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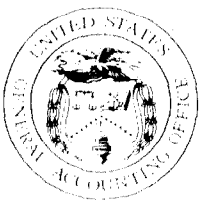
Report to the Subcommittee on Water Resources, Transportation and Infrastructure, Committee on Environment and Public Works, U.S. Senate

May 1991

HIGHWAY SAFETY

Interim Report on Safety Belt and Motorcycle Helmet Effectiveness



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Resources, Community, and
Economic Development Division

B-243679

May 10, 1991

The Honorable Daniel P. Moynihan, Chairman
The Honorable John H. Chafee, Ranking Minority Member
Subcommittee on Water Resources, Transportation and Infrastructure
Committee on Environment and Public Works
United States Senate

On April 20, 1990, you requested that we evaluate existing studies on the effectiveness of motorcycle helmets and automobile safety belts and synthesize their findings. As agreed, our work focused on answering three questions:

- What is the effectiveness of motorcycle helmets and auto safety belts in preventing fatalities and serious injuries?
- What is the impact of helmet/safety belt laws on fatality rates?
- What is the societal cost of nonuse?

This letter responds to Senator Chafee's April 9, 1991, request that we provide an interim report on the findings from our ongoing assignments on the effectiveness of motorcycle helmet and auto safety belt laws. It discusses the findings from our motorcycle helmet analysis and the findings from our safety belt analysis, which is still underway. In performing our analysis, we used the evaluation synthesis methodology, which is described in appendix I.

Results in Brief

We evaluated 49 studies relative to motorcycle helmet laws. These studies consistently demonstrated safety and economic benefits from universal helmet usage laws (i.e., laws that apply to all riders).

The studies comparing helmeted and nonhelmeted riders indicated that helmet use prevents deaths and reduces the severity of injury among surviving accident victims. The studies showed that helmeted riders experienced fatality rates that were 28 to 73 percent lower than for nonhelmeted riders. For helmeted riders, the incidence of head injuries rated "severe" or worse was 46 to 85 percent lower than for nonhelmeted riders.

Studies reported that helmet use ranges from 92 to 100 percent under universal laws compared with a range of 42 to 59 percent in states without a law or with limited laws applying only to the youngest riders.

Studies also showed that when universal laws were in effect, states experienced lower fatality rates than during periods before enactment or after repeal—generally 20 to 40 percent lower.

The available studies on societal costs indicated that helmet nonuse increased the cost of caring for injured riders. They also indicated that society incurs substantial indirect costs because nonhelmeted riders are more likely to lose earning capacity through disability or death.

Of the 85 auto safety belt studies we reviewed, 34 related to safety belt equipment effectiveness. Like the motorcycle helmet studies noted above, they were relatively consistent in their findings, with most estimating that belted occupants tended to survive crashes 50 to 75 percent more frequently than unbelted occupants. Most of the estimates of the reduction in serious injury were in the 44- to 66- percent range; that is, belted occupants on average were seriously injured 44 to 66 percent less frequently than were unbelted occupants. Finally, hospital admission rates were substantially lower for belted as opposed to unbelted occupants. We are currently analyzing the studies dealing with the effectiveness of mandatory belt use laws and the societal costs associated with the nonuse of belts. Our final report will discuss these issues.

Background

The Department of Transportation (DOT) formerly required states to have universal helmet laws (applying to all motorcycle riders) as a condition of receiving their full allotment of federal-aid highway funds. By 1975, 47 states had enacted such laws. However, the requirement was rescinded by congressional action in 1976, and subsequently, many states repealed their laws or limited them to riders under age 18. Currently, 23 states plus the District of Columbia have universal helmet laws (i.e., laws that apply to all riders), 24 have limited laws, and 3 have no laws.

DOT has encouraged but not required auto safety belt use laws. Thirty-eight states plus the District of Columbia now have safety belt use laws. But the laws' provisions, the observed use rates, and the nonuse penalties vary widely between states. Six states have primary enforcement provisions, whereby a traffic citation can be issued solely for a nonuse offense. The other 32 states and the District of Columbia have secondary enforcement provisions, whereby there must be another primary reason for stopping the vehicle.

