Fatal Pedestrian Injuries to Young Children: A Different Pattern of Injury

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Abstract: All pedestrian vehicle collision fatalities to children less than five years of age in Washington State were evaluated for a five-year period using State death certificates, coroners' reports, and police records. Although the majority of pedestrian fatalities to older children have been shown to be due to "dart-outs" into traffic with the child being struck by an oncoming car, pedestrian fatality incident for children less than five tended to occur when the child was backed over in the home driveway by the family van or light truck driven by a parent. Prevention of pedestrian injuries in this age group requires strategies aimed at safeguarding the driveway and reassessing the safety of light trucks and vans as family vehicles (*Am J Public Health* 1988; 78:793–795.)

Introduction

Pedestrian injuries to children most commonly occur when the child is struck by an oncoming vehicle while crossing a street.[1] However, in children less than five years, non-traffic motor vehicle pedestrian collisions are an important cause of death[2]; and the death rate attributed to non-traffic pedestrian injuries is higher in children of ages one through four than for any other age group.[3]

The purpose of this study was to examine death certificate, coroner, and police record data in order to provide a detailed description of fatal pedestrian-motor vehicle collisions to children less than five years of age.

Methods

Washington State death certificates from 1979–83 were searched to identify all deaths of children less than five years of age coded with pedestrian-motor vehicle collision as the cause of death (ICD9 E codes 814–825). Coroner reports were then accessed for additional information on each case. Where coroner reports were unavailable or contained an insufficient description of the circumstances surrounding the injury, records of the state or municipal police department that investigated the incident were then examined where available.

Data abstracted from death certificates included age and sex of child, types of injuries sustained, and date and hour of injury occurrence. The incident site (highway, driveway, etc.) was also coded on the death certificate. Additional information from coroner and police records included vehicle type, its direction of travel, the relationship of the driver to the injured child, and a more detailed description of the incident site.

Average annual death rates were calculated based on the 1982 population estimates from Washington State Vital Statistics.[4] Statistical tests for linear trend were carried out using linear regression analysis.[5]

Results

There were 71 fatal motor-vehicle pedestrian injuries to children less than age five recorded in Washington State during the five-year study period. Pedestrian fatalities were separated into "traffic" and "non-traffic" fatalities by ICD9 coding. Traffic pedestrian collisions (E814.7) occur on a street or highway. Non-traffic pedestrian collisions (E822.7) occur away from general traffic, e.g., driveways, apartment building or store parking lots, and lane ways.

Information on the death certificate was supplemented by coroners' reports for 44 cases, by police reports for 14 cases, and by both records for five cases. Neither supplemental record was available for eight cases.

Forty-five deaths (63%) were coded on the state register as pedestrian injuries occurring in traffic; 26 (37%) were coded as non-traffic pedestrian vehicle collisions. However, it was evident from the police and coroner data that many deaths coded as traffic-related were actually not traffic-related. A review of the injury site from the different data sources resulted in our reclassifying 15 of the 45 (33%) traffic-related deaths as non-traffic related because the site of the incident was either a driveway or a parking lot. Conversely, we found no misclassification of non-traffic fatalities as traffic-related. After correcting this misclassification, it was apparent that the majority (41/71 or 58%) of all incidents were non-traffic related; 30 had occurred in driveways and 11 in apartment building or store parking lots.

Average annual death rates by age of child for non-traffic and traffic-related incidents are shown in Table 1. The lowest risk for both types of incidents occurred for children less than one year of age. From ages one through four, there was a clear trend of decreasing risk for non-traffic related fatality with increasing age. This trend was not apparent for traffic-related fatalities where the greatest risk appeared for those three years of age.

Death rates were higher among males than females for both types of incident. This risk difference was more evident in non-traffic injuries (Table 1).

TABLE 1—Average Annual Death Rates by Age and Sex of Child for Non-Traffic and Traffic-Related Pedestrian Incidents

	Non-Traffic[a]		Traffic	
Age (years)	No.	Rate[b]	No.	Rate[b]
0	0	—	2	0.6
1	19	5.8	7	2.2
2	11	3.4	4	1.2
3	7	2.2	10	3.1
4	4	1.2	7	2.2
1–4[c]	41	3.2	28	2.2
Male	25	3.8	16	2.4
Female	16	2.5	14	2.2

[a]Linear regression coefficient = −1.50; standard error = 0.23.
[b]Per 100,000 population, Washington State Vital Statistics Records.
[c]Excludes children under 1 year of age.

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TABLE 2—Characteristics of Non-Traffic and Traffic-Related Pedestrian Vehicle Collisions to Children Less than Age Five

Characteristics	Non-Traffic	Traffic
Vehicle Type[a]		
Light Truck	16	1
4 × 4 Truck or Jeep	6	0
Van	6	3
Passenger Auto	9	25
Vehicle Direction[b]		
Forward	9	29
Reverse	23	1
Fell/Jump from vehicle	3	0
Driver[c]		
Father	10	0
Mother	4	0
Other Family or Visiting Friend	6	0
Other	8	27

[a]Vehicle type unknown for 4 non-traffic and 1 traffic incident(s).
[b]Vehicle direction unknown for 6 non-traffic incidents.
[c]Driver unknown for 13 non-traffic and 3 traffic incidents.

Distributions of deaths by hour of day and by season of year were similar for the two types of injury. A majority, 63 per cent of traffic-related pedestrian fatalities and 71 per cent of non-traffic fatalities, occurred between the hours of noon and 7:00 pm. More than 80 per cent of traffic and non-traffic pedestrian fatalities occurred during the six-month period from April to September.

