

Status Report

Insurance Institute for Highway Safety | Highway Loss Data Institute

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Why are women at greater risk?

Small speed increases lead to far worse crashes

Rear autobrake cuts backing crashes

Introducing teens to driving technology



Vehicle choice, crash differences help explain why women face greater injury risks

Women are much more likely than men to suffer a serious injury when they are involved in a crash, but much of the heightened risk is related to the types of vehicles women drive and the circumstances of their crashes, rather than physical differences, new research from IIHS shows.

“Our study shows that today’s crash testing programs have helped women as much as men,” says Jessica Jermakian, IIHS vice president of vehicle research and one of the study’s authors. “That said, we found that women are substantially more likely to suffer leg injuries, which is something that will require more investigation.”

Though men are involved in more fatal crashes than women, on a per-crash basis women are 20-28 percent more likely than men to be killed and 37-73 percent more likely to be seriously injured after adjusting for speed and other factors. However, when IIHS researchers limited the comparison to similar crashes, they found those discrepancies mostly disappeared and that crashworthiness improvements have benefited men and women more or less equally.

“The numbers indicate that women more often drive smaller, lighter cars and that they’re more likely than men to be driving the struck vehicle in side-impact

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“Injury risks and crashworthiness benefits for females and males: Which differences are physiological?”
by M.L. Brumbelow and J.S. Jermakian

To request this paper, email researchpapers@iihs.org.

and front-into-rear crashes,” says Jermakian. “Once you account for that, the difference in the odds of most injuries narrows dramatically.”

Recently, the discrepancy in injury risk for men and women has prompted calls for new crash test dummies that better reflect how women’s bodies react to the forces of collisions and other changes to crash-testing programs.

In a 2019 article, Consumer Reports argued that the absence of a dummy that represents an average adult female has had “deadly consequences.” The same year, author Caroline Criado Perez flagged the issue in her book *Invisible Women: Data Bias in a World Designed for Men*, prompting many newspaper articles on the subject.

With this new study, IIHS sought to shed more light on the issue and to see what kind of changes to its vehicle testing program might be warranted.

The researchers analyzed the injuries of men and women in police-reported tow-away front and side crashes from 1998-2015.

In front crashes, they found women were 3 times as likely to experience a moderate injury such as a broken bone or concussion and twice as likely to suffer a serious one like a collapsed lung or traumatic brain injury. In side crashes, the odds of a moderate injury were about equal for men and women, while women were about 50 percent more likely to be seriously injured, but neither of those results was statistically significant.

To determine how much of the discrepancy was due to physical differences between

men and women, the researchers then repeated the analysis with a limited set of “compatible” front crashes. This subset was restricted to single-vehicle crashes and two-vehicle crashes in which the vehicles were a similar size or weight or the crash configuration was such that a size or weight difference would not have played a big role. To further reduce differences among crashes, only those with a front airbag deployment were included.

The sample included too few cases to do the same thing with side crashes.

Limiting the analysis to compatible front impacts flattened the disparity considerably, though women were still twice as likely to be moderately injured and a bit more likely to be seriously hurt.

A further analysis of those crashes, as well as the unrestricted set of side crashes, showed that good ratings in the Institute’s moderate overlap front and side tests lowered the odds of most injuries more or less equally for both sexes. In the compatible front crashes, the benefits of a good rating in the moderate overlap front test were greater for women except in the case of leg injuries, where the benefit was similar. In the side-impact crashes, a good rating in the side test benefited men and women about equally where moderate injuries were concerned, but the benefits of a more crashworthy vehicle were greater for women for most types of serious injuries.

These results are in line with previous research that shows serious and fatal injury risk has declined more for women than men as vehicles have gotten safer.

One explanation of the higher injury rates for women could be vehicle choice. Men and women crashed in minivans and SUVs in about equal proportions. However, around 70 percent of women crashed in cars, compared with about 60 percent of men. More than 20 percent of men crashed in pickups, compared with less than 5 percent of women. Within vehicle classes, men also tended to crash in heavier vehicles. Larger, heavier vehicles provide more protection in crashes than smaller, lighter ones, so both differences mean women are exposed to greater risk.

