FINAL REPORT - THE PEDESTRIAN CRASH DATA STUDY

Augustus "Chip" B. Chidester
Ruth A. Isenberg
National Highway Traffic Safety Administration
United States of America
Paper Number 248

ABSTRACT

A Pedestrian Crash Data Study (PCDS) was initiated within the United States to collect detailed crash reconstruction data on pedestrian crashes from July 1994 until December 31, 1998. This paper will report on the pedestrian crash circumstances, including pre-crash, at crash, and injury consequences for the 521 pedestrian crashes that were researched during the four and one half years that the study was fully implemented.

Information on the first eighteen months of data collection was presented in a paper titled "Pedestrian Crash Data Study - An Interim Evaluation" at the ESV Conference held in June 1996. This paper was followed by subsequent analysis in 1998 at the next conference titled "Update on the Pedestrian Crash Data Study (PCDS)."

BACKGROUND

In 1992, a need was identified for the National Highway Traffic Safety Administration (NHTSA) within the United States Department of Transportation to collect pedestrian crash data through the Crashworthiness Data System (CDS), a component of the National Automotive Sampling System (NASS), formerly known as the National Accident Sampling System. The detailed pedestrian crash data that NASS had collected prior to 1987, when the Crashworthiness Data System (CDS) was implemented, had become obsolete due to the introduction of new and aerodynamically designed vehicles in the market place. Current pedestrian crash data were needed to ensure that pedestrian crash analyses capabilities were consistent with real world crash events.

Data collection for the Pedestrian Crash Data Study began in July 1994, and concluded on December 31, 1998. During that time, 521 pedestrian crashes were investigated at six sites across the United States. This paper will highlight findings from those 521 pedestrian crashes.

SIZE AND NATURE OF THE PROBLEM

During the years of this study, the numbers for both pedestrian fatalities and people injured declined. In 1994, pedestrian-vehicle impacts resulted in 5,472 pedestrian fatalities and 90,000 pedestrians injured. Figures for 1998 represent a decrease when 5,220 pedestrians were killed and 69,000 were injured. Generally, pedestrian fatalities have hovered about the low 5,000 mark, whereas in terms of injuries, there has been a consistent and definite decrease from 90,000 injured in 1994 to 69,000 injured in 1998. Passenger car, van, and light truck involvements account for about 91 percent of the pedestrian fatalities and for about 96 percent of the pedestrians injured.

Data on pedestrian injuries from the 1982-1986 NASS data files, the previous pedestrian data files used for analyses, show that approximately 40 percent of the pedestrian injuries resulted from contact with the vehicle, 32 percent resulted from contact with the ground and 26 percent of the injuries resulted from unknown contact sources. Data collected in the PCDS can now be used to determine if newly designed vehicles are creating the same or different types of injury patterns. These data from the 521 crashes will show the types of injuries sustained and the contact mechanisms involved in pedestrian impacts with late model year vehicles.

SCOPE OF PEDESTRIAN CRASH DATA STUDY

The PCDS was operational at six sites that were selected because of the number of pedestrian crashes that occurred at these locations. The sites selected to participate in the PCDS were: Seattle, Washington; Chicago, Illinois; Buffalo, New York; Fort Lauderdale, Florida; Dallas, Texas; and, San Antonio, Texas. The PCDS was designed to be a clinical study and was never designed to represent a sample of pedestrian crashes, even though it operated within the framework of the NASS CDS.

For this study, a pedestrian was considered as any person who was on a trafficway or on a sidewalk or path contiguous with a trafficway, or on private property and became in contact with the ground. Persons in or on a nonmotorist conveyance were excluded from this study.

For a crash to qualify for the Pedestrian Crash Data Study:

- The vehicle had to be moving in a forward direction at the time of the impact.
- The vehicle had to be a late-model-year passenger car, light truck or van. Late-model-year was defined as being manufactured in the last 5 years during the study's cycle. It also included non-late-model-year vehicles where the exterior design was the same as late-model-year-vehicles (e.g. Ford Taurus 1988 to 1994).
- The pedestrian could not be lying down or sitting prior to impact.
- The striking portion of the vehicle's structure had to be original equipment manufacturer (OEM) without previous damage and/or parts removed in the impact area.
- The pedestrian impacts were the vehicle's only impacts.
- The first point of contact between the vehicle and the pedestrian must have been forward of the top of the A-pillar.

Although originally intended to collect data on approximately 1,000 crashes, financial and staffing constraints within the NASS CDS prevented the completion of this number. In the end, the PCDS collected data on a final figure of 521 pedestrian crashes for clinical analysis. In 1994, 15 cases were initiated, 80 cases during 1995, 190 cases during 1996, 152 cases during 1997, and 84 cases in 1998.

OPERATIONAL PROCEDURES

As originally designed, the data continued to be collected through on-scene crash investigations (or within 24 hours) of pedestrian crashes involving late model year passenger cars, vans, and light trucks. If a vehicle or pedestrian could not be located and interviewed, or the vehicle damage measurements could not be obtained within 24 hours of the crash, the case was dropped from the study.

Police cooperation was established at each site to conduct the on-scene crash investigations or follow-ups within 24 hours. Notification of crashes was facilitated through a variety of media including the telephone and monitoring of police and emergency medical services radio frequencies.

When an investigation was conducted on-scene, the researcher notified the police of his or her presence immediately upon arrival at the scene and proper investigation protocols were followed so as to ensure no interference or disruption to any police investigation. Once a determination was made that the case met the selection criteria, the crash investigation commenced.