Helmets Are Effective in Preventing Deaths and Reducing Injury Severity

We conducted a broad search for published and unpublished studies on motorcycle helmets and identified over 900 citations (i.e., abstracts, bibliographies, etc.), many of which were duplicate presentations. As explained in appendix I, we narrowed the material to 49 studies for consideration by a review panel, who then eliminated 3 studies that did not meet minimum criteria for methodological soundness.

Eleven studies compared fatality rates among helmeted and nonhelmeted riders. The studies varied according to their definitions of the rider population studied, but all reported lower fatality rates for helmeted riders, ranging from 28 to 73 percent lower, with the majority in the middle ranging from 36 to 68 percent. In addition, 11 studies compared injury severity, and they indicated that helmet use reduced the incidence of critical and serious injuries among surviving riders. This was attributable to the rate of severe or worse head injuries, which was reported as 46 to 85 percent lower among helmeted riders.

One author contended that although helmet use reduces the severity of head injuries, it increases the likelihood of severe neck injuries. However, this author's conclusion was based on only four cases of severe neck injuries among helmeted riders, and our expert panel considered the analysis unacceptable. We found no other evidence to support this author's position. The five other studies with data on severe neck injuries indicated that they were much less common in motorcycle accidents than severe head injuries and that they were more often found among nonhelmeted riders.

Some have asserted that helmet use makes riders more accident-prone by interfering with riders' hearing and field of vision, or by encouraging riders to take more risks. Four studies provided evidence that hearing or vision restrictions did not contribute to accidents. Also, the evidence we reviewed indicated that helmeted riders had fewer accidents than nonhelmeted riders. However, helmeted riders may have had fewer accidents because, as six studies reported, helmeted riders were less likely to exhibit risky behavior such as riding under the influence of alcohol.

Universal Helmet Laws Increase Helmet Use and Reduce Fatality Rates

Nine studies had data on helmet use from roadside observations and/or accident reports. They reported that helmet use under universal laws ranged from 92 to 100 percent. States with limited laws did not achieve noticeably different use levels from states where no laws were in effect, with most reported figures ranging from 42 to 59 percent.

Twenty studies compared fatality rates under universal helmet laws with fatality rates during periods before enactment or after repeal. Despite variations in the scope, length of study period, and analytical approach, the studies were remarkably consistent in finding that lower fatality rates occurred when universal helmet laws were in effect. Several of these studies contained enough historical data to compare periods before a helmet law was enacted, while it was in effect, and after it was repealed. They showed that decreases in fatality rates when laws were enacted were matched by comparable increases when they were repealed. This increased our confidence that the helmet laws were directly related to the lower fatality rates.

Most of the results reported in these studies fell in a 20- to 40-percent-lower range for fatality rates under universal helmet laws. If applied to the 29 states not having universal laws in 1989 (and assuming that motorcyclists in those states were similar to their counterparts in the states with universal laws), a 20- to 40-percent decrease would have meant about 400 to 800 fewer deaths.

Helmet Nonuse Increases the Cost of Caring for Injured Riders

The available studies on the societal cost of helmet nonuse indicated that nonhelmeted riders were more likely to

- need ambulance service,
- be admitted to a hospital as an inpatient,
- have higher hospital charges,
- need neurosurgery and intensive care,
- need rehabilitation, and
- be permanently impaired and need long-term care.

The magnitude of costs to care for injured riders was unclear because very little information was available for motorcyclists on costs such as surgeons' fees, rehospitalization and rehabilitation, and extended care. There is evidence from other studies, however, that these costs are very large for serious and critical head injuries. A study of surviving trauma victims (not only motorcyclists) at two Maryland hospitals found average first-year costs of about $92,000 for serious head injuries and $171,000 for critical head injuries.[1] Many of these patients were still convalescing 1 year after their accidents. A recent study that used data from the National Highway Traffic Safety Administration's (NHTSA) National Accident Sampling System and workman's compensation

[1] All cost figures cited in this report have been updated to 1990 dollars.

claims estimated long-term medical costs of motor vehicle accident victims at about $84,000 for those with serious head injuries and $291,000 for those who survived critical head injuries.

Although the available studies did not report directly on the cost of income replacement benefits, they did indicate that society incurs substantial indirect costs because nonhelmeted riders are more likely to lose earning capacity through disability or death.