In a separate analysis of data from the federal Fatality Analysis Reporting System, the researchers also found that in two-vehicle front-to-rear and front-to-side crashes, men are more likely to be driving the striking vehicle. Because the driver of the striking vehicle is at lower risk of injury than the struck vehicle in such crashes, this could also account for some of the differences in crash outcomes for men and women.

The researchers’ analysis of compatible front crashes did show some sex-related differences, however. Women were still more than 2½ times as likely to suffer moderate leg injuries. They were also about 70 percent more likely than men to suffer serious leg injuries, though that figure wasn’t statistically significant.

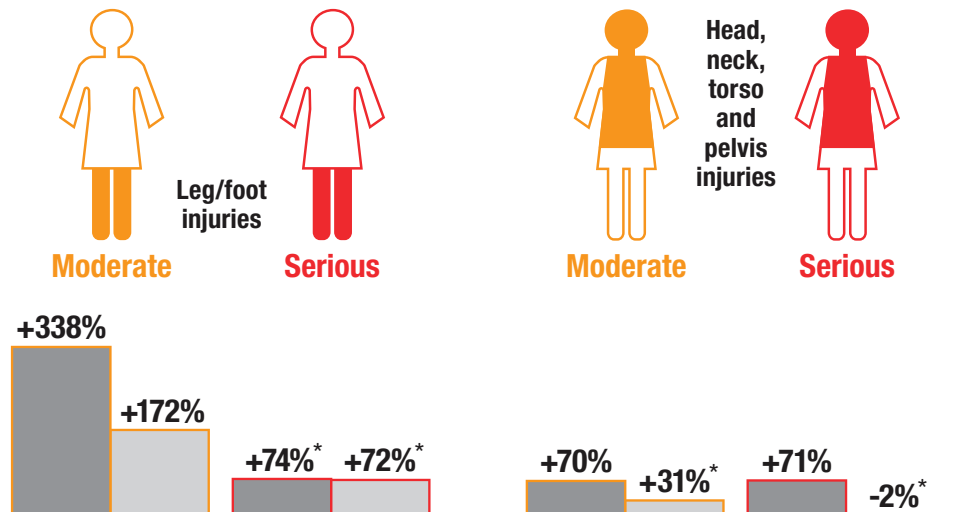
“The good news is that changes like strengthening the occupant compartment and improving seat belts and airbags have helped protect both men and women,” says Jermakian. “Homing in on the risk disparities that still exist in compatible crashes gives us an opportunity to make further gains.” ■

Female injury risk relative to males

ALL FRONT CRASHES

CONTROLLING FOR VEHICLE AND CRASH DIFFERENCES

* not statistically significant



Crash tests show how higher speeds undermine advances in crash protection

Drivers want to save time, and local transportation agencies want to improve traffic flow, but at what cost? With posted speed limits increasing on roadways around the country, a vehicle's ability to protect drivers in crashes is in doubt.

Small speed increases can have huge effects on crash outcomes, as shown in new crash tests by the AAA Foundation for Traffic Safety, IIHS and Humanetics. The safety organizations conducted crashes at three different impact speeds (40, 50 and 56 mph). They found the slightly higher speeds were enough to increase the driver's risk of severe injury or death.

Drivers often travel faster than posted speed limits, but when officials raise limits to match travel speeds, people still go faster. Today, 41 states allow speeds of 70 mph or higher on some roadways. Of those, eight states have maximum speeds of 80 mph or more. A 2019 IIHS study found that rising speed limits have cost nearly 37,000 lives over 25 years. AAA and IIHS urge policymakers to factor in this danger from higher speeds when considering speed limit changes.

