

# STATUS REPORT

INSURANCE INSTITUTE  
FOR HIGHWAY SAFETY

Special issue: pedestrian injuries

Vol. 34, No. 3, March 13, 1999



## Little steps, bigger ones to protect **PEDESTRIANS**

They wait at corners, gingerly putting one foot forward when the traffic slows and then stepping back when a car starts to turn. The most vulnerable people on the road, pedestrians often are left to fend for themselves. In big cities, they account for more than a third of all motor vehicle deaths. Yet they're often the poor stepchildren in the sense that there's less attention to reducing pedestrian deaths and injuries, compared with deaths in vehicles. And when attention is paid, the focus is mainly on pedestrians' behavior, even though drivers are negligent in many fatal collisions between pedestrians and motor vehicles. This special *Status Report* focuses on effective ways to reduce pedestrian deaths and injuries. Some ways are relatively simple and inexpensive. Other measures require bigger steps like redesigning cars and roadways.



## PEDESTRIAN DEATHS AND INJURIES, 1997

Age (years)	Population (thousands)	Pedestrian deaths	DEATH RATE (per 100,000 people)	Pedestrian injuries	INJURY RATE (per million people)
0-4	19,150	165	0.9	4,000	2
5-9	19,738	240	1.2	11,000	6
10-15	22,910	239	1.0	11,000	5
16-20	18,936	300	1.6	7,000	4
21-24	13,774	253	1.8	5,000	4
25-34	39,610	757	1.9	9,000	2
35-44	43,998	922	2.1	12,000	3
45-54	33,633	701	2.1	8,000	2
55-64	21,813	488	2.2	4,000	2
65-69	9,762	242	2.5	2,000	2
70-79	15,799	505	3.2	4,000	3
80+	8,514	409	4.8	1,000	1
Total	267,636	5,307	2.0	77,000	3

Source: Fatality Analysis Reporting System, NASS General Estimates Systems, U.S. Dept. of Transportation

**It's a big problem  
but pedestrian deaths  
aren't as numerous  
as they used to be**

The pedestrian death toll was 5,307 in 1997, and about 77,000 more were injured. "While far too many pedestrians are being killed or injured, there's been an improving trend over the last 20 years," Institute senior vice president Allan Williams points out. Pedestrians accounted for 13 percent of all motor vehicle deaths that occurred in 1997, down from 15.5 percent in 1985 and 17 percent in 1975.

These are lower percentages than in many other countries. For example, pedestrians account for 40 percent of motor vehicle deaths in Russia, 38 percent in Poland, 36 percent in Israel, and 28 percent in England. The problem is even bigger in developing countries. Pedestrians account for more than half of all motor vehicle deaths in Ethiopia, for example, and 43 percent in Kenya.

**Youngest and oldest pedestrians:** In the United States, children ages 5-15 have the highest injury rates as pedestrians. Although elderly pedestrians are struck less frequently than children, they're more likely to die from their injuries. Among people

65 and older, the pedestrian death rate per 100,000 population is nearly twice as high as it is for people in other age groups.

Improvements in pedestrian death rates have been greatest among the youngest and oldest people. Among children 9 years and younger, pedestrian deaths per 100,000 declined 74 percent during 1975-97, and the decline was 56 percent among people 65 years and older. This compares with a 21 percent decline among people 20-34 years old.

Such improvements occurred as part of an overall 6 percent decline in motor vehicle deaths. But deaths in some groups went down much more — 29 percent among pedestrians, 33 percent among motorcyclists, and 19 percent among bicyclists. During the same years, passenger vehicle occupant deaths increased 5 percent.

**Alcohol-impaired walking:** Alcohol is a major contributor to adult pedestrian deaths. One-third of all fatally injured pedestrians age 16 and older have blood alcohol concentrations (BACs) of 0.10 percent or more. While this is a high proportion, it represents an improvement compared with the 41 percent of adult pedestrians with BACs this high in 1980.

The situation is worse at night than during the day. More than half of all adult pedestrians killed at night have BACs of 0.10 percent or higher.

Motor vehicle drivers with high BACs represent another obvious threat to pedestrians. The National Highway Traffic Safety Administration reports that drivers in more than 10 percent of fatal pedestrian crashes have BACs of 0.10 percent or more. Research hasn't established this proportion more precisely, in large part because so many drivers in fatal pedestrian crashes aren't ever tested for alcohol. About 20 percent of them leave the scene of the crash.

**Trends in pedestrian deaths:** While vehicle miles have steadily increased over time, people apparently are walking less. There's evidence that the amount of pedestrian exposure to vehicle traffic has decreased. Ten percent of all trips by chil-

dren 5-15 years old in 1995, for example, involved walking or biking, down from 14 percent in 1990 and 16 percent in 1977, according to the Nationwide Personal Transportation Survey.

