Med.* 1992;21:266–272.
10. Branas CC, Knudson MM. Helmet laws and motorcycle rider death rates. *Acc Anal Prev.* 2001;33:641–648.
11. Without motorcycle helmets we all pay the price. Washington DC: National Highway Traffic Safety Administration; 2000.
12. Missouri Department of Health and Senior Services Center for Health Information Management and Evaluation. Focus. . . motorcycle helmets reduce head injuries and hospitalizations. *Missouri Monthly Vital Statistics;* June 2002:36–40.
13. Lawrence BA, Max W, Miller TR. Costs of Injuries Resulting from Motorcycle Crashes: A Literature Review. DOT HS 809 242. Washington DC: National Highway Traffic Safety Administration, 2002.
14. Hotz GA, Cohn SM, Popkin C. The impact of a repealed motorcycle helmet law in Miami-Dade County. *J Trauma.* 2002;52:469–474.
15. Sosin DM, Sacks JJ. Motorcycle helmet-use laws and head injury prevention. *JAMA.* 1992;267:1649–1651.
16. Braddock M, Schwartz R, Lapidus G, Banco L, Jacobs L. A population-based study of motorcycle injury and costs. *Ann Emer Med.* 1992;21:273–278.

17. Muller A. Evaluation of the Costs and Benefits of Motorcycle Helmet Laws. *Am J Pub Health.* 1980;70:586–592.

18. Lacey JK. Motorcycle Helmet Crash Cost in North Carolina. University of North Carolina Highway Safety Research Center, 2001.

19. Center for Health System Research and Analysis. Motorcycle Crashes, Wisconsin, 1994–1998. Wisconsin CODES; 2001.

20. Schneider H. An Analysis of Motorcycle Crashes, 1996 to 2002. Louisiana State University; May 2003.

21. Centers for Disease Control, National Center for Injury Prevention and Control, Web-based Injury Statistics Query and Reporting System (WISQARSTM). Available at http://webappa.cdc.gov/sasweb/ncipc/nfirates2001.html. Accessed March 16, 2006.

22. McSwain NE Jr., Lummis M. Impact of Repeal of Motorcycle Helmet Law. *Surg Gyn Obst.* 1980;151:215–224.

23. Fleming NS, Becker ER. The Impact of the Texas 1989 Motorcycle Helmet Law on Total and Head-Related Fatalities, Severe Injuries, and Overall Injuries. *Med Care.* 1992;30:832–845.

24. Sosin DM, Sacks JJ, Holmgreen P. Head Injury—Associated Deaths From Motorcycle Crashes. *JAMA.* 1990;264:2395–2399.

25. Bledsoe GH, Schexnayder SM, Carey MJ, et al. The Negative Impact of the Repeal of the Arkansas Motorcycle Helmet Law. *J Trauma.* 2002;53:1078–1087.

26. Peek-Asa C, Kraus JF. Estimates of Injury Impairment After Acute Traumatic Injury in Motorcycle Crashes Before and After Passage of a Mandatory Helmet Use Law. *Ann Emer Med.* 997;29:630–636.

27. Richter M, Otte D, Lehmann U, et al. Head Injury Mechanisms in Helmet-Protected Motorcyclists: Prospective Multicenter Study. *J Trauma.* 2001;51:949–958.

28. Muller A. Florida's Motorcycle Helmet Law Repeal and Fatality Rates. *Am J Public Health.* 2004;94:556–558.

29. Rivara FP, Dicker BG, Bergman AB, Dacey R, Herman C. Motorcycle Trauma. *JAMA.* 1988;260:221–223.

30. Further Analysis of Motorcycle Helmet Effectiveness Using CODES Linked Data. Washington DC: National Highway Traffic Safety Administration; January 1998.

DISCUSSION

Dr. Norman E. McSwain Jr. (New Orleans, Louisiana): The authors have taken another look at the cost of riding motorcycles without protection of helmets by looking at those non-transported riders from the scene.

To the opening statement in the abstract, the economic impact of helmet use remains controversial, I would disagree. For the medical and scientific community, the multiple studies that have been done demonstrate an increase in cost associated with head injury and is fairly well accepted.

The motorcycle organizations, which have been mentioned, particularly the American Motorcycle Association and ABATE have the attitude of, "Don't confuse me with facts, my mind is made up" or, "My personal freedom to be involved in a crash and receive major enemies, injuries—enemies, too—and make society pay for it is none of society's business."

It is expected that the politicians will bend to whoever applies the most pressure without regard to fact. There is no confusion. It just seems that some people choose to ignore the facts.

The multiple political fights that I've been involved in, in the last 30 years, regarding mandatory motorcycle helmet legislation, have demonstrated to me that legislatures have no regard for life and injury. All they care about is money. Therefore, another article continuing to prove these costs is timely and important.