DATA COLLECTION FORMS

Data were collected and automated on 144 different variables in the Pedestrian Crash Data Study. Environmental, human, and vehicle data were collected for all phases of the crash. As shown in table 1, there were 24 variables in the pre-crash phase, 38 variables in the at-crash phase and 82 or more variables in the post-crash phase.

Additionally, there were six variables that were derived on the analysis files , such as the Maximum AIS (MAIS), Day of Week, and Injury Severity Score (ISS). A complete listing of the automated variables by the five primary data collection forms is included in the appendix to this paper.

Table 1.
The Distribution of PCDS Variables by their Relationship to the Crash Events

Number of PCDS Variables by Event Type			
	Pre-Crash	At-Crash	Post- Crash
Environmental	11	11	0
Human	11	16	47*
Vehicle	2	11	35

* add 13 variables per injury

The Accident Form collected data on the general characteristics of the event such as the time of day, the vehicle class, and the general area of damage for the vehicle involved.

The Pedestrian Assessment Form documented data on the characteristics of the pedestrian (age, sex, height, weight), their avoidance actions, orientation at impact, alcohol and drug presence, and the consequences of their injuries in relation to their treatment, hospital stay, and injury severity. Height measurements included ground to knee, hip, shoulder and overall height.

The Pedestrian Injury Form contained thirteen variables for **each** injury documented from official or unofficial records. Each injury was coded according to AIS90 injury descriptors with modifications for NASS CDS. In addition to the injury description, additional data collected for each injury included: the contact source of the injury; the striking profile; the type of damage; and the damage depth on the vehicle. Injuries were documented sequentially on the form by order of occurrence.

The General Vehicle Form contained vehicle make and model data, official record data for the driver, such as alcohol and drug information, pre-crash data as to vehicle movement, environmental data, and reconstruction data for determining impact speed.

The Vehicle Exterior Form contained pedestrian contact data for both front and side pedestrian contacts, front and side pedestrian vertical and ground to head contact measurements, detailed hood measurements, material identifications, and vehicle dimensions. Non-automated data included: the scene diagram; the crash case summary form; and interview forms for the pedestrian and driver.

NEW DATA COLLECTION TECHNIQUES

The two new techniques implemented for this study in 1994 included the use of video cameras to quickly document the on-scene crash data and the development of a contour gauge to quickly and accurately measure pedestrian contacts on the vehicles. Both of these techniques were described in great detail in the two PCDS papers referenced earlier.

During the duration of the PCDS, the Hi8 video camera proved to be an expedient and effective method to capture important data. Even after sanitization occurred, the integrity of the enhanced information was retained.

The contour gauge was created to provide a frame of reference on the vehicle for verifying the accuracy of the measurements and to provide an efficient and uniform method to document the pedestrian contact evidence. It was proven to be a reliable source for data documentation and its use in other applications should be examined in the future.

DATA ANALYSIS

Data from 521 pedestrian crashes were analyzed for this final report on the PCDS. All cases were single vehicle and single pedestrian events with an equal number of drivers and pedestrians involved.

Pedestrian Characteristics

Males and females were almost evenly divided throughout the study. Final count reflected a tally of 266 males (51%) and 255 females (49%). Four of the females who were involved were reported to be pregnant. One of the four women in their first trimester received an AIS 3 injury due to an open fracture of the tibial shaft. Two other women received minor AIS 1 injuries. The fourth woman who was in her second trimester also only received minor AIS 1 injuries. In terms of age, there were no pedestrians under the age of two. Ninety-six (18%) of the pedestrians were between the ages of 2 and 12, while 59 (11%) were between the ages of 13 and 18. The vast majority, 302 pedestrians or 58%, were between the ages of 19 and 65, with an additional 52 (10%) between the ages of sixty-six and seventy-nine years of age. There were 11 pedestrians (2%) who were 80 years or older (two were 93 years of age). Of these eleven individuals, seven (64%) were fatalities. One pedestrian's age was unknown. Figure 1 shows the distribution of the pedestrians by age groupings.

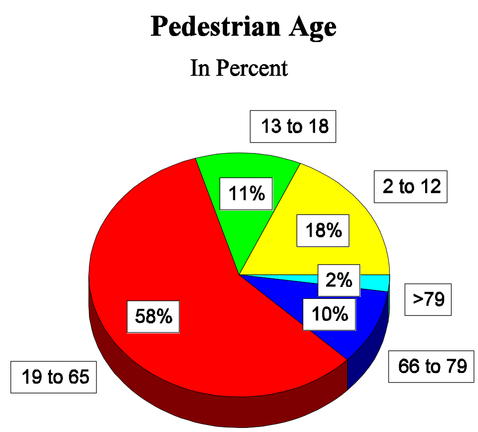

Figure 1. Percentage of involved pedestrians by age.

In regards to overall height, 103 (22%) of the pedestrians were 152 centimeters (5 feet) or shorter with the most predominant group 176 (39%) of pedestrians being between 153 and 168 cm (between 5' and 5' 6"). One hundred fifty-four (33%) were between 169 and 183 cm (5'7" to 6 feet) and twenty-six pedestrians (6%) were over 183 cm (six feet) tall. The height of the pedestrian appears to have some correlation to the Maximum AIS (MAIS) as seen in the Figure 2 below.

