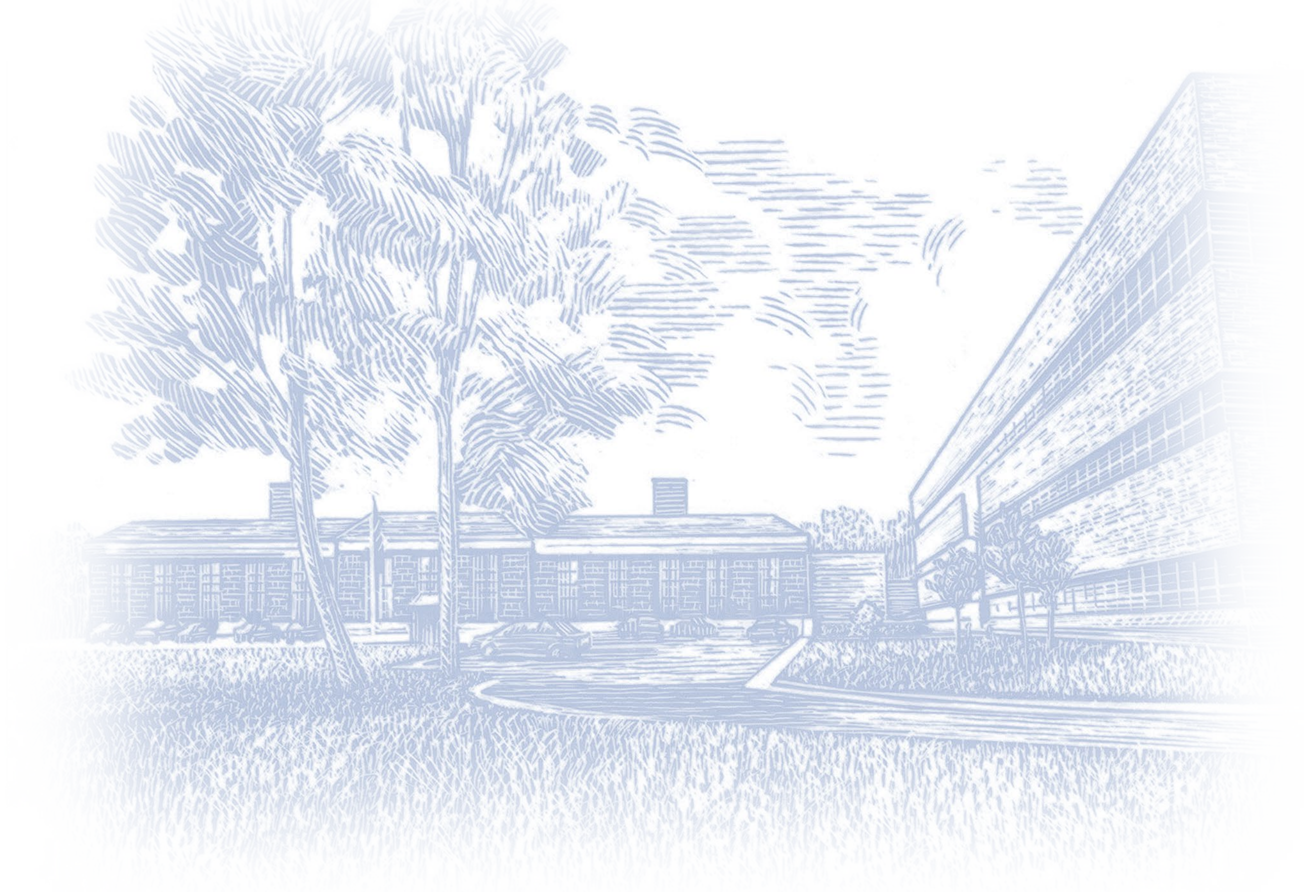
Injuries to Pedestrians and Bicyclists: An Analysis Based on Hospital Emergency Department Data

Publication No.: FHWA-RD-99-078 **1999**



U.S. Department of Transportation
Federal Highway Administration

Federal Highway Administration
Turner-Fairbank Highway Research Center
6300 Georgetown Pike, McLean, VA 22101

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Foreword

Contact: Carol Tan Esse at Carol.Tan Esse@fhwa.dot.gov

Traditionally, the U.S. DOT has relied on State motor vehicle crash data as their primary source of information on events causing injury to pedestrians and bicyclists. These data have often been referred to as "the tip of the iceberg," however, because they are limited almost entirely to motor vehicle-related events that occur on public roadways. Specifically, they exclude: (1) many bicycle-motor vehicle and pedestrian-motor vehicle crashes that occur in non-roadway locations such as parking lots, driveways, and sidewalks, and (2) bicyclist and pedestrian falls or other non-collision events that do not involve a motor vehicle, regardless of whether they occur on a roadway or in a non-roadway location.