"We conducted these crash tests to assess the effect of speeds on drivers and learned that a small increase could make a big difference on the harm to a human body," says Dr. David Yang, executive director of the AAA Foundation for Traffic Safety. "A speeding driver may arrive at their destination a few

minutes faster, but is the trade-off of getting severely injured or even losing one's life worth it if a crash occurs?"

The AAA Foundation collaborated with IIHS and Humanetics, the leading manufacturer of biofidelic crash test dummies, to examine how speed affects the likelihood and severity of occupant injury in a crash. Three 2010 Honda CR-V EX crossovers were used because they represented the average age (11.8 years) of a typical vehicle on U.S. roadways and earned the top rating in the IIHS moderate overlap front test. Calspan Corporation conducted all the tests in its crash laboratory in Buffalo, New York.

As the crash speed increased in the tests, researchers found more structural damage and greater forces on the dummy's entire body.

"Higher speed limits cancel out the benefits of vehicle safety improvements like airbags and improved structural designs," says Dr. David Harkey, IIHS president. "The faster a driver is going before a crash, the less likely it is that they'll be able to get down to a survivable speed even if they have a chance to brake before impact."

At the 40 mph impact speed, there was minimal intrusion into the driver's space. But at the 50 mph impact speed, there was noticeable deformation of the driver side door opening, dashboard and foot area. At 56 mph, the vehicle interior was significantly compromised, with the dummy's sensors registering severe neck injuries and a

likelihood of fractures to the long bones in the lower leg.

"Our crash test dummies are instrumented with hundreds of sensors to measure the injury risk so that we understand the scientific limits of safety and injury prevention. Understanding that the risk of serious and permanent injury becomes significantly higher in crashes beyond statutory speed limits clearly demonstrates why there are limits in the first place," says Jack Jensen, vice president of engineering at Humanetics.

At both 50 and 56 mph, the steering wheel's upward movement caused the dummy's head to go through the deployed airbag. This caused the face to smash into the steering wheel. Measurements taken from the dummy showed a high risk of facial fractures and severe brain injury.

When correctly set and enforced, speed limits improve traffic flow and maximize all public road users' safety.

"Cars are safer than they've ever been, but nobody's figured out how to make them defy the laws of physics," says Harkey of IIHS. "Rather than raising speed limits, states should vigorously enforce the limits they have. This includes using proven countermeasures like high-visibility enforcement and carefully implemented speed-camera programs to consistently and equitably enforce speed limits 24/7."

Speed limits should not be raised or lowered only to manipulate traffic volume on a

/i\ IIHS RESEARCH

"Impact of speeds on drivers and vehicles — results from crash tests" by W. Kim et al.

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particular roadway. States are urged to use engineering and traffic surveys when setting maximum speed limits.

“Policymakers need to also think beyond enforcement to control speeds and should consider infrastructure changes based on road type to calm traffic flow appropriately so that posted speed limits are followed,” says Jake Nelson, AAA director of traffic safety advocacy and research.

This study is the second part of the AAA Foundation for Traffic Safety research examining the effect of posted speed limit changes on safety. In the Foundation’s first study, traffic engineers were asked how posted speed limits are set and what factors they consider in changing them.

The research tests were conducted following the same protocol that is used for the IIHS moderate overlap evaluation; only the speed was varied. With a test dummy representing an average-sized male in the driver’s seat, the cars were crashed with 40 percent of the vehicle’s front on the driver side overlapping the barrier.

IIHS has been conducting this type of test, which simulates a head-on, partial-overlap impact between two vehicles of the same weight and size traveling at the same speed, since 1995. Since 2013, 100 percent of new vehicles have earned a good rating when tested at the 40 mph impact speed. ■



Tests were conducted at three different impact speeds. Slightly higher speeds were enough to increase the driver’s risk of severe injury or death.



Evidence mounts for effectiveness of rear autobrake

Front automatic emergency braking (AEB) systems have greater potential to save lives, but rear AEB is saving drivers the hassle and expense of many a fender bender, an updated analysis from HLDI shows.