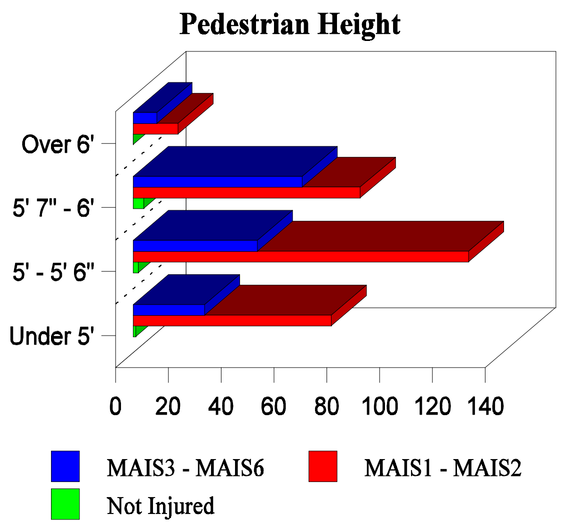

Figure 2. Distribution of MAIS by pedestrian height.

Height data was unknown for 62 individuals in the study. It appears that for the known population in the database, that taller individuals were more likely to receive a serious injury (MAIS3 - MAIS6). Sixty-four (42%) of the 154 Individuals between 5'7" and 6' received a serious injury. This group represented 44% of all the MAIS3 - MAIS6 injuries in the file. This could be attributed to the likelihood of head contact on the vehicle's windshield or some other structure and requires further investigation.

Vehicle Characteristics

Figure 3 shows the distribution of the vehicle types by overall registrations in the United States and their involvement in the PCDS. Of the involved vehicles, 355 (68%) were passenger cars and 166 vehicles (32%) were other light vehicles, collectively referred to as light trucks (pickups), vans, and utility vehicles. However, within the "other" group, the mix of vehicles found in this study differs slightly from registration data. In this population of other light vehicles, 32 (6%) were utility vehicles, 72 (14%) were vans and 62 vehicles (12%) were pick up trucks. This represents a slight over representation for passenger cars and vans and a slight under representation of utility vehicles and pickup trucks (Figure 3).

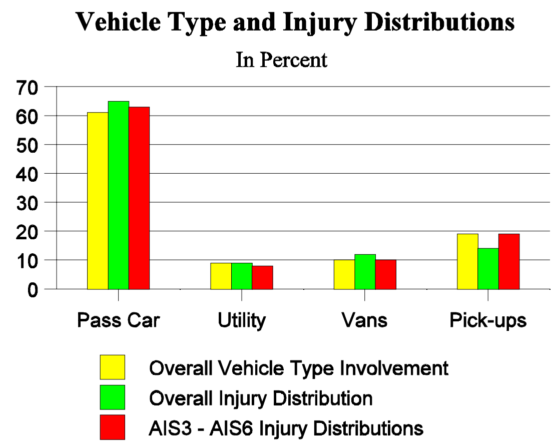

Figure 4. Percentage of vehicle types distributed by involvement and injury distributions.

Figure 4 shows the distribution of pedestrian injuries by vehicle type by crash involvement, involvement of vehicle type for all injuries and involvement of the vehicle types for serious injuries AIS3 - AIS6. There were a total of 4,184 injuries documented for the 521 pedestrians. Of these, 2,713 (65%) were from

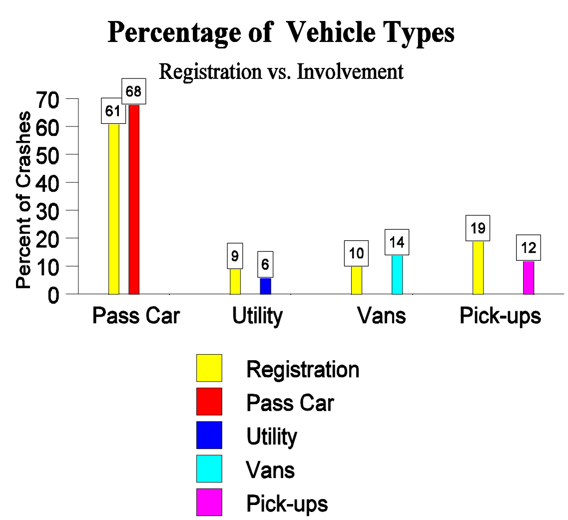

Figure 4. Percentage of vehicle types by registration and involvement.

passenger cars, 608 (14%) were from pickup trucks, 359 (9%) were from utility vehicles and 504 (12%) were from vans.

When the serious injuries (AIS3 - AIS6) were examined the involvement by vehicle type changed significantly. There were 743 injuries coded at the AIS3 - AIS6 injury severity levels. Passenger cars accounted for 473 (63%), utility vehicles for 61 (8%), and vans for 72 injuries or 10%. Pickup trucks accounted for 143 or 19% of the serious injuries which is greater than their overall distribution of 12% in the crash population and their involvement of 14% in general injury causation. This is nearly identical to the composition of vehicle registrations in the United States.

Pre-Crash

Prior to the crash, the physical motions of the pedestrians, were reported as 289 (55%) were walking, 21(4%) were stationary and the motions of 12 other pedestrians (3%) were unknown or demonstrated some other minor movement as hopping, skipping, etc. A significant number, 199 or 38%, of the pedestrians were running or jogging, but it is not known if this is related to any type of intended physical activity or trying to avoid the oncoming vehicle.

In relation to the pedestrian's motion prior to any avoidance actions, 453 (87%) of the pedestrians were attempting to cross the roadway and another 13 (3%) were off a roadway but attempting to cross a driveway. This supports the fact that 389 (75%) of the pedestrians had their chest orientation either to the left or the right of the striking vehicle prior to the impact.

