

Motorcycle Antilock Braking Systems and Crash Risk Estimated from Case-Control Comparisons

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IIHS Study and Conclusion

- IIHS compared fatalities per registered vehicle-year for motorcycles equipped with ABS (identified by decoding the VIN) and motorcycles without ABS
- The study identified different levels of fatal-crash involvement between the two study populations
- It found 6.4 fatal crashes per 10,000 registered vehicle-years for the non-ABS group compared to 4.1 for the ABS group -- a claimed improvement of 37 percent
- These conclusions were published by IIHS in 2010

IHS Study Confounding Factors

- Several possible confounding factors were not addressed
- Unknown is whether riders who select ABS travel more or fewer miles per year
- Whether the availability of ABS affects how riders use their motorcycle
- No data available to address these questions directly, which leaves unresolved the possibility of selection bias

NHTSA Approach

- The NHTSA study is based on case-control comparisons, which we think are better suited to analyzing crash-avoidance (vs. crash worthiness) issues
- Case crashes are those that might be prevented (or otherwise affected) by a specific countermeasure
- Control crashes are those that are unlikely to be affected by that countermeasure

NHTSA Approach

- Control crashes are used as a measure of crash exposure
- The ratio of case to control crashes is interpreted as a measure of crash risk
- The number control crashes is interpreted as a measure of exposure to crash involvement
- NHTSA used fatal and other police-reported crash data

NHTSA Study

- For fatal crashes we used 2001-2008 Fatality Analysis Reporting System data (FARS)
- For comparisons of all police-reported crashes we used 2001-2010 crash data from the State Data System (SDS)
- We used the motorcycle models and years identified in the IIHS report as having ABS as an option

NHTSA Study

- The vehicles identified include:
 - 2008 Harley-Davidson V-Rod,
 - 2001-2008 Honda Gold Wing 1800,
 - 2002-2008 Honda Interceptor 800,
 - 2001-2007 Honda Reflex,
 - 2003-2008 Honda ST1300,
 - 2003-2008 Honda Silver Wing,
 - 2008-2009 Kawasaki Concours 14,
 - 2007-2008 Suzuki Bandit 1250,
 - 2006-2008 Suzuki Burgman 650,
 - 2007-2008 Suzuki SV650,
 - 2007-2008 Suzuki V-Strom 650,
 - 2006-2008 Triumph Sprint ST, and
 - 2004-2005 Yamaha FJR1300

NHTSA Study – Crash Classification

- NHTSA classified crashes as either case or control using two alternative definitions of a non culpable vehicle
 - Under what NHTSA calls the “strict” definition, the control group includes stationary motorcycles and those moving very slowly with police-reported travel speed < 16 kph
 - Or were reported as stopped, parked, entering or leaving a parked position, starting in traffic, backing, being pushed by a person, or riderless
- The strict definition of “crashes of interest” includes all other crash-involved motorcycles

NHTSA Study – Crash Classification

- Under what NHTSA calls the "relaxed" definition of the control group, an assessment of driver fault was considered
- Fault was defined from any driver contributing circumstances such as possible moving violations, other police identified improper actions, failures to act, or being under the influence of intoxicants
- All other drivers were considered to not be at fault for this application

NHTSA Study – Crash Classification

- The “relaxed” definition of the control group includes motorcycle crashes covered by the “strict” definition plus multi-vehicle crashes in which the motorcyclist was not at fault but another driver in the crash was at fault
- The "relaxed definition of crashes of interest" includes all other crash-involved motorcycles

NHTSA Analysis

- Under the null hypothesis that ABS does not affect crash risk, we would expect a similar ratio of case to control crashes for both groups
- Under the hypothesis that ABS prevents crashes, we would expect a lower ratio of case to control crashes for the ABS group than for the non-ABS group

NHTSA Analysis

- The 2001-2008 FARS data include 356 motorcycles with optional ABS that was identifiable from the VIN
- There were 302 non-ABS and 54 ABS motorcycles in fatal crashes available for this study
- A simple comparison using the relaxed definition of the control group shows that the ratio of crashes of interest to control-group crashes was:
 - $44 / 10 = 4.40$ with ABS
 - $243 / 59 = 4.12$ without ABS

NHTSA Analysis

- The calculated ratio of case to control crashes for ABS motorcycles was slightly higher than the rate for non-ABS motorcycles
 - However, this result was found not statistically significant
- NHTSA also explored police-reported pre-crash braking as a function of ABS availability, but ran into difficulty due to factors such as the possibility of ABS eliminating skid marks

NHTSA Analysis

- We also considered the broader perspective, which includes motorcycles in all types of police-reported crashes
- Using the relaxed definition of the control group, the ratio of crashes of interest to control-group crashes was:
 - $1,629 / 626 = 2.60$ without ABS
 - $280 / 118 = 2.37$ with ABS
- Again this result was found not statistically significant

NHTSA Analysis

- We also used the State data for comparisons that may suggest differences in vehicle use
- We found that posted speed limit, vehicle age, rider age, light condition, and helmet use were similar
- There were differences in the mix of male and female riders in crashes as a function of ABS availability. Male riders were 94.60 percent of those on non-ABS motorcycles and 97.04 percent of those on ABS motorcycles

NHTSA Analysis

- Because of the potential bias associated with the mix of riders, we re-calculated the ratio of crashes of interest to control-group crashes separately for male and female riders
 - The results were found not statistically significant
- NHTSA also considered difference in road conditions as a function of ABS availability and the possibility of a variety of other biases
 - All the results were found not statistically significant

Conclusions

- Using a case-control comparison methodology for motorcycles with and without ABS, and using two sets of data (fatal crashes and, separately, all police-reported crashes), we did not find statistically-significant results to suggest that ABS affects motorcycle crash risk
- Conclusions from these comparisons would depend on three assumptions
 - That crashes involving non-culpable motorcycles are an adequate control group
 - That the ABS itself was the only difference, notwithstanding possible biases associated with the owner's decision to purchase optional ABS affecting how the vehicle is used
 - that the experience on the motorcycles that were available with optional ABS was typical of the experience expected on a wider range of models
- Finally, the null results should be treated with caution because of the small numbers of control-group motorcycle crashes available for many of the comparisons