Seat belts

Bias in estimates of seat belt effectiveness

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An objective measure of seat belt use is needed to enable us to assess their effectiveness

A lack of consensus on the effectiveness of seat belts, when used, is remarkable given that belts have been standard equipment in passenger cars for more than 30 years in the highly industrialized countries. In the 1970s, examination of 19 studies of seat belt effectiveness, when used, found estimates varying from 7.5% to 85.6%. The correlation of the estimates with reported use suggested that the higher estimates were in error because of claimed use by non-users in crashes.¹ Comparisons of police reported belt use by the fatally injured and survivors in front seats of the same vehicle before 1985 in the United States indicated belt effectiveness of about 40%–45%.² Studies using this method were thought to be more valid because within-vehicle crash forces were more similar than comparisons of occupants of vehicles among a variety of types of crashes.

When belt use laws were enacted in a number of states in the United States in the mid to late 1980s, belt use increased substantially and car model year specific death rates declined commensurate with a belt effectiveness of 45%, when used. That estimate controlled for changes in vehicle crashworthiness, alcohol involvement, economic conditions, vehicle size, and vehicle age.³ While it did not account for belt use in the vehicles in which people died, it had the advantage that the observations of belt use by model year of vehicle in the population were independent of knowledge of the crashes.

In contrast to the 40%–45% effectiveness estimate in data before 1986, 60%–65% effectiveness in older as well as newer model cars was found in 1986 and subsequent years using the within-vehicle comparison method. An analyst in the National Highway Traffic Safety Administration did a thorough study of subgroups of drivers and passengers to identify potential biases and concluded that the jump in belt effectiveness estimates was biased by self reported belt use by survivors probably because of the laws requiring use. He indicated that

the 45% estimate of belt effectiveness in passenger cars is more realistic given the potential biases in reported belt use in crashes and that changes in death rates over time in relation to observed belt use in the driving population are incompatible with 60%–65% effectiveness. A telling commentary on police reports in that study is the finding that 65% of dead drivers in multiple vehicle collisions were judged culpable by police while only 32% of the surviving drivers in the same crashes were considered culpable.⁴

In this issue of the journal, Cummings references these studies as expressing concern about self reports of belt use, ignoring the detailed analyses they contain (see p 338). He compares belt effectiveness using police reports and investigations by multidisciplinary teams for the National Accident Sampling System (NASS), the latter supposed better investigators than police. He concludes that police reports are valid indicators of belt use because the seat belt effectiveness using either police reports or NASS investigations are similar. Since his analysis produces implausible belt effectiveness coefficients based on data from each of the two groups, I think he merely demonstrates that NASS investigators are just as biased as the police. I do not mean that they are intentionally biased but knowing the outcome could shade anyone's judgment.

In a paper to be published elsewhere, kindly provided to me by Cummings, he and his colleagues attribute the large increase in belt effectiveness estimates using within-vehicle comparisons primarily to a phenomenon called non-differential misclassification, which means that random error in seat belt use classifications will result in an understatement of effectiveness in within-vehicle comparisons when use is low. They claim the theory is supported based on trends in police reported use in such crashes and a simulation of its effect on effectiveness estimates.⁵ What is not explained adequately by the theory is the sudden gap in police reported use by the dead and survivors that appeared in the mid-1980s.

An alternative theory is that the political push for belt use laws during the mid 1980s sensitized police and NASS investigators to the importance of belts. Some may have taken the illogical step of assuming that if the person died, the belts were not in use. I have read court testimony by police officers that made such an assumption. In one of the recent studies claiming high belt effectiveness, missing data on velocity changes in crashes were imputed partly from injury severity scores,⁶ again a cause imputed from an effect and then used as a control in the study, a true scientific "no-no". I suspect that, in the past, I and others placed too much emphasis on the problem of self reports by crash survivors and not enough emphasis on the potential bias of investigators judging the cause based on the outcome. Of course, that is why we require double blind studies in assessing the effects and safety of drugs rather than rely on the judgments of physicians and patients who know which drug was taken and the outcome. Would that all injury prevention researchers were as careful. This field is littered with the tattered reputations of well intentioned people who made overly zealous claims of effectiveness of countermeasures.

What is needed is an objective measure of belt use and other conditions, such as speed and crash forces, in crashes. Such a measure may be forthcoming with the installation of "black boxes" in vehicles that provide a measure of such conditions. If the manufacturers install them in sufficient numbers and make the codes available for qualified independent researchers to read the data, we will at last be able to know the effectiveness of seat belts. If so, I expect that it will be nearer 40%–45% than 60%–65%.

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