The vehicle driver's pre-crash attention to the driving task was reported as paying full attention for 414, or for 80% of the crashes. It was reported that the driver was distracted by a person, object or event outside the vehicle for 33 or 6% of the crashes. Driver attention for 60 crashes (11%) was either another or unknown circumstance.

Prior to the critical event, 339 (65%) of the drivers indicated that the vehicle was moving straight. A turning maneuver accounted for 121 crashes (25%). However, there was disparity between left and right vehicle turns. A pedestrian was more likely to be struck in a left turn for 92 (18%) crashes rather than a right turn for 39 crashes or 8%.

Drivers made no avoidance maneuvers in 198 (39%) of the crashes. When a maneuver was undertaken, almost all of the actions involved some type of braking action. When a braking action involved a steering maneuver, about two thirds of the drivers chose to go to the left rather than the right.

At Crash

The crashes were almost evenly divided between intersection related and non-intersection related events. The weather was reported as being clear for 434 (83%) crashes and rainy for 79 (15%) of the crashes. However, wet roads accounted for 109 (21%) of the crashes. The vast majority of 341 (65%) crashes occurred during daylight. The remaining occurred when it was dark but lighted 114 (22%), dark alone 30 (6%), dusk and dawn accounted for 36 (7%) of the crashes.

The variables describing the pedestrian's orientation at impact enables the examination of the pedestrian's body, as it interacts with the vehicle at impact. At various impact speeds the orientation of the pedestrian has contributed to the level of injury. The pedestrian is wrapped or carried by the vehicle in 215 (41%) of the cases. The pedestrian is knocked to the ground in 133 (26%) crashes, thrown in 68 (13%), shunted or pushed aside in 53 (10%), passed over in 19 (4%). Other types of impacts accounted for the 33 (6%) remaining cases as noted in Figure 5.

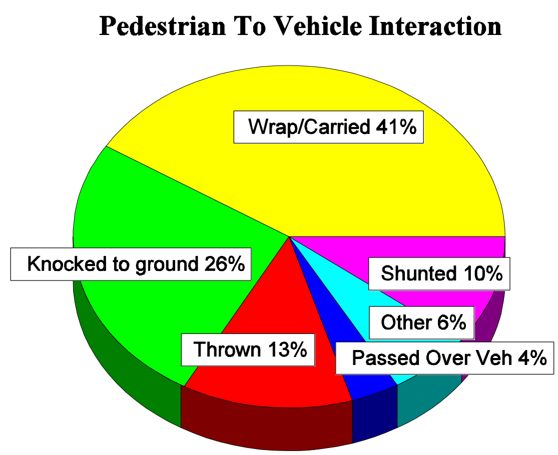

Figure 5. Percentage of crashes distributed by pedestrian to vehicle interaction.

Three hundred fifty-six (68%) of the pedestrians struck were oriented with their side to the striking vehicle, with 89 (17%) facing the vehicle and 53 (10%) facing away. In examining the leg orientation, 376 (63%) of the pedestrians had one leg forward and apart from the other leg at impact.

The pedestrian's arm orientations at impact were almost evenly divided: 152 (29%) pedestrians impacted were holding something in their hands or arms, 153 (29%) were not holding anything, 151 (29%) had their arms extended, and the remaining 66 (13%) had their arms in an unknown or other manner.

Figure 6 shows the distribution of impact speeds in the PCDS grouped in 15 KMPH (9 MPH) ranges. The impact speed is coded as a measure of severity in 82 percent of the cases.

The exterior of the vehicle that struck the

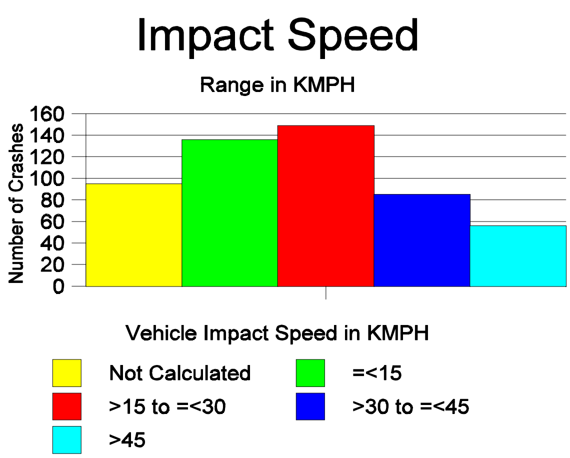

Figure 6. Number of crashes broken down by impact speed.

pedestrian was throughly documented, including 37 automated variables and detailed sketches of pedestrian contacts. The documentation was based on the plane of initial contact. The front plane contains data on 420 cases. The remaining 101 cases are either side or the plane of initial contact is unknown.

The wrap distance is defined as the continuous distance, measured following the contour of the vehicle, from the ground to the point where the pedstrian's head contacted. The ground to head contact is collected for both planes. Previous studies have shown the head contact to be a significant source of injury. However, in the 420 front plane contacts, 192 (46%) had no head contact (see Figure 7.)