Rear AEB was the standout feature in HLDI's annual compilation of its research on the impact of crash avoidance technologies.

The updated rear AEB analysis adds insurance data for model year 2015-18 Subaru vehicles with and without the feature to an earlier analysis of 2014-15 General Motors vehicles. The researchers found that vehicles equipped with rear AEB had 28 percent fewer property damage liability claims and 10 percent fewer collision claims across the two manufacturers.

Collision insurance covers damage to the insured driver's vehicle, while property damage liability insurance covers damage to the other vehicle involved in a crash when the insured driver is at fault.

"We haven't seen that kind of reduction in claims for vehicle and other property damage from any other advanced driver assistance system," says HLDI Senior Vice President Matt Moore.

The impact of rear AEB on injury crashes was relatively small, which makes sense based on the type of crashes the technology is designed to avoid.

"Backing crashes generally happen at lower speeds than front-to-rear crashes," Moore says. "That means they're less dangerous, but the costs from vehicle damage can add up."

Low-speed backing crashes represent a substantial portion of insurance claims, a separate HLDI analysis that looked at the point of impact of crashes found. Collision claims with rear damage of less than \$2,000 accounted for 17 percent of all collision claims and over \$8 billion in estimated damage during calendar years 2010-17.

In comparison, HLDI has found that front AEB reduces the frequency of collision claims by 3 percent and property damage liability claims by 14 percent. However, it slashes the frequency of bodily injury liability claims, which are for injuries that at-fault drivers inflict on occupants of other vehicles or others on the road, by nearly a quarter.

A similar study of police-reported crashes by IIHS found that the technology reduced front-to-rear crashes by 50 percent.

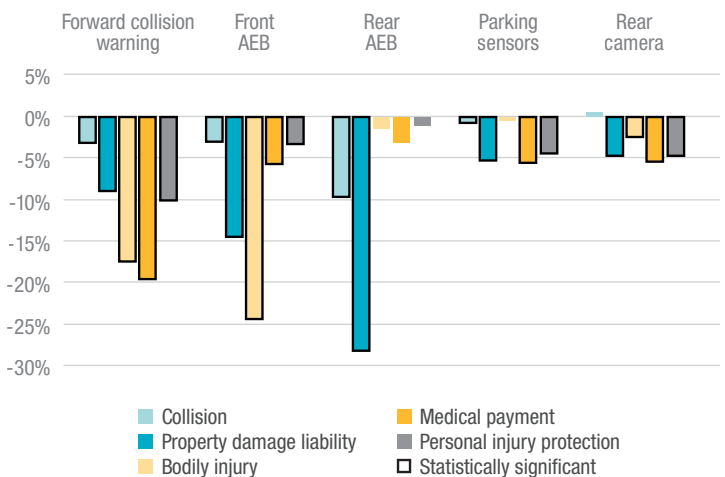
/i\ HLDI RESEARCH

"Compendium of HLDI collision avoidance research"
HLDI Bulletin Vol. 37, No. 12: December 2020

To request this paper, email researchpapers@iihs.org.

Both front and rear AEB use sensors like cameras or radar to detect when the vehicle is getting too close to an obstacle and automatically apply the brakes to avoid or mitigate collisions. IIHS tests and rates both systems. Only front crash prevention performance is a criterion for the Institute's *TOP SAFETY PICK* and *TOP SAFETY PICK+* awards.

Effect of crash avoidance features on insurance claim rates



HLDI also found that two other features designed to prevent backing crashes, parking sensors and rear cameras, which are both more common than rear AEB, were much less effective. Data from seven other manufacturers showed that rear cameras reduced the frequency of property damage liability claims by 5 percent and actually increased the frequency of collision claims slightly, though that increase was not statistically significant. Parking sensors also reduced the frequency of property damage liability claims by 5 percent and reduced the frequency of collision claims by 1 percent.