This report presents a descriptive analysis of data collected prospectively at eight hospital emergency departments over approximately a 1-year time period in three States: California, New York, and North Carolina. Information was gathered on 2,509 persons treated for injuries incurred while bicycling or walking. Results show that 70 percent of the reported bicycle injury events and 64 percent of the reported pedestrian injury events did not involve a motor vehicle. In addition, 31 percent of the bicyclists and 53 percent of the pedestrians were injured in non-roadway locations such as sidewalks, parking lots, or off-road trails. Alcohol was a factor in one-fourth of the pedestrian-motor vehicle injury events and 15 percent of the bicycle-motor vehicle injury events for those age 20 and older. The emergency department data were also examined in conjunction with statewide hospital discharge and motor vehicle crash data in an attempt to better define the overall scope and magnitude of the pedestrian and bicyclist injury problem.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
FHWA-RD-99-078		
4. Title and Subtitle INJURIES TO PEDESTRIANS AND BICYCLISTS: AN ANALYSIS BASED ON HOSPITAL EMERGENCY DEPARTMENT DATA		**5. Report Date** **6. Performing Organization Code**
7. Author(s) Jane C. Stutts and William W. Hunter		**8. Performing Organization Report No.**
9. Performing Organization Name and Address University of North Carolina Highway Safety Research Center 730 Airport Road, CB #3430 Chapel Hill, NC 27599-3430		**10. Work Unit No. (TRAIS)** **11. Contract or Grant No.** DTFH61-92-C-00138
12. Sponsoring Agency Name and Address Office of Safety Research, Development, and Technology Federal Highway Administration 6300 Georgetown Pike McLean, VA 22101-2296		**13. Type of Report and Period Covered** Final Report November 1993 - June 1997 **14. Sponsoring Agency Code**
15. Supplementary Notes Contracting Officer's Technical Representative (COTR): Carol Tan Esse, HRDS		

16. Abstract

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17. Key Words	**18. Distribution Statement**
Bicycle injury, pedestrian injury, bicycle fall, pedestrian fall, non-roadway, non-motor vehicle, alcohol.	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

19. Security Classif. (of this report)	**20. Security Classif. (of this page)**	**21. No. of Pages**	**22. Price**
Unclassified	Unclassified	133	

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SI* (Modern Metric) Conversion Factors

Approximate Conversions to SI Units				
Symbol	**When You Know**	**Multiply By**	**To Find**	**Symbol**
		Length		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		Area		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		Volume		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		Mass		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		Temperature (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		Illumination		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		Force and Pressure or Stress		

lbf	poundforce	4.45	newtons	N
lbf/in²	poundforce per square inch	6.89	kilopascals	kPa

Approximate Conversions from SI Units

Symbol	When You Know	Multiply By	To Find	Symbol
		Length		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		Area		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		Volume		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		Mass		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		Temperature (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		Illumination		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl

Force and Pressure or Stress				
N	newtons	02.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

* SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

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CHAPTER 1. INTRODUCTION

Background

Walking and bicycling are basic forms of transportation that are accessible to virtually all Americans. For many individuals--those too young or too old to drive, those who cannot afford to own a car, or those who simply choose *not* to own a car--walking or bicycling may be the only viable option for meeting personal transportation needs. Others may choose to park their automobile and walk or bicycle for fitness, health, economic, or environmental reasons, or simply for the enjoyment of being outdoors.

Figure. Picture of woman riding bike on street.

Over the past decade the Federal Government has taken unprecedented steps to increase support for bicycling and walking at the national as well as State and local levels. The National Bicycling and Walking Study, mandated by Congress in 1991, established two far-reaching goals: the first, to double the percentage of trips made by bicycling and walking, and the second, to reduce by 10 percent the number of bicyclists and pedestrians killed or injured in traffic crashes (FHWA, 1994). The Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, and its successor, the Transportation Equity Act for the 21st Century (TEA-21), have established the necessary funding opportunities and policies for achieving these goals.