Outcome vs. Injury

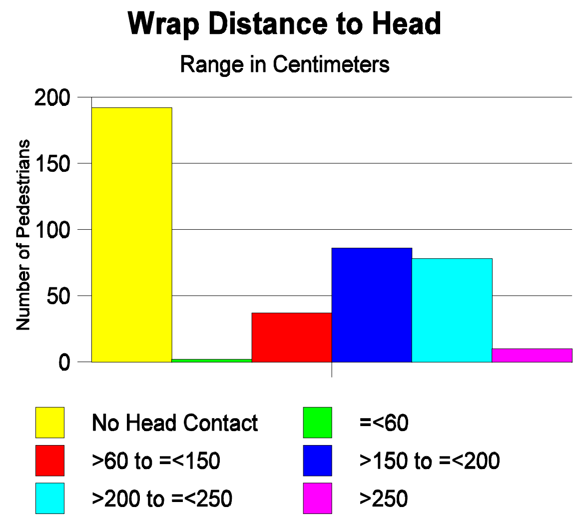

Figure 7. Head Contact Wrap Distance.

Of the 521 pedestrians involved in crashes only 17 (3%) were not injured or received no treatment for their injuries. There were 63 (12%) fatalities and 440 (85%) surviving injured who required medical treatment. Exactly half of those involved, 264 or 50% were treated at a trauma center and 185 or 36% were transported to a hospital for treatment. Of the 154 pedestrians that were hospitalized for their injuries, the average hospital stay was 9 days.

Injury data were collected from both official and unofficial data sources (autopsy reports, hospital discharge summaries and emergency room reports, interview data, etc.) and coded to NASS injury coding protocols which are based upon AIS90. The AIS90 developed by the Association for the Advancement of Automotive Medicine is a systematic way to describe injuries by using a specific coded format. One major modification that NASS made to AIS90 was the inclusion of a single digit to account for the location or aspect of the injury on the body region (e.g. left leg, right arm, forehead, etc.) injured.

The overall distribution for Maximum AIS (MAIS), which is the highest single AIS code for a pedestrian with multiple injury levels, is shown in Figure 8 . The highest AIS severity sustained by any pedestrian in any crash was an AIS 6 of which eighteen pedestrians received such injuries.

A total of 4184 injuries were sustained by the 511 pedestrians who were injured or killed. Lower extremity injuries accounted for 1,372 or 33% of the

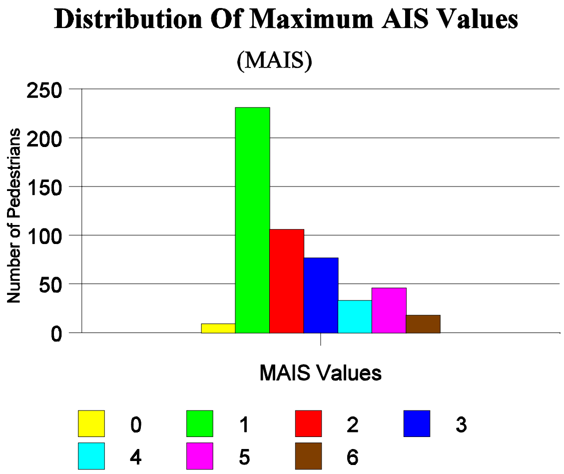

Figure 8. Number of crashes broken down by maximum AIS.

injuries followed by the upper extremities having 827 or 20% of the total injuries. The head and face were the next most frequent body regions injured having 699 (17%) and 677 (16%), respectively, of the injuries. The total injury distributions for all body regions are shown in Figure 9.

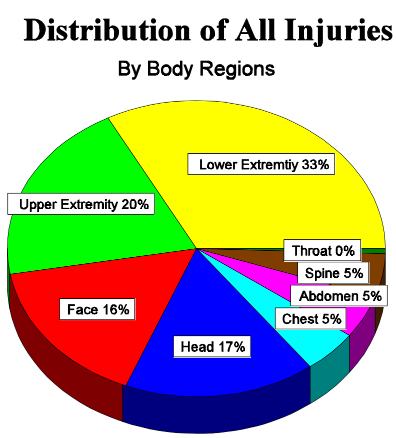

Figure 9. Percentage of all injuries distributed by body region.

It is noted that overall injury distributions among body regions change when soft tissue or integumentary injuries are excluded from the total injury distributions.

Distributions for the 1,506 non-integumentary injuries among body regions is shown in Figure 10. Lower extremity injuries remain the most frequent body region injured with 476 (32%) injuries. Of that number, 441 or 92% of serious injury to the lower extremity were fractures to the skeletal system. However, the head represents 452 (30%) of the injuries, with the remaining injuries almost evenly divided among the remaining body regions. In regard to non-integumentary head injuries, it is noted that 57 injuries were skull fractures, 270 were injuries to the brain and 120 injuries involved loss of consciousness.

Soft tissue (integumentary) injuries (AIS 1) accounted for 2678 or 64% of the 4184 injuries sustained by the pedestrians. To identify specific serious injuries

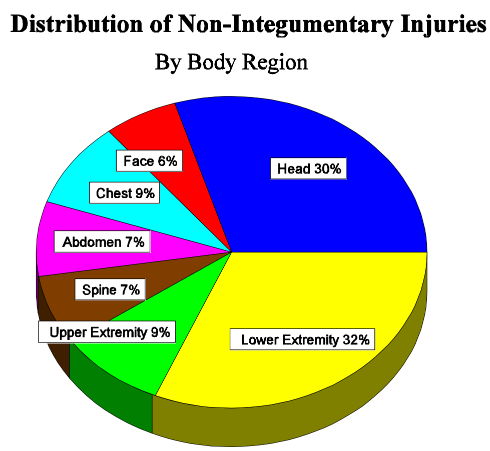

Figure 10. Percentage of all non-integumentary injuries by body region.