"Claims data show that collision avoidance technologies that automatically intervene to prevent or mitigate crashes are more effective than warning-based systems," says Moore, noting that forward collision warning is also associated with smaller claims reductions than front AEB.

Aside from rear AEB, front AEB and forward collision warning are the only stand-alone driver assistance features analyzed by HLDI that show double-digit percent reductions in claim frequency under any type of coverage. ■

Parents worry vehicle tech might prevent teens from mastering the basics

IIHS RESEARCH

“Learning to drive: parental attitudes toward introducing teen drivers to advanced driver assistance systems” by R.A. Weast, A.S. Mueller and K. Kolodge

To request this paper, email researchpapers@iihs.org.

Advanced driver assistance features have the potential to improve safety for young, novice drivers, but parents have mixed opinions about how to introduce such technologies to their teenagers, a new study from IIHS shows.

“Parents who have used advanced driving assistance features with their teens worry that things like blind spot monitoring or lane departure warning systems could prevent them from learning the basics of driving, but they’re also aware those same features might save them from a crash,” says IIHS Research Scientist Rebecca Weast, the lead author of the study.

Teenage drivers are 3 times as likely as those 20 or older to be involved in a fatal crash. Those deaths are often the result of single-vehicle crashes caused by speeding or other errors that cause the driver to lose control.

Because teens most often drive older, cheaper vehicles, they’re also less likely to benefit from proven crash prevention technologies like automatic emergency braking (AEB) — which is expected to be installed in less than a quarter of the vehicles on U.S. roads by 2023 despite a major push from manufacturers. But AEB and other features like blind spot monitoring systems and sensors that warn the driver when the vehicle is drifting out of its lane are becoming more and more common on the cars that their parents drive and they learn on.

To explore how parents feel about these technologies, IIHS worked with J.D. Power to conduct three focus groups. The discussions involved a total of 21 parents who had used a vehicle equipped with at least four common driver assistance features to teach their teens to drive. These common features included blind spot monitoring, forward collision warning, front or rear AEB, lane departure warning and lane departure prevention — which steers the vehicle back on



course when it drifts out of its lane. While many parents said they believe these features provide some safety benefits, they were divided about when and how they should be used during the process of learning to drive.

“Those features make driving safer, but they don’t make you a safer driver,” said one parent.

“Say my teen is driving in a car with all those features engaged [and] that’s what they get used to. Then they go out and buy their own car, and it’s got none of those features. That would be really scary for me.”

Overall, the parents expressed doubts about the technology more often than strong faith in its effectiveness. Some complained that the beeps and buzzes and warning lights could themselves be distracting, or that systems that momentarily take over the steering wheel to prevent lane departures could startle their teen into overreacting.

However, others were optimistic that the technologies could give fearful teens the confidence to learn. A few used the system alerts to help monitor the teen’s driving and give immediate feedback about unsafe maneuvers. AEB had already helped another parent’s teen avoid a crash.

Parents’ opinions were split about whether new drivers should be introduced to the driving assistance features at the beginning of the learning process or after they’d learned some of the basic skills. “I’m training my daughter to use all the technology that’s available with the car,” said a third parent, adding that young people are often more tech-savvy than older adults. “If it’s there, why not?”

The study did not include parents who had decided not to use these features at all during the learning process. However, some said they turned the features off after experimenting with them during driving practice to ensure their child didn’t use them as a crutch. These parents said they would later incorporate them into their sessions, since such technology was only going to become more common.

“More research is needed to determine what role these features should play in learning to drive and how to ensure new drivers use these features properly,” says Weast. “That’s complicated because owners of vehicles with advanced driver assistance systems often themselves don’t understand their capabilities and limitations.” ■



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IIHS is an independent, nonprofit scientific and educational organization dedicated to reducing the losses — deaths, injuries and property damage — from motor vehicle crashes.

HLDI shares and supports this mission through scientific studies of insurance data representing the human and economic losses resulting from the ownership and operation of different types of vehicles and by publishing insurance loss results by vehicle make and model.

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