The purpose of the current study was to broaden understanding about the safety of pedestrians and bicyclists. Traditionally, the U.S. Department of Transportation has relied on State motor vehicle crash data, based on reports completed by police and other law enforcement officers, as their primary source of information on events causing injury to pedestrians and bicyclists. While these data provide considerable information to help guide safety program and countermeasure development, they have often been referred to as "the tip of the iceberg" because they are limited almost entirely to motor vehicle-related events that occur on public roadways. Specifically, they exclude: (1) many bicycle-motor vehicle and pedestrian-motor vehicle crashes that occur in non-roadway locations such as parking lots, driveways, and sidewalks, and (2) bicycle and pedestrian falls that do not involve a motor vehicle, regardless of whether they occur on a roadway or in a non-roadway location. There is also evidence that even many pedestrian- and bicycle-motor vehicle collisions occurring on public roadways are not reported in police crash files.

The number of "missed" cases is substantial. More bicyclists are injured in bicycle-only events than in collisions with motor vehicles, and falls are a leading cause of injury for people of all ages and especially for the elderly. While a large percentage of falls occur on stairs and inside buildings or homes, pedestrians walking or jogging on sidewalks, stepping off curbs, and crossing roadways also fall, and this information is largely unreported.

The current study was conducted to provide a more accurate description of the entire spectrum of events causing injury to pedestrians and bicyclists, as an aid to more effective countermeasure and program development. Specifically, the study sought to:

a. determine the frequency and characteristics of pedestrian and bicyclist collisions with motor vehicles occurring in non-roadway locations;
b. determine the frequency and characteristics of pedestrian and bicyclist injuries resulting from transport-related collisions or falls that do not involve a motor vehicle, including bicycle-bicycle, pedestrian-bicycle, bicycle-only, and pedestrian-only events;
c. determine the relative significance of non-roadway and non-motor vehicle events to the overall pedestrian and bicyclist injury problem;
d. explore the role that alcohol plays in injuries incurred by pedestrians and bicyclists; and
e. to the extent possible, combine available information from multiple data sources to estimate overall numbers of injured pedestrians and bicyclists.

The diagram in figure 1 identifies the four categories of pedestrian and bicyclist injury events addressed by this study, as defined by the location of the event with respect to the roadway and whether or not a motor vehicle was involved. Currently, most of what is known about collisions involving pedestrians and bicyclists falls into category A, since these are the events most likely to be reported by police and to appear on State motor vehicle crash files. However, with the more widespread use of External Cause of Injury or "E-codes" (U.S. Department of Health and Human Services, 1991) in hospital discharge and even some emergency department databases, more information is becoming available on the other categories of injury-causing events. The current report has combined information from police reports as well as medical sources to provide information with regard to all four quadrants of the matrix.

	Motor Vehicle	Non-Motor Vehicle
Roadway	A	B
Non-roadway	C	D

Figure 1. Types of events causing injury to pedestrians and bicyclists.

Literature Review

number of studies conducted in the United States as well as in Australia, New Zealand, and several European nations provide insight into non-roadway and non-motor vehicle-related events causing injury to pedestrians and bicyclists. Some of these studies address only a subset of the matrix shown in figure 1, for example, motor vehicle and non-motor vehicle-related bicycle crashes occurring on the roadway (quadrants A and C), or motor vehicle-related bicycle crashes occurring in both roadway and non-roadway locations (quadrants A and B). Other studies address all four areas of interest. Most of the studies have relied on a combination of police and hospital or emergency department data, sometimes supplemented by surveys or interviews. In some cases, direct comparisons have been drawn between databases.

The specific results of the studies vary widely; however, they all confirm that non-roadway and non-motor vehicle events pose significant threats to the safety of pedestrians and bicyclists. They also reveal that official road accident statistics, as determined from police crash reports, greatly underestimate the numbers of pedestrians and bicyclists being injured.

Foreign Research Studies

In Western Australia, hospital admission and police crash report data spanning the 15-month period October 1987-December 1988 were linked to produce a Road Injury Database (Rosman and Knuiman, 1994). Police crash reports were identified for 74 percent of the bicyclists and 69 percent of the pedestrians who had been admitted to a hospital for treatment of injuries resulting from (reportable) collisions with motor vehicles.