It's impossible to relate numbers of pedestrian deaths directly to amounts of walking because, as the U.S. Department of Transportation points out, there's an "absence of meaningful exposure measures (such as hours of exposure to traffic) .... bicyclists and walkers often take trips too short in length to be counted in national surveys. Also trips that begin and end at a residence, without an intermediate stop, are not counted, thus excluding much recreational biking or walking."

What we do know is that pedestrians represent the second largest group of motor vehicle deaths, following only passenger vehicle occupant deaths. Fortunately, the pedestrian death problem is improving, not worsening. Still more can be done to reduce the risk for walkers.

#### EDUCATING CHILD PEDESTRIANS

**E**ducation programs alone often aren't successful in changing people's behavior to reduce highway safety problems. However, studies indicate that educating children can help reduce pedestrian deaths and injuries. In particular, a program called "Willy Whistle," which first was tested more than 20 years ago, improved children's street crossing behavior and lowered their crash involvement compared with children who hadn't participated. Yet only a limited number of children have been reached by programs like "Willy Whistle." An initiative under way at the National Highway Traffic Safety Administration will update and redesign educational materials for child pedestrians and seek to increase distribution.

## Countermeasures big and small

### Methods range from changing the timing of traffic signals to designing new roadways with pedestrians in mind

Almost three of every four pedestrian deaths occur in cities, where redesigning streets to better accommodate pedestrians isn't always an option. Fortunately, there are other ways to improve pedestrian safety, and some of the countermeasures are relatively inexpensive and easy to apply. "Signs, signals, and pavement markings can help by alerting pedestrians and motorists to each other's presence and increasing their physical separation from one another," says Richard Retting, the Institute's senior transportation engineer.

**Signal light and other intersection improvements:** Improvements at intersections with signal lights include extending the time for pedestrians to cross with a green light. Institute research has shown that giving pedestrians a three-second head start by using a leading pedestrian interval — a signal timing technique that allows pedestrians to begin crossing before turning vehicles see a green light — reduces conflicts and makes it easier for pedestrians to cross (see *Status Report*, May 2, 1998; on the web at [www.highwaysafety.org](http://www.highwaysafety.org)). This measure would be especially helpful to elderly pedestrians.

Special warning signs and pavement markings designed to prompt pedestrians crossing the street to look for turning vehicles also may help. An Institute study of three busy intersections found that such prompts and crosswalk warnings decreased conflicts. "These are relatively inexpensive methods that could be widely applied," Retting adds.

Another effective measure involves new signal technology to remind pedestrians at busy intersections to look for turning vehicles. This signal incorporates ani- (cont'd on p.6)



# Vehicle designs affect the harm that's inflicted on pedestrians

## Getting 'run over' usually isn't the problem when vehicles hit pedestrians

The popular terminology to describe a crash between a motor vehicle and a pedestrian is to say the pedestrian was "run over." But this is rarely the case. Research shows that hitting a vehicle's hood, fender, or windshield areas typically causes the most serious pedestrian injuries, especially head injuries. Impacts with bumpers and hoods are the source of many leg and pelvic injuries.

Altering the front-end designs of vehicles can influence the type and severity of these injuries. Friendlier designs are likely to become more common in Europe because of proposed regulatory action. A working group of the European Enhanced Vehicle Safety Committee developed three impact tests to assess vehicle performance in relation to potential pedestrian injuries. Impactors designed to represent an adult leg, adult upper leg, and child and adult heads are separately propelled at 40 km/h (25 mph) into the parts of cars — bumper, leading edge of the hood, top of the hood — known to cause serious injuries to pedestrians. The impactors are instrumented to determine pedestrian injury risk, and vehicles must absorb energy to meet the specified injury risk criteria.