Automobile Safety Belts Are Effective in Preventing Deaths and Reducing Serious Injury

Our search for studies on the safety belt issue identified over 2,500 citations. Using criteria similar to those for motorcycle helmets, we narrowed that figure down to 85 studies for the review panel's consideration. To date, the review panel has completed its review of studies related to the effectiveness of safety belts, but has not yet analyzed all studies dealing with the effectiveness of mandatory safety belt use laws and those addressing the societal costs related to the nonuse of safety belts. Our final report will discuss these issues.

As with the studies on motorcyle helmets, few of the studies were so strong as to permit an unequivocal statement as to the effectiveness of safety belts. However, every one of the 11 studies on fatality reduction accepted by the review panel concluded that safety belts were very effective. The percentage reduction for belted vehicle occupants ranged from 41 to 94, but most of the estimates clustered in the range of 50 to 75 percent. The consistency and relatively narrow range of estimates provides strong evidence of safety belt effectiveness.

We found similar results regarding the question of safety belt effectiveness in reducing injuries. All eight studies accepted by the review panel reported a reduction in injuries among belted vehicle occupants ranging from 17 to 88 percent, with most of the estimates clustered in the range of 44 to 66 percent.

Finally, we found four studies that examined the effect of safety belts on hospital admissions. Each of the four studies examined the relative hospitalization rate of belted and unbelted vehicle occupants. Hospital admission rates for belted occupants were 56 to 74 percent lower than for unbelted occupants.

We performed our work from May 1990 through April 1991 in accordance with generally accepted government auditing standards. We discussed the report with NHTSA officials, who said they found our results to be consistent with their work. As requested by your office, we did not obtain official agency comments on a draft of this report.

We anticipate issuing our final reports on motorcycle helmets and seat belts later this year. They will contain greater detail on our analysis of the individual research studies and our overall conclusions.

As agreed with your office, this report is being issued on an unrestricted basis. We are sending copies to the appropriate congressional committees, the Secretary of Transportation, the Administrator of NHTSA, and other interested parties. We will also make copies available to others upon request. If you have any questions about this report, please contact me on (202) 275-1000. Major contributors to this report are listed in appendix II.

K. M. Mead

Kenneth M. Mead
Director, Transportation Issues

Description of Evaluation Synthesis Methodology

We applied the evaluation synthesis methodology that we have used in previous reviews of highway safety and other issues. The evaluation synthesis methodology is distinguished from a general literature search by (1) the rigor of the search for candidate studies (both published and unpublished) and (2) a qualitative review of the studies by a panel of experts in evaluation research methodology to ensure that the synthesis results are based only on the most substantiated research.

Our objective was to critically examine the existing body of relevant literature and determine what conclusions could be reasonably drawn from the collective evidence. Individual studies may have limitations of scope, missing data, large margins of error, or other uncertainties. However, as we pointed out in a 1983 paper on evaluation synthesis, "A series of independently conducted case studies consistent in their findings may yield a stronger vote of confidence than would any study taken individually."[1] Thus, to the extent that studies of varying scope and analytical technique reach consistently similar conclusions, their collective value for answering a question is enhanced.

We identified relevant documents by (1) conducting searches of computerized bibliographic files, (2) contacting state highway safety officials, (3) interviewing experts in the field, and (4) performing a follow-up of references noted in studies we obtained. We identified over 900 motorcycle helmet and over 2,500 safety belt citations. We narrowed this literature to a more manageable size by eliminating those that

- were duplicates or multiple papers based on the same data,
- did not contain original data or analyses,
- were published before 1975 (for helmets) or 1980 (for safety belts), or
- were based on foreign experience.

Two review panels, each composed of three evaluation research methodologists, then evaluated each of the remaining studies (49 for helmets and 85 for safety belts). To critically assess the methodological quality of the evaluations, each of the three panelists rated each study independently. The panels then met to discuss the strengths and weaknesses of each study to reconcile differences in individual ratings. Those studies that were methodologically the most acceptable were then synthesized by study question.

[1] The Evaluation Synthesis. GAO/Institute for Program Evaluation, Apr. 1983, p. 34.

Major Contributors to This Report

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