Examining the bicycle cases in more detail, it was found that of 842 bicycle-related hospital admissions, 76 percent were the result of a bicycle-only crash, 21 percent a bicycle-motor vehicle crash, and 4 percent were of unknown etiology (Piggott, 1994). In contrast, for the 1,066 police-reported bicycle crashes, only 8 percent were bicycle-only falls, 84 percent resulted from a collision with a motor vehicle, and 9 percent were unknown. Also, whereas 72 percent of the bicycle-motor vehicle cases were linked to the police crash files, only 5 percent of the bicycle-only crashes were linked. The authors conclude that "casualties from bicycle-only crashes are seriously underreported to the police." Information on the location of the injury events was not reported, although it was noted that the police-reported cases arose primarily from on-road collisions.

In a survey of hospitals carried out nationwide in Australia in 1990-1991, pedestrians comprised 15 percent of all admissions for road traffic injuries and bicyclists 9 percent (O'Connor and KPMG Peat Marwick, 1993). For this sample of hospital admissions, 94 percent of the pedestrians were injured in motor vehicle traffic accidents and 5 percent in motor vehicle non-traffic accidents, with just over 1 percent falling into a category of "other" road vehicle accidents. In contrast, 68 percent of the admitted bicyclists were injured in collisions with motor vehicles (63 percent on road, 5 percent off-road) and 32 percent in other, bicycle-only events. The authors of the report note that minor injuries requiring only emergency department treatment were especially likely to be underreported by police, with over twice as many cases appearing on emergency department files as on police files.

A New Zealand study revealed that nearly three-quarters (74 percent) of bicyclists admitted to a hospital for treatment during 1988 were injured on the roadway; however, only a third of these involved collisions with a motor vehicle (Collins, 1993). In addition to being injured on the roadway, bicyclists were also injured at home (9 percent) and at recreational or sport sites (4 percent). In 13 percent of the cases, the place of injury was noted as "other" or "unknown." Although representing only a third of hospital admissions, bicycle-motor vehicle collisions were much more likely to result in serious injury or death. In the 10-year period 1979-88, 238 bicyclists were fatally injured in New Zealand: 209 (88 percent) in collisions with a motor vehicle, and 228 (96 percent) on the roadway.

Studies using hospital discharge and emergency department data in Finland and Denmark also report high percentages of bicyclists being injured on public roadways, but many of these incidents did not involve a motor vehicle. In Finland, 80 percent of hospitalized bicyclists were injured in road-related accidents. Non-motor vehicle events accounted for 58-72 percent of the inpatients and 93 percent of the outpatients treated (Olkkonen, 1993). In Denmark, the results of a mail survey sent to 3,000 bicyclists treated at a large hospital emergency department revealed that 60 percent of the bicyclists had been injured in bicycle-only events and only 40 percent in collisions with other vehicles. Forty-two percent of the crashes had occurred on the roadway and an additional 44 percent on bicycle "tracks" or bicycle lanes along the roadway (Larsen, 1994).

When hospital databases have been compared to official road accident statistics, results have generally shown significantly fewer cases reported in the police-based files. In a New Zealand study, the ratio of official Ministry of Transport records for numbers of road accident victims compared to hospital admission figures was computed for various categories of road users over the 10-year period 1973-1982 (Morrison and Kjellstrom, 1987). Overall, the ratio of police-reported to hospital-reported cases was .66, but dropped to about .20 for bicyclists and .50 for pedestrians. For all categories of road users, the ratio declined over the 10-year study period.

European and British studies add to the range of findings. Maas and Harris (1984) reported ratios of .78 and .82 for numbers of police-reported versus hospital-reported pedestrian and bicyclist injuries, respectively, in The Netherlands during the early 1970s. In a subsequent article, Harris (1990) reported that these ratios had declined to less than 70 percent by the late 1980s. Using information gathered from a national telephone survey that was restricted to "reportable" accidents, but which included all levels of injury severity, not just hospital cases, Harris documented ratios of .11 for bicyclists and .25 for pedestrians. The .11 figure for bicyclists was the lowest of any of the examined road-user groups. In other research, a German study reported ratios of .30 for hospitalized bicyclists and .20 for bicyclists receiving outpatient treatment only (Hautzinger et al., 1993), while an early British study reported .24 for bicyclists receiving either inpatient or outpatient treatment (Bull and Roberts, 1973).