(AIS 3 to 6), individual AIS severities were dropped along with injury levels for the injury definitions contained in the NASS Injury Coding Manual. This resulted in 98 different injury combinations being identified where injury to the cerebrum was clearly identified as being the most frequent serious injury. The following is a listing of the ten most frequent injuries that occurred along with the injury's count:

Injury	Count
Brain - Cerebrum Injury	226
Tibia Fractures	130
Fibula Fractures	113
Head - Loss of Consciousness	61
Pelvis Fractures	59
Rib Fractures	59

Femur Fractures	43
Humerus Fractures	36
Cervical Spine Injury	36
Lung Injury	36

Data in Figure 11 represents the first five injuries from the above list with the injury source noted for each injury. As can be seen, front bumper contacts are predominant for tibia and fibula fractures and windshield glazing contacts are the primary source for both cerebrum and closed head injuries. More information on injury severity and their contacts is included in figure 12.

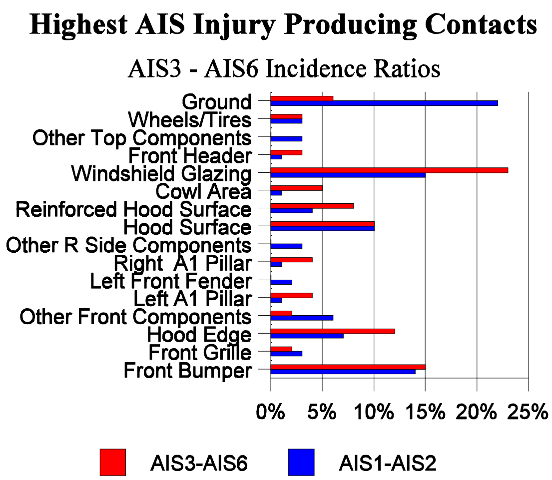

Figure 12. Relationship of the major AIS3-AIS6 injury producing contacts to AIS1-AIS2 injury levels.

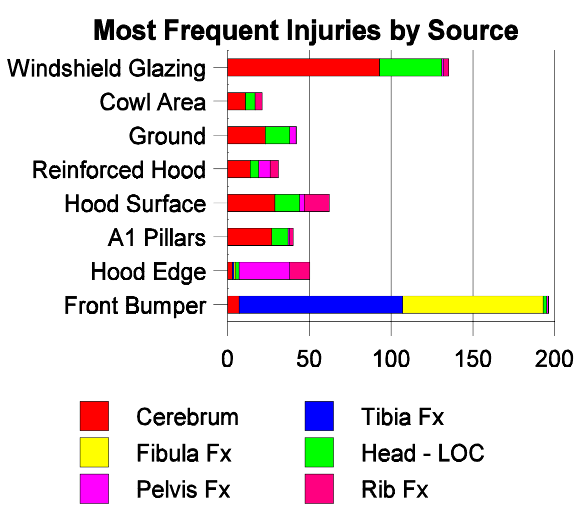

Figure 11 . Most common injuries identified by injury source.

Injuries were documented on the injury forms according to the sequence in which the body region contacted the vehicle or other injury component (e.g. ground) and there was no limit to the actual number of injuries that were coded for an individual. Lower extremity contacts accounted for 348 or 68% of the first injuries received for the 511 pedestrians that were injured. Head contacts were 34 or 7%. As the number of injury producing contacts increase, there is a reduction in the number of lower extremity contacts and an increase in the number of contacts to the head and face. The data documents that head and facial injuries follow extremity injuries during the crash sequence.

The known injury mechanism sources were coded for all but two of the injuries (4,182) in the data file. Forty-nine different contacts were coded as causing injuries with the most common injury contributors by AIS severity grouping shown in Figure 12. The ground was the most frequent injury contact (22%) for lower severity injuries whereas windshield glazing was the most frequent injury (23%) source for serious injuries. Minor injuries (AIS1-2) were most likely to be caused by the front bumper (14%), hood surface (10%), windshield glazing (15%), and ground (22%). Serious injuries (AIS 3-6) were more frequently to be caused by contact with the front bumper (15%), hood edge (12%), hood surface (10%), and windshield glazing (23%). There were other areas on the vehicles where there was a significant increase in the ratio of minor to serious injury. These areas included both the A and B Pillars, reinforced hood surfaces where the hood had been reinforced from below, and the cowl area of the vehicle. These areas all represented areas where a greater likelihood of serious or life threatening injury would occur.

MAIS Injury severities were also tabulated against impact speeds. In Figure 13, it is clear that impact speed does affect the severity of the outcome. This is especially true when the unknown impact speeds are disqualified from the counts. In that case, approximately 121 of the 129 (94%) MAIS 3-6 injuries occur at impact speed greater than 15 KMPH. The vast majority of MAIS 1 injuries occurred at the two lowest groupings of impact speeds (below 31KMPH). MAIS2 injuries were retained as a separate MAIS injury group since many upper and lower extremity, and facial fractures are at the AIS2 level and could appear prior to the occurrence of more severe internal injury. It is clearly seen that MAIS2 injuries appear more frequently at this impact speed level. At impact speeds above 30 KMPH the number of MAIS3-6 injuries rise substantially which is a clear indicator of speed having significant impact on MAIS severity and outcome.