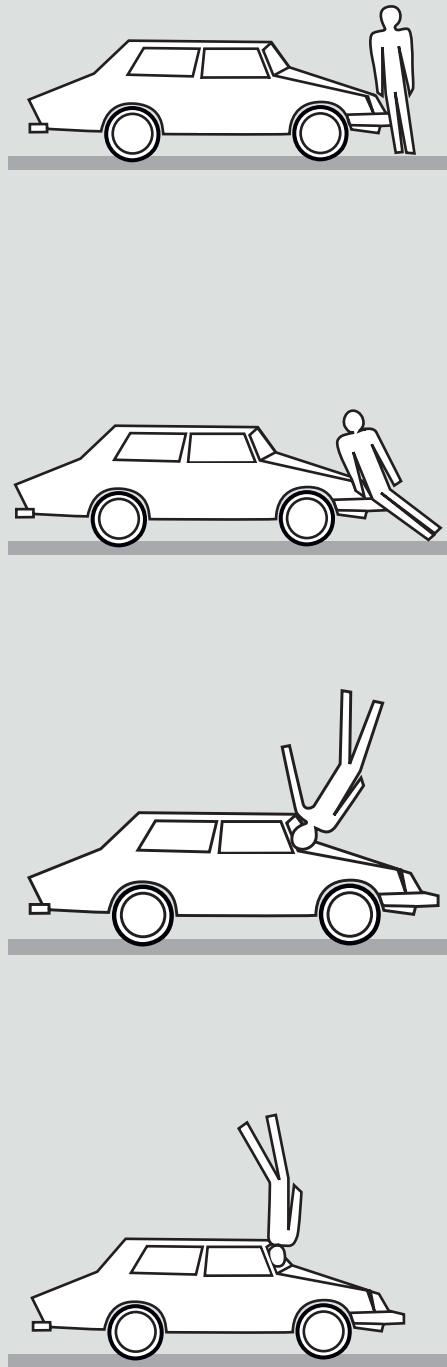
These test procedures are the subject of a European Commission directive to be considered by the European Parliament later this year. If approved, cars sold in Europe within a few years will become more pedestrian friendly. Meanwhile, the European New Car Assessment Program includes the results of the same 25 mph pedestrian impact tests in its published vehicle evaluations.



**The intersection where this crash occurred isn't considered dangerous. It's in a well lighted commercial area where a succession of signal lights keeps vehicle traffic in check. Until last month, no pedestrian deaths had occurred in this area. On February 5, Scott Bates, the legislative clerk of the U.S. Senate, and his wife were crossing Lee Highway at Harrison Street, near their home in Arlington, Virginia, when a car struck and killed him. Pedestrians like Bates often are said to have been "run over," but he wasn't. His pattern of movement was probably similar to what has been demonstrated in tests (above right). These tracings from high-speed photographs of 35 mph cadaver-into-car impacts show the dynamics of actual car-pedestrian collisions like the one that killed Bates.**



Gregory R. Ruth

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an injury severity while requiring achievable levels of energy absorption from the car structure."

Vehicles aren't yet designed to meet dynamic pedestrian test requirements, and results from Europe's New Car Assessment Program indicate room for improvement. Among 20 cars tested in Europe and sold in the United States as well as Europe, most earn only two stars out of a maximum of four in ratings for pedestrian injury potential. These ratings are based on the 25 mph impact tests.

At the same time, some parts of cars do appear to offer relatively high levels of protection. Lawrence says this indicates "that solutions to the problem of achieving better pedestrian safety are often readily available, low in cost, and could be applied over a higher proportion of the car surface."

In the United States, the federal government decided in the early 1990s not to proceed with regulations that would have required vehicle modifications to lessen pedestrian injuries. The National Highway Traffic Safety Administration backed off despite its own promising research findings (see *Status Report*, March 14, 1992). For example, it had worked out a procedure to measure hood deformation in impacts and was considering requiring automakers to design more forgiving hoods, fenders, and other surfaces to reduce serious pedestrian head injuries. The agency also had studied vehicle designs that might lower the risk and severity of thoracic and leg injuries to pedestrians and reduce overall risks to children.

Roger Saul of the National Highway Traffic Safety Administration says the agency resumed pedestrian biomechanical research around 1994, after suspending it in the early 1990s. Saul, who represents the U.S. government on an international committee to harmonize vehicle safety standards, says even if uniform international regulations don't materialize, a unified research approach should spur more U.S. testing to assess vehicles' potential to injure pedestrians.

Graham Lawrence of England's Transport Research Laboratory helped develop the test procedures. He explains that using separate impactors, or subsystems, is preferable in several respects to using complete dummies. If a whole dummy were used, it would be hard to control the impact locations of separate body parts to test the specific areas of interest, especially

the head. A range of dummies would be needed to represent pedestrians of different sizes. And it would be difficult to achieve repeatable test results.

The 40 km/h (25 mph) speed at which the subsystems hit cars was chosen, Lawrence explains, because "protection effective at this speed was practical and would produce significant reductions in pedestrian

(cont'd from p.3) mation to display a pair of eyes looking back and forth. Signals plus warning lights aimed at motorists also can help — a recent Institute-sponsored study indicates fewer conflicts where pedestrian-activated flashing beacons were accompanied by signs directing motorists to yield when the beacons are lit.

Another issue at traffic lights is allowing right turns on red. Institute studies have found this increases pedestrian colli-

to see. "The advanced stop lines reduce the number of drivers who stop within the crosswalk," Retting points out. "Moving the lines also increases the time it takes for cars to enter an intersection after the light turns green."