These studies in the foreign literature all point to the fact that official road accident statistics, based on police crash reports, underestimate injuries to pedestrians and bicyclists due to an underreporting of events that do not involve a motor vehicle, those that occur off the public roadway, and/or those that result in relatively less serious injuries. Part of this is due to the specific reportability requirements in effect. The international definition of a road traffic accident is an accident occurring or originating on a way or street open to public traffic, resulting in one or more persons being injured or killed, and involving at least one moving vehicle (United Nations, 1994). In many countries, however, only accidents involving a *motor* vehicle are reported. And regardless of specific reportability requirements, medical sources such as hospital emergency departments and hospital discharge databases consistently capture significantly larger populations of injured pedestrians and bicyclists.

U.S. Research Studies

The same trends observed abroad are reflected in the U.S. literature. In the United States, a traffic accident is officially defined as

"an accident that involved a motor vehicle that occurred on a public highway or road in the U.S. and that resulted in property damage or personal injury. Does not include accidents that have happened in a parking lot, in a driveway, on a private road, or in a foreign country." (USDOT, 1996, p. 189).

In practice, some States do report crashes that occur in public parking lots, driveways, or other "public vehicular areas," and even in private off-road locations in cases of serious injury. These cases, however, are generally excluded from national databases such as FARS (Fatal Accident Reporting System). Reporting practices vary from State to State. In a recent study of pedestrian and bicyclist crashes based on police crash reports from six States (California, Florida, Maryland, Minnesota, North Carolina, and Utah), the percentage of pedestrian crashes that were coded as occurring on private property varied from only 4 percent in California to 25 percent in Florida (Hunter et al., 1996). Walker (1993) noted that both Florida and Indiana reported "non-traffic" collisions; and although he concluded that the Indiana data were the most reliable, they were still found to capture less than half of all non-traffic events.

An early U.S. study that provided information on differences between official traffic accident databases and medical records was the Northeastern Ohio Trauma Study (Barancik and Fife, 1985). The study was based on a probability sampling of emergency department visits during 1977 to 42 hospitals in a 5-county region. Crash reports were identified for 55 percent of the emergency department patients treated for injuries received in a motor vehicle crash, and for 74 percent of the crash victims who were subsequently hospitalized. Separate information for pedestrians and bicyclists was not reported.

A number of emergency department studies have been carried out focusing on events causing injury to bicyclists. Generally, the studies have shown that a large percentage of bicyclist injuries treated in hospital emergency departments do not involve a motor vehicle. Actual percentages vary, depending on the particular setting of the study, but range from 13 percent in Minneapolis (Davis et al., 1980) to 50 percent in Boulder (Watts et al., 1986).

Analyzing special survey data collected by participating hospital emergency departments in North Carolina (10 hospitals in 1985 and 15 in 1986), Stutts et al. (1990) found that only 18 percent of the bicyclists were injured in collisions with motor vehicles. More than half (53 percent) of the injury events occurred in roadway locations, 17 percent in driveways, 6 percent on sidewalks, and 24 percent in other non-roadway locations such as parking lots, yards, or on private unpaved roads. While 60 percent of the bicycle injury cases involving a motor vehicle were linked to the North Carolina crash file, only 10 percent of all reported cases were linked.

One of the most comprehensive studies of injuries to bicyclists was carried out under the direction of the U.S. Consumer Product Safety Commission using 1991 National Electronic Injury Surveillance System (NEISS) data supplemented by followup telephone interviews with the injured bicyclists (Rodgers, 1995; Rodgers, 1993). The study also included analysis of bicycle-related deaths reported in FARS and a national random-digit dial telephone survey for gathering information on bicyclist exposure to crashes and injuries. NEISS is a representative sampling of U.S. hospital emergency departments. Only 10 percent of the bicycle injury cases reported through NEISS involved a collision or near collision with a moving motor vehicle. Just over half (53 percent) of the reported injuries occurred on a public roadway (mostly neighborhood streets), 5 percent on unpaved roads, 12 percent on sidewalks or playgrounds, 5 percent on trails, and less than 1 percent on bicycle paths. The remaining 25 percent were unaccounted for.

Baker et al. (1993) also examined NEISS data and reported the following locations for bicycle-related injuries reported by the system in 1987, 1989, and 1990: 34 percent on roadways, 28 percent at home (includes sidewalks and driveways), 6 percent at other public locations (schools, sport or recreational sites, etc.), and 32 percent unknown. Overall, 12 percent of the cases in this 3-year file were reported to involve a motor vehicle.

