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Analysis of Fatal Pedestrian Injuries in King County, WA, and Prospects for Prevention

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Synopsis

Pedestrian fatalities caused by motor vehicles in King County, WA, over a 12-month period were reviewed to examine the potential for prevention by various strategies. Cases were identified through the King County Medical Examiner's Office. Between April 1, 1985, and March 31, 1986, a total of 38 pedestrians died of motor vehicle injuries. The victims were generally children (N=11), the elderly (N=13), or intoxicated adults (N=9). Supervision of the child was inadequate in 64 percent of the children's deaths. The driver was at fault in deaths of seven children, five adults, and three elderly persons. None of the children and only one of the elderly victims was injured at night. The majority of injuries occurred on major thoroughfares; only 16 percent occurred on residential streets.

Possible strategies for prevention appear to include improved enforcement of pedestrian right-of-way laws, changes in vehicle design, modification of the environment (particularly in urban areas), and improved training programs for children.

As DEATHS FROM OTHER causes have decreased dramatically over the past 50 years due to improving social conditions and more effective medical care, injuries have become the most important cause of death during the first half of the human lifespan (*1*). In the injury field, most attention has appropriately been given to reducing the toll of death and disability for the occupants of motor vehicles. The problem of pedestrians struck by motor vehicles, however, has received relatively little attention.

Approximately 8,000 persons a year are killed as pedestrians, making it the second largest category of motor vehicle deaths (*2*). Pedestrian deaths comprise about one-sixth of all traffic related deaths, half of the traffic deaths of children, and one-third of those among the elderly. Among children, pedestrian injury is the third leading cause among deaths attributable to unintentional injury and the leading cause of deaths from trauma among 5 to 9-year-olds (*3*).

Prevention of many other types of injuries has been successfully approached on a national or State level. For example, motor vehicle occupant injuries

have decreased with the implementation of Federal motor vehicle safety standards and State seat belt laws (*4*). Childhood deaths from poisoning have dropped markedly with the advent of the Poison Packaging Prevention Act (*5*). Pedestrian injuries, however, are different and must be approached at a local level, with interventions geared to the specific problems in the community.

This report is an analysis of pedestrian injuries in one community, and it provides the basis for appropriately targeting strategies for a community injury prevention program.

Materials and Methods

All deaths occurring in King County, WA, from a pedestrian-motor vehicle collision (ICDA codes 810–819, 820–825 in which the last digit was 0.7) during the 12-month period April 1, 1985, to March 31, 1986, were reviewed. Autopsies were performed on all victims by the King County Medical Examiner's Office under the direction of one of the authors (Dr. Reay). Circumstances of the injury were determined by on-site investigations, including interviews with witnesses and relatives conducted by personnel of the King County Medical Examiner's Office and the police department. Data on registered vehicles and licensed drivers in King County were obtained from the Department of Licensing. The severity of injury was assessed using the Abbreviated Injury Scale (AIS) (*6*) and the Injury Severity Score (ISS) (*7*) based on the findings at autopsy. The AIS is a numeric scale ranging from 1 (minor injury) to 6 (maximum injury—virtually unsurvivable). The ISS is a method of assessing the severity of multiply injured patients; it is defined as the sum of squares of the highest AIS rating for each of the three most severely injured body regions. Individuals sustaining an injury of AIS 6 severity are automatically given an ISS score of 75, the maximum possible. The ISS has become the most widely used measure for assessing overall injury severity (*8*).

Results

Thirty-eight persons died of pedestrian injuries in King County during this 12-month period.

The victim. Fatally injured pedestrians appeared to divide naturally into three groups (see table): 11 children, 13 persons over age 65, and 14 persons 15–65 years old. The children ranged in age from a stillborn infant (delivered at 32 weeks because of a pedestrian-motor vehicle collision involving his mother) to 14 years. Seven children (64 percent) were injured while they were walking or playing without adult supervision. Another child, a retarded 9-year-old, functioned at an approximately 6-year-old level.

Fourteen victims were in the 15–65 year age group; nine (64 percent) of these victims with a mean age of 46 years (range 22–62) had been drinking at the time of the incident. Of the other five victims, one was mentally retarded and two were bystanders who were walking on sidewalks when struck by motor vehicles involved in collisions with other vehicles.

The 13 elderly victims ranged in age from 68 to 86 years. None were intoxicated at the time of the incident. Apparent mental confusion, in which the victim's pedestrian behavior was erratic or heedless of traffic control devices, played a definite role in the collision which killed two elderly victims and a possible role in five other collisions.