The authors have taken a look at this problem by addressing the differential costs when such individuals have been protected by helmets and are not transported to the hospital and, therefore, decrease the cost per crash when factoring in to these equations.

One is always pleased when a patient is presented and supports ones own biases; however, I'm concerned with this study that it has two separate data bases which do not use compatible information, and there is multiplying apples and oranges together that result in neither apples nor oranges nor grapefruits.

Did you make an effort to use the PARS Data, and that's one of the data bases that you did use, the PARS data, in only those areas that submit their data to the National Trauma Data Bank?

In addition to measuring these different populations, I believe that the PARS data bank has a potential of being flawed.

Only 22 states, I think, currently have motorcycle helmet laws regarding adults. The known lack of use, when this has been proven by multiple studies in states without laws and without such legislation, I find it difficult to believe that almost two-thirds of the victims in these crashes were helmeted.

The forms filled out by law enforcement officers after the fact have a seasonal difference in motorcycle helmet use.

I would ask the authors to comment on their use of PARS data to determine accurate helmet use. To assist in this comparison, what was the average population in those states without helmet legislation during your study period compared to those states with laws?

However, the major deficit I find in this paper is that the authors did not take into consideration rehabilitation costs, which they have mentioned.

In our paper, which we presented to this association more than 15 years ago, we found that the average disability was 26 days with helmets worn and 51 days when they were not worn.

I believe if the authors had gone the extra step to gather these rehabilitation costs, they would have found a much greater difference. We found based on 1989 dollars that the cost to society, including rehabilitation and lost wages. was $4.9 billion.

This patient only looks at a quarter million dollars or a quarter billion dollars. I would ask the authors to comment on this difference, which I think is rehab and lost wages cost. Why did they not make an attempt to gather such a data?

I would also point out that our studies, which involved about 25,000 bike crashes, indicated that when helmets were worn mandatorily, there was a decreased crash rate which I thought was extremely interesting, regardless of what the bikers say.

Dr. John R. Clarke (Philadelphia, Pennsylvania): To echo Dr. McSwain, there is a large amount of literature which

suggests that the societal costs are high but that they're not persuasive.

We rescinded the helmet law in Pennsylvania last year, and the trauma surgeons in the state had a bet as to how long each one would take to see a patient, who was a preventable death due to that, and for me it was six weeks.

A fellow went through the windshield and had a brain injury from which he couldn't recover. I had to talk to his wife and explain what happened. I stayed away from the preventability aspect of it, but clearly, she was crushed by the transactions of the day.

It did make me think that perhaps from a public relations point of view, we were barking up the wrong tree, since it's pretty clear that societal cost is not persuasive, and that we should perhaps, from a public relations point of view, be orienting ourselves more to family responsibility versus personal freedoms, something along the lines of, "If you care about freedom let the wind blow through your hair, but if you care about your family wear a helmet."

I was wondering what your perspective was on the public relations strategy, given that the societal costs clearly have not been a persuasive strategy.

Dr. Michael Rhodes (Newark, Delaware): The question I have is some have suggested that if you don't wear the helmet, it may actually cost less, because you're going to die early.

Do you have any of your data that suggests the mortality data between the two groups, and is there even an inkling of truth to the fact that if you don't wear a helmet you're going to get knocked off quicker, and it could be cheaper for society?

Dr. Brian Eastridge (Dallas, Texas): First of all, Dr. McSwain, indeed, there is no controversy in our minds and that controversy is societal basically with respect to those of us in society that ride motorcycles.

I would agree that legislators tend to concentrate on cost and tend to minimize the effect of the personal or public relations aspect of this clearly prominent entity.

Again, we looked at our NHTSA data, and we were aware that the PARS data or the GES data does have some flaws, but at the time it was the most substantial data base for which we could gather that data, whether or not those patients were admitted to the hospital.

Again, there is a bias, probably introduced based on a geographical representation in that population. With respect to your question about the population with laws versus no laws, we did not gather that data.

Again, likely, we are looking at the tip of the iceberg with respect to pre and inpatient costs, whereas, the true base of the iceberg is the long-term disability and the cost to society on a long-term basis. I would agree with that.

We mentioned that as a limitation of our study, but that will be a course of future study to do basically a composite work looking at pre-, inpatient and posthospital data.

Dr. Clarke, I agree with your point that public relations should be a large part of this, perhaps not even from a family perspective, but also from a legislative perspective to try to drive home the point that there is more out there when the legislatures are making these decisions than just the bottom dollar.

Dr. Rhodes, interestingly, we did have that data. We did not put it up in our presentation. The length of stay between helmeted and nonhelmeted motorcyclists was not statistically different for inpatient stay. It was seven versus nine days.

The mortality between the groups was again, was statistically significant. Though there were small numbers of patients, there was an 8% mortality in the nonhelmeted group and a 4% mortality in the helmeted group.