The Rodgers (1993; 1995) and Baker et al. (1993) studies also made comparisons between bicycle-related deaths reported by the National Center for Health Statistics (NCHS) based on death certificate data and the FARS data based on State police crash reports. Generally, these comparisons revealed that FARS contains 8-10 percent fewer bicycle-related deaths than does the NCHS database. This was attributed to the fact that approximately 10-14 percent of bicycle-related fatalities do not involve a motor vehicle and/or do not occur on public roadways. These findings are supported by earlier analyses carried out by the Centers for Disease Control and Prevention, showing that 90 percent of bicyclist fatalities involve motor vehicles and 86 percent occur on public roadways (Sacks et al., 1991) .

Pedestrian studies utilizing emergency department and other sources of data besides police crash reports have focused primarily on motor vehicle events involving young children. One of the earliest such studies examined fatally injured pedestrians ages 5 and under in Washington State. A review of coroner and other medical records showed that 58 percent of the reported fatalities resulted from non-traffic (i.e., non-roadway) events, with backing accidents in driveways being the single largest contributor (Brison et al., 1988). Agran et al. (1990) reported that 25 percent of injuries serious enough to require hospitalization in pedestrians under age 15 occurred in non-traffic events, while Walker (1993) reported that 20 percent of injuries to pedestrians under age 16 were due to non-traffic events. In general, the proportion of non-traffic events declined with increasing age in each of these studies. Using police reports on non-traffic injuries provided by the State of Indiana, Walker (1993) also developed a taxonomy of non-traffic pedestrian-motor vehicle crash types that included driveways, parking lots, alleys, and private streets.

In a national analysis of childhood injury deaths using NCHS mortality tapes, 16 percent of all fatalities for children ages 0-14 were found to result from pedestrian-motor vehicle collisions. Of these, 15 percent were non-traffic events occurring in parking lots, driveways, and other off-road locations (Waller et al., 1989).

One of the few studies to examine pedestrian accidents or falls not involving a motor vehicle was carried out by Eck and Simpson (1996). Noting the lack of available information to guide traffic engineers in developing effective countermeasures for such events, the authors explored the feasibility of using emergency department and emergency medical services records to supplement police accident report data. Although their approach did not prove practical for routine use, it did point out the importance of surface condition to pedestrian safety. Slippery surfaces from ice or snow and surface holes or openings were identified as being especially problematical for pedestrians (Eck and Simpson, 1996).

Summary

The literature review has included a broad range of studies carried out in the United States, Australia, New Zealand, The Netherlands, Denmark, and Germany. Although the varying methodologies, data sources, reporting requirements, and traffic environments make it difficult to draw consensus from the studies, the following summary statements are offered:

- Official motor vehicle crash statistics have been shown to significantly underestimate the numbers of injured pedestrians and bicyclists. Between 60 and 75 percent of hospitalized victims of pedestrian- and bicycle-motor vehicle crashes were identified in official motor vehicle crash files. For patients receiving only emergency department treatment, the reported percentages ranged from 50-60 percent. Reported ratios of police-reported to hospital-reported injury cases ranged from .50 to .78 for pedestrians and from .20 to .82 for bicyclists. These ratios dropped when emergency department cases were included in the database.
- The reported percentages of bicyclists admitted to a hospital as a result of a bicycle-only rather than a bicycle-motor vehicle event varied widely, but most estimates fell in the 60-70 percent range.
- On average, between 5 and 20 percent of bicyclists admitted to a hospital were injured in motor vehicle events that occurred in a non-roadway or non-traffic environment. The percentage of non-roadway cases was higher in The Netherlands, which has a large network of off-road bicycle paths. It was also higher in the U.S. studies reviewed, where non-roadway percentages ranged from 25-50 percent.
- The percentage of pedestrians injured in non-roadway events was highest in the youngest age groups. Approximately 20-25 percent of young pedestrians were reported injured in non-roadway events.

CHAPTER 2. METHODS

Overview

The current study was carried out to provide the Federal Highway Administration (FHWA) and the National Highway Traffic Safety Administration (NHTSA) with more complete information on the full spectrum of situations and events causing injury to pedestrians and bicyclists in order to increase awareness of the problem and to help guide program and countermeasure development.

Figure. EMT removing bicycle accident victim.