CONCLUSIONS

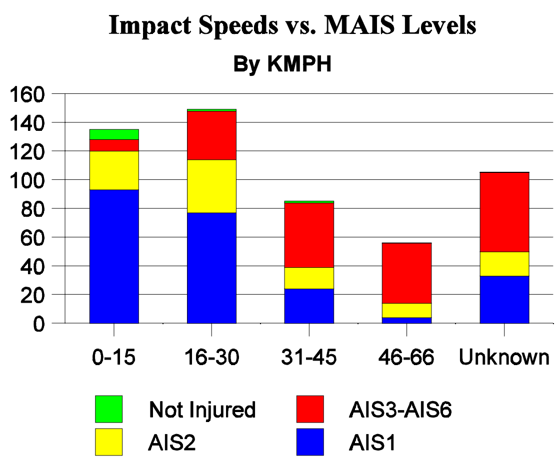

Figure 13. The distribution of impact speeds by MAIS levels.

The Pedestrian Crash Data Study (PCDS) can be used to determine if newly designed vehicles are creating the same or different types of injury patterns in pedestrian crashes. The PCDS concluded data collection on December 31, 1998 having completed 521 pedestrian crashes involving late model year vehicles.

The new data collection techniques implemented for the PDCS improved the data documentation and efficiency for these on-scene studies. The use of video cameras and a portable contour gauge proved to be very effective means to collect the on-scene physical evidence and vehicle damage data. These devices provided a method to accurately document contacts on the vehicle for reconstruction purposes by cnsistent and uniform application on the vehicles to ensure quality control. In addition, the success of the video sanitization efforts have ensured that the video tapes can be quickly and accurately sanitized without any loss of resolution or the information presented on the tape.

The vehicle mechanisms producing serious injuries (AIS 3 - 6) requires further study. Injury contacts with the front bumper, hood edge, hood surface and windshield have consistently produced more serious injuries than other components of the vehicle. Additionally, there are other areas of the vehicle (A and B pillars, cowl area, and hoods with below surface reinforcement) where actually numbers are low but the AIS severities (AIS 3 or greater) within those cells are high. The injury data also has documented that head and facial injuries follow extremity injuries during the crash sequence. The data also show that elderly pedestrians (65 years of age or older) had a much higher mortality than younger individuals. Although they comprised only 13% of the population in the study, their group represented 30% of the fatalities.

One hundred and ninety-nine (38%) of the pedestrians were struck by a vehicle while jogging. Joggers were more likely to receive a serious injury (41%) than pedestrians who were walking at a fast pace.

DATA AVAILABILITY

Data for all 521 cases from the Pedestrian Crash Data Study (PCDS) will be available from the National Automotive Sampling System's web page beginning June 2001. The videos will also be available for viewing and can be downloaded free of charge to personal computers. Individuals wishing to obtain the complete data file including the videos can do so by contacting the office identified below. The videos and data collection will be available on DVD. Paper copies of the data collection as well as the SAS data file will also be available.

Web address:

HTTP://WWW-NASS.NHTSA.DOT.GOV/NASS

Marjorie Saccoccio, DTS-44
DOT/Volpe National Transportation Systems Center
Kendall Square
Cambridge, MA 02142
USA

REFERENCES

1 Abbreviated Injury Scale - 1990 Revision, Association for the Advancement of Automotive Medicine, Des Plains, IL, 1990.

2 Documentation for the Data File of the Pedestrian Injury Causation Study, U. S. Department of Transportation, National Highway Traffic Safety Administration, 1982.

3 Pedestrian Crash Data Study, 1996 Data Collection, Coding and Editing Manual, U. S. Department of Transportation, National Highway Traffic Safety Administration, 1996.

4 National Accident Sampling System. Crashworthiness Data System, AIS-90 Injury Coding Manual, U. S. Department of Transportation, National Highway Traffic Safety Administration, 1993.

5. Traffic Safety Facts 1996, A Compilation of Motor Vehicle Crash Data from the Fatal Accident Reporting System and the General Estimates System, U. S. Department of Transportation, NHTSA, 1997.

6. Isenberg R., Chidester C., and Kaufman R., "Pedestrian Crash Data Study (PCDS) - An Interim Evaluation", ESV Paper, June 1996.

7. Isenberg R., Chidester C., and Mavros S., "Update On The Pedestrian Crash Data Study (PCDS)", ESV Paper, June 1998.

APPENDIX 1

PEDESTRIAN CRASH DATA STUDY VARIABLE LIST

PEDESTRIAN ACCIDENT FORM

AC01 Primary Sampling Unit
AC02 Case Number - Stratum
AC03 Number of General Vehicle Forms Submitted
AC04 Date of Accident
AC05 Time of Accident
AC06 SS15 Administrative Use
AC07 SS16 Pedestrian Crash Data Study
AC08 SS17 Impact Fires
AC09 SS18
AC10 SS19
AC11 Number of Recorded Events in this Accident
AC12 Accident Event Sequence No.
AC13 Vehicle Number
AC14 Class of Vehicle
AC15 General Area of Damage
AC16 Vehicle Number or Object Contacted
AC17 Class of Vehicle
AC18 General Area of Damage