The vehicle and driver. The mean age of the drivers was 35.6 years (median 31 years); five (13 percent) were under 21 and two (5 percent) over 65 years of age. This age distribution compares to 7.2 percent under 21 and the 9.0 percent over 65 years (median age 37 years) for all licensed drivers in King County. The driver was judged to be at least partly at fault in 15 deaths (40 percent): seven children, five of those 15–65, and three of the elderly. The driver was speeding in three incidents, collided with another motor vehicle in two incidents (two pedestrians were killed in one collision), was inattentive in three incidents, and failed to yield to pedestrians in the remainder.

No vehicles had defects which contributed to the collision. The vehicles, however, were different from the average registered vehicle in King County in two respects: the median age of the vehicle was 11 years (compared with 8 years for all registered vehicles), and 34 percent were pick-up trucks or vans (compared to 14 percent of all registered vehicles). The drivers of pick-up trucks and vans were judged to be at fault in 39 percent of these 15 cases, identical to the proportion of drivers of other vehicles.

The environment. The weather did not appear to play any role in the collisions; none occurred during snow, fog, or with ice on the road. The time of the injury varied significantly by group. None of the children and only one elderly victim was hit at night. In contrast, 10 of the 14 adult victims were

injured at night; street lighting was adequate in all but two of these incidents.

Six victims were in marked crosswalks at the time of the collision. Two children (sisters) were struck on their way to school while crossing in a marked crosswalk by a motor vehicle which failed to stop. Four elderly victims were struck in crosswalks: two by motor vehicles turning and two by vehicles failing to yield the right of way. In the crosswalk injuries of two children and three elderly, the driver was at fault.

Seventy-four percent of the collisions occurred on major arterials (N=28); only six (16 percent) occurred on residential streets. The remainder occurred in nontraffic incidents: one intoxicated adult was run over by her own vehicle when she attempted to stop it from rolling in a parking lot; one toddler was run over by a vehicle backing down his driveway; another child was run over by a truck backing up in a lot; and one elderly woman's purse caught in a car door, and she was killed when the car backed down the driveway.

Injury severity and cause of death. The severity of injury and cause of death varied with age. The median ISS of the fatalities was 50 (range 16–75) for the children, 50 (range 29–75) for those 15–65, and 25 (range 9–36) for those over 65. Spinal cord-brainstem transection was the cause of death of four children and four of the adults; an additional five children, two adults, and six of the elderly died of closed head injuries. The majority of victims dying of central nervous system injuries also had multiple injuries to other body areas. Injuries of extremities were common in all age groups, occurring in 26 (68 percent) of the victims. Death in the two younger age groups was usually due to severe injuries; in the elderly, it was usually caused by a combination of injuries and pre-existing chronic disease and debility.

Pedestrian fatalities, King County, WA, April 1, 1985–March 31, 1986, by age group and risk factor

Risk factor	Age group (years)		
	Under 15 (N = 11)	15–65 (N = 14)	Older than 65 (N = 13)
Host factors:			
Intoxication	0	9	0
Lack of supervision	7	NA	NA
Physical or mental impairment	1	1	2
The agent:			
Mean driver age (years)	32.3	32.1	40.9
Mean vehicle age (years)	11.5	11.0	10.0
Number of trucks	2	5	5
Environment:			
Number at night	0	1	10
Arterial roads	6	10	12
Number of marked crosswalks	2	0	4
The injury:			
Median ISS score [1]	50	50	25
Brain or spinal cord injury	9	6	6

[1] Injury Severity Score.
NOTE: NA = not applicable.

Discussion

This study provides important lessons for the developers of a pedestrian injury prevention program. The severe and multiple injuries indicate that improvement in medical care is not likely to make a significant impact on mortality caused by trauma inflicted on pedestrians. Prevention of pedestrian fatalities must primarily rest on prevention of the injuries from occurring. This review of pedestrian fatalities in the community clearly outlines areas where interventions are likely to have little impact and suggests other areas where prevention programs should be developed, implemented, and evaluated. Although the number of injuries analyzed was small, the data are useful for the purpose of devising effective interventions, and they are in agreement with other studies.

In general, passive strategies, in which the environment or the vehicles are changed, have been the most effective methods for reducing morbidity and mortality from injuries (*9*). The study indicates that this may be less true of injuries to pedestrians. Most injuries occurred on urban arterials where the placement of speed bumps or other traffic control devices is not feasible. Better lighting of roadways or retro-reflective clothing would also have had minimal impact; intoxicated adults appear to be the major group injured at night, and most of these injuries occurred on well-lighted urban arterials. A study of pedestrian injuries in rural areas concluded that, despite 80 percent of the collisions occurring at night, improvement in roadway lighting was a viable option in only a limited number of incidents (*10*).