FHWA was especially interested in obtaining more detailed information on the location of the injury events with respect to the roadway and on the particular characteristics of road-related events not involving a motor vehicle. Both FHWA and NHTSA were also interested in any additional information that could be gathered on alcohol as a precipitating factor in bicyclist and pedestrian injuries.

The general study approach coupled prospective data collection at hospital emergency departments with retrospective analyses of statewide hospital discharge and motor vehicle crash file data. These databases were analyzed independently and in conjunction with one another to address the study's key research questions.

Three geographically dispersed States were identified and invited to participate in the study--California, New York State, and North Carolina. California and New York State were targeted because they each mandate recording of an External Cause of Injury or "E-Code" (U.S. Department of Health and Human Services, 1991) for each hospital discharge. Although North Carolina does not require E-coding, E-codes are used in the North Carolina Trauma Registry, which incorporates data from approximately a dozen hospitals, including all of the State's Level I and Level II trauma centers. Also, limited E-coded hospital discharge data were available from a North Carolina Hospital Inpatient Discharge Database, formerly maintained by the North Carolina Medical Database Commission.

In each of the three States, two or three hospital emergency departments were identified that were willing to participate in the data collection. For this phase of the study, a special survey form was developed for use in recording information about pedestrian and bicyclist cases to be included in the study (see appendix A). Emergency department data were collected over approximately a 1-year time period at each of the hospitals.

The emergency department survey forms were all forwarded to the Highway Safety Research Center for entry into a computerized datafile and were analyzed using SAS statistical software (SAS, Incorporated, Cary, NC). Project staff also obtained computer files of the hospital discharge data from California and New York State, as well as the Trauma Registry and Medical Database Commission data from North Carolina. Finally, motor vehicle crash data were obtained from each of the States corresponding to the available hospital data. A more detailed description of the data and study methodology follows.

Data Collection Procedures

Emergency Department Data Collection

The following hospitals participated in the emergency department data collection:

New York	
Erie County Medical Center	Buffalo, NY
Millard Fillmore	Buffalo, NY
Children's Hospital	Buffalo, NY
California	
Goleta Valley Hospital Santa Barbara	County, CA
St. John's Medical Center	Oxnard, CA
Doctors Medical Center	Modesto, CA
North Carolina	
Pitt County Memorial Hospital	Greenville, NC
New Hanover Regional Medical Center	Wilmington, NC

In New York State, the hospitals were located in a large urban setting and its surrounding suburbs; in California, in smaller urban settings; and in North Carolina, in smaller urban settings that also pulled from large rural areas. Prior to initiating data collection activities, project personnel met with emergency department staff at each hospital to explain the project, provide in-service training, and finalize the specific data collection procedures.

Appendix B contains a copy of the case identification guidelines that were developed for the in-service training of the emergency department data collection staff. Figure 2 highlights the key definitions adopted for the study.

The actual process of collecting the emergency department data varied across the sites. Data collection activities in the Buffalo area were coordinated through a physician who was also

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Bicyclist: Any person riding or being carried on a bicycle or other two- or three-wheeled vehicle operated solely by pedals.

Includes: bicycle, tricycle, big wheel, pedal scooter

Excludes: mopeds, other motor-assisted bicycles, motorized scooters

Pedestrian: Any person traveling from one location to another, not in or on a motor vehicle or other road vehicle. Also includes persons working or playing in roadways or other areas generally open to vehicular traffic.

Includes:

(1) all persons injured as a result of being struck by a motor vehicle, regardless of where the collision took place.

(2) other persons injured as the result of a fall or other mishap while walking, running, standing, working, playing, lying, etc. on a public street or highway or in a public vehicular area (PVA). A PVA is any area

that is generally open to and used by the public for vehicular traffic, including entrances to public buildings, parking lots and garages, service stations, stores, restaurants, businesses, etc.

(3) persons injured on other public transportation-related facilities not generally open to vehicular traffic, including, but not limited to, public walkways (sidewalks), alleyways, multi-purpose trails, etc.

Excludes:

(1) persons injured on private property unless a motor vehicle is involved.

(2) persons injured on public property not serving a transportation function (playgrounds, ballfields, parks, etc.) unless a motor vehicle is involved.

(3) any injury incurred while inside a building, residence, or other structure, with the exception of parking garages and similar facilities.

Figure 2. Case identification definitions for emergency department data collection.