DERIVED VARIABLES

Day of Week
Year
Stratification
Month

PEDESTRIAN ASSESSMENT FORM

PED01 Primary Sampling Unit
PED02 Case Number - Stratum
PED03 Pedestrian Number
PED04 Pedestrian's Age
PED05 Pedestrian's Sex
PED06 Pedestrian's Overall Height
PED07 Pedestrian's Height - Ground to knee
PED08 Pedestrian's Height - Ground to Hip
PED09 Pedestrian's Height - Ground to Shoulder
PED10 Pedestrian's Weight
PED11 Pedestrian Attitude
PED12 Pedestrian Motion
PED13 Pedestrian's Action Relative to Vehicle
PED14 Pedestrian's Body (Chest)Orientation Prior Impact
PED15 Pedestrian's First Avoidance Actions
PED16 Pedestrian's Head Orientation at Initial Impact
PED17 Pedestrian Body (Chest)Orientation Initial Impact
PED18 Pedestrian's Arm Orientation at Initial Impact
PED19 Pedestrian's leg Orientation at Initial Impact
PED20 Vehicle/Pedestrian's Interaction
PED21 Police Reported Alcohol Presence
PED22 Alcohol Test Result for Pedestrian
PED23 Police Reported Other Drug Presence for Pedestrian
PED24 Other Drug Specimen Test Result for Pedestrian
PED25 Injury Severity (Police Rating)
PED26 Treatment - Mortality
PED27 Type of Medical Facility
PED28 Hospital Stay
PED29 Working Days Lost
PED30 Glasgow Coma Scale (GCS) Score
PED31 Was the Pedestrian Given Blood?
PED32 Arterial Blood Gases (ABG)-HCO3
PED33 Time to Death
PED34 1st Medically Reported Cause of Death
PED35 2nd Medically Reported Cause of Death
PED36 3rd Medically Reported Cause of Death
PED37 Number of Recorded Injuries for This Pedestrian

DERIVED VARIABLES

Maximum AIS
Injury Severity Score

PEDESTRIAN INJURY FORM

PI01 Primary Sampling Unit Number
PI02 Case Number - Stratification
PI03 Pedestrian Number
PI04 BLANK
PI05 Source of Injury Data
PI06 Body Region
PI07 Type of Anatomic Structure
PI08 Specific Anatomic Structure
PI09 Level of Injury
PI10 AIS Severity
PI11 Aspect
PI12 Injury Source
PI13 Injury Source Confidence Level
PI14 Direct/Indirect Injury
PI15 Striking Profile
PI16 Type of Damage
PI17 Damage Depth

PEDESTRIAN GENERAL VEHICLE

VEH01 Primary Sampling Unit Number

VEH02 Case Number - Stratum
VEH03 Vehicle Number
VEH04 Vehicle Model Year
VEH05 Vehicle Make
VEH06 Vehicle Model
VEH07 Body Type
VEH08 Vehicle Identification Number
VEH09 Police Reported Travel Speed
VEH10 Speed Limit
VEH11 Police Reported Alcohol Presence for Driver
VEH12 Alcohol Test Result for Driver
VEH13 Police Reported Other Drug Presence for Driver
VEH14 Other Drug Specimen Test Result for Driver
VEH15 Vehicle Curb Weight
VEH16 Vehicle Cargo Weight
VEH17 Vehicle Special Use(This Trip)
VEH18 Impact Speed
VEH19 Accuracy Range of Impact Speed Estimate
VEH20 Data Source of Impact Speed
VEH21 Driver's Attention to Driving
VEH22 Pre-Event Vehicle Movement
VEH23 Critical Precrash Event
VEH24 Attempted Avoidance Maneuver
VEH25 Precrash Stability After Avoidance Maneuver
VEH26 Precrash Direction Consequences of Avoidance Maneuver
VEH27 Relation to Junction
VEH28 Trafficway Flow
VEH29 Number of Travel Lanes
VEH30 Roadway Alignment
VEH31 Roadway Profile
VEH32 Roadway Surface Type
VEH33 Roadway Surface Condition
VEH34 Traffic Control Device
VEH35 Traffic Control Device Functioning
VEH36 Light Conditions
VEH37 Atmospheric Conditions

PEDESTRIAN EXTERIOR VEHICLE FORM

PEV01 Primary Sampling Unit
PEV02 Case Number - Stratum
PEV03 Vehicle Number
PEV04 Original Wheelbase
PEV05 Original Average Track Width
PEV06 Hood Material
PEV07 Hood Original
PEV08 Hood Length
PEV09 Hood Width Forward Opening
PEV10 Hood Width Midway
PEV11 Hood Width Rear Opening
PEV12 Hood/Fender Vertical/Lateral Crush From Pedestrian
PEV13 Windshield Contact Damage From Pedestrian Contact
PEV14 Front Bumper Cover Material
PEV15 Front Bumper Reinforcement Material
PEV16 Front Bumper - Bottom Height
PEV17 Front Bumper - Top Height
PEV18 Forward Hood Opening
PEV19 Front Bumper Lead
PEV20 Ground to Forward Hood Opening
PEV21 Ground to Front/Top Transition Point
PEV22 Ground to Rear Hood Opening
PEV23 Ground to Base of Windshield
PEV24 Ground to Top of Windshield
PEV25 Ground to Head Contact
PEV26 Ground Clearance
PEV27 Side Bumper-Bottom Height
PEV28 Side Bumper-Top Height
PEV29 Centerline of Wheel
PEV30 Top of Tire
PEV31 Top of Wheel Well Opening
PEV32 Bottom of A-Pillar at Windshield
PEV33 Top of A-Pillar at Windshield
PEV34 Top of Side View Mirror
PEV35 Centerline to A-Pillar at Bottom of Windshield
PEV36 Centerline to A-Pillar at Top of Windshield
PEV37 Centerline to Maximum Side View Mirror Protrusion
PEV38 Ground to Side/Top Transition
PEV39 Ground to Hood Edge
PEV40 Ground to Centerline of Hood
PEV41 Ground to Head Contact