

Effects of ADAS on Impact Velocity and Injury Severity



An estimated 42,915 people were killed in the U.S. in 2021, the highest number since 2005 and an 18 percent increase from 2019, the last benchmark for pre-pandemic travel. Using National Highway Transportation Safety Administration's (NHTSA) Crash Investigation Sampling System (CISS) database, we found improved safety outcomes associated with the presence of three advanced driver assistance systems (ADAS) features - lane departure warning (LDW), forward collision warning (FCW), and blind spot detection (BSD). In particular, vehicles with ADAS features were less likely to be involved in fatal and severe crashes than vehicles of a similar age and body style.

KEY FINDING #1: ADAS Equipment Appears to Have a Slightly Protective Effect, with Caveats

Vehicles with ADAS equipment appear to be associated with a lower likelihood of being involved in a fatal crash compared to non-ADAS vehicles of a similar age. Additionally, occupants of ADAS-equipped vehicles may experience slightly lower rates of death and serious injury compared to occupants of similarly-aged vehicles without ADAS. However, it is difficult or impossible to disentangle the injury severity-related outcomes we observed from the effects of vehicle body style and size in the current sample. Thus, despite the promise of these results, more research in this area is critically needed. Changes to the CISS process can help provide key data for further studying this urgent question.

KEY FINDING #2: ADAS Equipment Appears to Mitigate Speed Differential

The differential between pre- and post-impact speeds (Delta V or ΔV) appears to be slightly lower for ADAS-equipped vehicles than for vehicles without ADAS. While there is no discernible difference in crash severity outcomes for vehicle occupants between ADAS vehicles and similarly-aged non-ADAS vehicles, ADAS vehicles appear to have a lower ΔV at the time of the crash, suggesting that ADAS features (e.g., automatic emergency braking) may directly or indirectly reduce speeds in advance of a crash. Indeed, research shows that a higher ΔV predicts both number of injuries and probability of suffering a serious (i.e., MAIS3+) injury.

KEY FINDING #3: ADAS Equipment Appears to Be Correlated with Crash Type

Crashes involving an ADAS vehicle appear to be less likely to be head-on collisions or rear-end crashes than crashes involving a similarly-aged vehicle without ADAS. In contrast, vehicles with ADAS appear to be more likely to be involved in angle crashes than similarly-aged vehicles without ADAS. Within these crash types, ADAS-involved angle crashes appear to have lower chances of resulting in death or serious injury than angle crashes with non-ADAS vehicles.

Recommended Improvements to the CISS Database



Our analysis of the National Highway Transportation Safety Administration's (NHTSA) Crash Investigation Sampling System (CISS) database found indications of improved safety outcomes associated with the presence of certain ADAS features. Our analysis also uncovered multiple limitations associated with the CISS data regarding the ability to dig deeper into the effects of ADAS features on the safety of vehicle occupants and non-occupants (e.g., pedestrians and bicyclists) involved in these crashes. The CISS database is relatively new and provides an excellent opportunity for detailed and nuanced investigations into the complex factors in transportation safety. The current limitations, however, prevent this investigation process from fulfilling its full potential in aiding safety professionals. The issues discussed below can provide useful directions for NHTSA and those conducting CISS investigations to continue to improve this valuable data source.

Key Insight #1: More Robust Data are Urgently Needed to Better Detect the Effect of ADAS on Vehicle Safety Outcomes in the General Population

A much larger sample size is needed to examine safety outcomes associated with ADAS features and control for confounding. The correlations between injury severity and both car age and body type, in particular, necessitate within-category and more advanced multivariate analyses of ADAS features and other vehicle characteristics that demand a larger sample. A larger sample would also provide a buffer for mis-coded records resulting from inconsistent coding between separate but related variables. There is also a need for more holistic, consistent, and accurate coding of ADAS attributes. While the database includes separate fields to indicate whether the technologies were 1) available and 2) equipped or activated at the time of the crash, unclear definitions and coding criteria for these variables and a high prevalence of missing values makes analysis difficult.

Key Insight #2: More Robust Data is Urgently Needed to Better Detect the Effect of ADAS on Pedestrian and Bicyclist Safety Outcomes in the General Population

CISS data currently lack information about people outside the vehicle (e.g., pedestrians or bicyclists) involved in crashes, leaving no way to study the effects of ADAS features on these crashes. With a national commitment to improve the significant and increasing disparities between driver, pedestrian, and bicyclist safety outcomes, better data are critical. Increased sample size, inclusion of pedestrian and bicyclist collisions even when no vehicle must be towed, and greater detail about non-occupants involved in a crash would improve the dataset and our understanding.

Key Insight #3: A Better Understanding of ADAS Prevalence within the Fleet is Necessary to Contextualize Safety Findings

An understanding of the extent of the effects of ADAS features on vehicle occupant safety outcomes is limited by a lack of publicly available data regarding the prevalence and type of ADAS features in vehicles in use today. Data on vehicle fleet distribution would also help clarify whether ADAS vehicles are underrepresented in samples like CISS, and whether that could be attributable to ADAS preventing crashes from occurring (in addition to or instead of ADAS reducing crash severity). We also critically need data on the use of ADAS features among those vehicles that have the features. A vehicle with disabled ADAS features has no more safety potential than a vehicle lacking those features.