Injuries to the head and neck were listed as the primary cause of death for 77 per cent of traffic and 81 per cent of non-traffic deaths. A light truck or van was the vehicle most commonly involved in non-traffic fatalities—76 per cent, compared to 14 per cent of traffic fatalities (Table 2). In all but one traffic-related fatality, the vehicle was moving forward when the child was struck. However, for two-thirds of non-traffic fatalities, the children were backed over; only one-fourth of them were struck while the vehicle was moving forward; the remainder fell or jumped from the vehicle before being struck (Table 2). A family member (most often the father) or a visiting family friend was involved in 71 per cent of non-traffic fatalities. There was no instance of a family member driving the vehicle in the traffic-related injury group.

Discussion

This study demonstrates a pattern of fatal pedestrian injury that is unique to children less than the age of five and points up the intervention strategies aimed at non-traffic pedestrian incidents in this age group.

Previous analyses have shown the incidence of traffic-related pedestrian fatalities in this age group to be higher than non-traffic pedestrian fatalities,[3] although the combined rate of all pedestrian fatalities for children of ages 1–4 was very similar to that found in this study. We found the rate of non-traffic pedestrian fatalities to be 50 per cent higher than that for traffic-related fatalities after correcting the misclassification of ICD9 codes. This pattern of incorrect coding of pedestrian injuries in the State of Washington may be a problem in other states as well. If so, previous analyses using death certificate data[2,3] have underestimated the incidence of non-traffic pedestrian injuries.

It is likely that the high non-traffic related mortality in ages 1–4 is due to the inability of the younger child to recognize environmental hazards[6] and to a decreased driver visibility for a smaller child.

Male children have been previously reported to have higher rates of pedestrian injury than females[1,3,7] and patterns of occurrence by hour of day and season of year were similar to those reported elsewhere for traffic-related pedestrian fatalities.[1,6,8]

Our finding that the primary cause of death was due to injuries to the head and neck for nearly 80 per cent of all pedestrian fatalities in this age group is also consistent with available data.[8,9] The preponderance of head and neck injury is probably explained by the height of a child relative to the vehicle's bumper. Many of the children were killed immediately. The importance of this observation is that there is little that can be done to manage such injuries medically. Improvement of prehospital or in-hospital services would be unlikely to decrease the toll of these injuries. Strategies for primary prevention of these incidents are likely to be the only hope for decreasing the number of fatalities from these injuries.

The pattern of non-traffic pedestrian injury as it relates to the vehicle type and driver is notable. The "typical" pattern of injury involved a situation in which a 1–2 year old child was backed over in his home driveway by a light truck or van driven by a family member. Within the scope of this study it was not possible to measure the risk for involvement in a non-traffic pedestrian collision for young children in families who own a light truck or van, relative to that for families who do not. However, as these vehicles were involved in 76 per cent of non-traffic pedestrian fatalities, it appears that children in families owning these vehicles may be at increased risk for fatal injury.

Families with small children may be more likely to own a van or light truck and therefore these vehicles may be over-represented in pedestrian-vehicle collisions occurring in driveways and parking lots where young children are present. However, the involvement of these vehicles in non-traffic collisions may also be due to the driver's inability to see a small child moving around the larger vehicle. This suggestion is supported by our finding that 66 per cent of the fatally injured children were backed over. Although data concerning the driver's identity were missing for over one-third of all non-traffic fatalities, our results suggest that, tragically, the driver in these incidents is most likely to be a family member.

Larger family vehicles have become more popular in recent years with the successful marketing of recreational trucks and minivans by several auto manufacturers. Our data from 1979-83 actually predate the minivan. With the continued success in sales of these vehicles, especially to families with small children, it will be important to assess their safety in terms of non-traffic pedestrian collisions involving young children and to explore issues such as impaired visibility. Changes in vehicle design have been effective in reducing pedestrian injuries.[10] The targeting of light trucks and vans for such changes may help to reduce the frequency of non-traffic pedestrian injuries.

Keeping young children away from vehicles in driveways or parking lots, or remembering to look for a toddler whenever the vehicle is backed, will not be a simple or inexpensive task, but needs to be addressed.

In summary, motor vehicle pedestrian collisions occurring on home driveways and in parking lots are important mechanisms of injury to young children. The data presented here provide new information on an important pattern of pedestrian injury in very young children. Reduction of these injuries will require different strategies for prevention than

the "dart-out" pattern of pedestrian injury common to older children.

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Hopkins Computer Model Shows Savings of Smoking Cessation Programs

Researchers at the Johns Hopkins School of Public Health have demonstrated—through a computer model—that there are economic benefits to smoking cessation programs. Based on data from a Hopkins study of 1,000 hospital nurses and their smoking habits, researchers used a computer model to generate hypothetical scenarios.

"We found that after five years an organization could save $4,000–$51,000 if the employees stopped smoking. And if the employee turnover rate is reduced by half—through incentives—the savings increase to the $44,000–$123,000 range," said Robert T. Swank, director of the Computer Center at the School. "Employers can use our model to predict the long-term effects, economic value and best method of implementing smoking cessation programs by plugging in their set of information," he explained.

The direct employer costs of smoking-related diseases have been documented particularly in relation to insurance costs and worker productivity. The Hopkins model, which can be used for any employee group in any industry, takes into account several new variables. The interaction of many factors is gauged over time, rather than the usual static model. Quitters are divided into long-term and short-term categories. Such variables as smoking bans and incentives to retain employees after they quit smoking also are included.

The researchers estimate that if employees stayed in the organization a minimum of three years after quitting smoking, the employer will begin to benefit economically.

The study, entitled "The Cost of Employee Smoking: A Computer Simulation of Hospital Nurses," by Diane M. Becker, ScD, and colleagues at Hopkins, appeared in *Archives of Internal Medicine,* February 1988.