Some environmental and design changes seem to have actually increased the risk of injury. Marked crosswalks, for example, appear to offer no protection to pedestrians, especially for children and the elderly. Data from San Diego indicate that use of marked crosswalks may actually increase the risk of pedestrian injury two-fold because they give pedestrians a false sense of security and drivers frequently fail to stop at crosswalks (*11*). As a result, the city of Seattle has chosen a policy of using

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marked crosswalks more selectively. The recent adoption of "right turn on red" laws has been found in one study to result in a 57 percent overall increase in pedestrian-motor vehicle collisions; in urban areas, such collisions increased by 79 percent, with elderly pedestrians at greatest risk (*12*). Consideration should be given to prohibiting right turns on red lights in urban areas with a high volume of pedestrians. More radical restructuring of the urban environment in which pedestrians are mixed with low-density, low-speed car traffic has been tried in a number of European communities (*13, 14*); however, no data are available to indicate the effects of such redesign on pedestrian injuries, particularly on children and the elderly.

Modification of the vehicle has been explored by others as a possible intervention (*15*). In view of the severe nature of many injuries to pedestrians and the predominance of head and visceral injuries as the cause of death, such modification to vehicles would be expected to have only minimal impact on fatalities. Likewise, vehicle inspection will not decrease pedestrian injuries; none of the vehicles had defects which contributed to the injury.

The reasons for the over-representation of older vehicles and of pick-up trucks in this series are unknown, but they may well be related to the aggressivity of drivers of these vehicles. This factor has been amply documented as accounting for the increased representation of light trucks in motor vehicle collisions (*16*).

The drivers were judged to be at least partially at fault in more than one-third of the pedestrian-motor vehicle collisions in this study. However desirable, modification of driving behavior to prevent pedestrian-motor vehicle collisions is likely to prove very difficult. Baker and co-workers found that drivers involved in fatal motor vehicle collisions had as many speeding convictions *after* being involved in the fatal collision as before the collision (*17*). High school driver education classes (*18*) and post-licensure defensive driving courses (*19*) have not been shown to be effective in decreasing the likelihood of motor vehicle crashes. An alternative to these approaches may be better enforcement by police of pedestrian right-of-way laws. Currently, it appears that pedestrians are penalized more often than drivers. In Seattle during 1985, there were 8,081 citations for jaywalking, but only 563 citations to drivers for failure to yield to pedestrians.

We are reluctantly left with considering the contribution of the pedestrian to these incidents and exploring the possibility of behavior changes. Although the study deals with fatal injuries in which the victims' accounts obviously cannot be obtained, the data were collected prospectively, and attempts were made to determine accurately the pedestrian's action at the time of the incident. The majority of injuries in this series occurred because the victim was incapacitated in some way; either as a child who possessed inadequate developmental skills for the task at hand, as an adult who was intoxicated, or as an elderly person with impaired physical and mental functioning. In addition, many of the elderly died, not so much from their injuries, which often were not very severe, but from a combination of trauma, debility, and pre-existing chronic illness.

Altering the behavior of intoxicated pedestrians is probably even more difficult than attempting to deal with the problem of intoxicated drivers. Coping with problems of mental confusion and increasing debility in the elderly can be approached not only at an individual level, but possibly by using the same community approach for children as described subsequently.

Community approaches to the prevention of injuries to pedestrians can perhaps have the greatest potential impact by focusing on children's injuries. How can this be done? A number of components are necessary. First, there is a need for a commitment of health professionals, law enforcement officials, and the general public to curtail the unacceptable toll of these injuries to children. The veil of fatalism surrounding pedestrian safety must be dispelled. Poor children, who are at greatly increased risk of injury and fatality, especially deserve our attention (*20*).

A new look must be taken at how children are taught pedestrian safety. Most existing programs have failed to improve behavior of children as pedestrians and to decrease the risk of injury, partly because most children under 10 lack the cognitive skills to make appropriate judgments

about crossing streets in traffic (*21*). These inappropriate expectations of children as pedestrians are also held by parents. One study found that 70 percent of 5-year-olds and 100 percent of 6-year-olds are allowed to play outside or walk to school without adult supervision (*22*). In our study, 7 of the 11 children who died were not supervised. A similarly high proportion of inadequately supervised children was found in a study from Sweden (*23*) and in a recent study from the United States (*24*). We propose to shift the focus of training programs to educating parents to avoid placing young children in situations for which they are developmentally not equipped and to educating young children to stay out of streets entirely. The training of pedestrian behavior should be geared to the developmental age and skills of the child. Future programs need to be evaluated with a rigorous scientific study of changes in observed behavior.

Individual adults and the community as a whole should assume a "corporate responsibility" about protecting children from motor vehicles. Community approaches to injury control appropriately shift the burden of responsibility from the individual to the community (*25*). Such an approach in Sweden has been at least partially responsible for that nation's having the lowest childhood mortality rate from trauma in the world (*26*). The United States should follow the lead of this European nation and begin to address this important and neglected problem.

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