In the suburbs, there's more that could be done, because neighborhoods built in the 1950s, 60s, and even early 1970s often were designed without any sidewalks. Simply adding them could significantly en-

Report, Dec. 5, 1998; on the web at [www.highwaysafety.org](http://www.highwaysafety.org)).

In many countries in Europe and elsewhere, officials have implemented so-called traffic calming techniques, which are intended to slow vehicles down. Such measures include narrowing the roads in certain locations, adding landscaping, and introducing speed humps to reduce speeds and discourage motorists from going through neighborhoods. One-way



sions, especially in urban areas. Some cities limit right turns on red where there are lots of pedestrians.

Getting rid of traffic lights altogether sometimes enhances safety. Institute-sponsored research shows that substituting four-way stop signs for traffic signals at low-volume intersections reduces pedestrian crashes by about 24 percent.

**Separation of vehicles, pedestrians:** A promising method to reduce pedestrian deaths and injuries is to move stop lines farther back from crosswalks than the usual four feet. This increases the separation between pedestrians and motorists, making the pedestrians easier for the motorists

to see. "The advanced stop lines reduce the number of drivers who stop within the crosswalk," Retting says. Research shows that the risk to pedestrians in areas without sidewalks is more than twice as high as in areas with sidewalks.

**Speeds and traffic patterns:** Yet another obvious measure is to lower traffic speeds on neighborhood streets. Retting notes that "conventional police enforcement can help ticket motorists who drive too fast on residential streets and in school zones, but enforcement resources are limited. What's needed is something to beef up police enforcement, and speed cameras can help." Research on the use of these in Europe, Australia, and, most recently, Canada is encouraging (see *Status*

streets can also make it easier for pedestrians to cross and reduce vehicle conflicts.

**Pedestrian visibility:** More than half of all fatal pedestrian crashes in the United States occur at night. The addition of roadway lighting significantly reduces pedestrian collisions.

Extending daylight saving time year-round also could help. Adding an hour of afternoon light would increase the visibility of both vehicles and pedestrians. Institute researchers have estimated that about 180 fatal crashes — 80 percent of them pedestrian collisions — could be avoided each year if daylight saving time were extended (see *Status Report*, April 3, 1993).

## Designing new roadways

**Ideal is to build roads and communities with pedestrians in mind, and new federal policies are encouraging pedestrian-friendly designs**

"All too often, pedestrians are an afterthought, if they're considered at all, when transportation design decisions are being made," the Institute's senior transportation engineer Richard Retting says. "This mind-set needs to change." But even if it does change, it isn't an easy option to go back and redesign the streets in central cities to do a better job of ac-

of bicycling and walking for everyday travel." The funds include national highway system and surface transportation money for pedestrian walkways and bicycle facilities on land adjacent to any highway in the system, including interstates, or on other public roads.

The Federal Highway Administration and National Highway Traffic Safety Administration have embarked on pedestrian safety research including the development



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commodating pedestrians. It's in the new suburban developments that planners have more opportunities to factor in pedestrian safety.

"Overpasses, skywalks, underpasses, and other grade-separated crossings are examples of more expensive measures that could be implemented," Retting points out. "If these measures are adopted, planners need to keep in mind that the walkways have to be clean, well lighted, and safe. Otherwise, pedestrians won't use them."

Federal backing is available for such plans, after years of inattention to pedestrian safety. For example, funds are available under the 1998 Transportation Equity Act to "enhance the ability of communities to invest in projects that can improve the safety and practicality

of databases to obtain more information on pedestrian and cyclist injury causation.

Studies are under way to evaluate intersection treatments and other related measures. There's also more focus on alcohol-impaired pedestrians and a joint effort with the Centers for Disease Control on research to, among other things, reduce child pedestrian injuries.

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## Special issue

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Vol. 34, No. 3, March 13, 1999

This special issue focuses on ways to reduce pedestrian deaths and injuries. Other special issues have focused on the following subjects:

- Truck safety ..... 33:8 (1998)
- Urban crashes ..... 33:4 (1998)
- Crash compatibility ..... 33:1 (1997)
- Airbags ..... 32:9 (1997)
- Truck driver fatigue ..... 32:6 (1997)
- Head restraints ..... 32:4 (1997)
- Side impact ..... 31:8 (1996)
- Driver death rates ..... 30:9 (1995)
- Whiplash injuries ..... 30:8 (1995)
- Airbag effectiveness ..... 30:3 (1995)
- 16-year-old drivers ..... 29:13 (1994)
- Driver death rates ..... 29:11 (1994)

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ISSN 0018-988X

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