Director of Research for the Department of Emergency Medicine at the University of Buffalo. At the three participating Buffalo hospitals, emergency department staff were trained to identify prospective cases and either completed a supplementary checklist or a draft version of the survey form for each case identified. Once every 1-2 weeks, a data collector supported by the project would visit the emergency department and, working from the information sheets and patient cover sheets, fill out the final survey forms. When information was incomplete or unclear, the data collector was usually able to contact the patient by telephone to obtain the required information. The data collector also played a key role in providing feedback to the emergency department staffs and motivating them to maintain interest in the data collection over the 1-year study period.

In California, the project worked through a local subcontractor to help identify and solicit hospitals to participate in the study, train hospital staff, and oversee the data collection activities. However, at each of the three California hospitals, emergency department personnel completed the actual survey forms themselves. At the Goleta Valley and Modesto sites, the survey forms were completed by hospital staff at the time of the emergency department visit. At the Oxnard site, cases were identified on a weekly basis from a computerized record of all injury cases, and the survey forms were completed by a team of three emergency department nurses. Although no follow-up telephone calls were made to the patients, information recorded in the medical files was generally sufficient to complete the survey form.

At New Hanover Regional Medical Center in Wilmington, N.C., the data collection procedure included a combination of survey forms completed by emergency department staff at the time of treatment and a retrospective examination of case logs to capture any missed cases. All survey forms were completed by the hospital staff. The other North Carolina site, Pitt County Memorial Hospital in Greenville, was the only emergency department where patient injuries are routinely E-coded. Because of this, it was possible to identify cases electronically from the hospital's computerized emergency department records. In order to ensure that patient records contained the necessary information to complete all questions on the survey, including the detailed location of the injury event, emergency department staff were trained to record these particular details in their case documentation.

The actual dates of data collection also varied among the hospitals, but generally spanned a 1-year time period. All data were collected between January 1, 1995 and May 1, 1996.

Hospital Discharge Data

As already noted, California and New York State were selected as data collection sites because each mandates recording of an E-code for all persons discharged from the hospital, and because the State hospital discharge database was centrally maintained and accessible for research purposes. For the current study, project staff developed a list of E-codes that could be used to identify each of the various categories of pedestrian and bicyclist injury events (see table 1).

Table 1. E-code groupings for identification of pedestrian and bicyclist injury cases.

Crash Type	On-roadway (traffic)	Off-roadway (non-traffic)
Bicycle-motor vehicle	E810.6 - E819.6	E820.6 - E825.6
Bicycle only	E826.1 and Place = E849.5	E826.1 and Place = Otherwise
Bicycle-pedestrian (pedestrian injured)	E826.0 and Place = E849.5	E826.0 and Place = Otherwise
Pedestrian-motor vehicle	E810.7 - E819.7	E820.7 - E825.7
Pedestrian only (fall)	E880.9 and Place = E849.5 E883.2 E883.9 E884.9 E885	E880 - E888, otherwise
All other motor vehicle	E810 - E819, except if .6 or .7	E820 - E825, except if .6 or .7

The list is relatively straightforward with respect to bicycle-motor vehicle and pedestrian-motor vehicle events. Bicycle-only events can be identified, but their place of occurrence cannot be identified unless a second E-code (E849) is provided that specifically identifies Place of Occurrence. For example, an E-code of 849.5 identifies an event that occurs on a street or highway. Unfortunately, this second E-code is not typically used with motor vehicle and other road-vehicle events. Second E-codes are recommended, however, when the primary event is a fall, so that pedestrian-only falls that occur on a street or highway can be identified if the primary E-code is a fall and the Place of Occurrence is coded as 849.5. However, pedestrian falls that occur in other off-road locations, including parking lots, sidewalks, and driveways, generally cannot be differentiated from falls occurring on stairs, inside homes, on playgrounds, etc.

With these caveats, New York and California each provided their most recent year(s) of hospital discharge data (1994 in California and 1994-1995 in New York State) on a computerized datafile. The data included all of the E-codes listed in table 1, except for pedestrian falls where no place of injury was recorded. Both States also provided summary tables of fall accidents to be utilized in the analyses.

As noted above, North Carolina does not require that E-codes be reported on hospital discharge records. However, all of the State's Level I and Level II trauma centers include E-codes on the data they submit to the North Carolina Trauma Registry (NCTR). For the current study, a computerized dataset was obtained of all motor vehicle traffic injury discharges during 1994 and 1995. In addition, the project obtained a computerized dataset of bicycle and pedestrian injury cases identified in the North Carolina Medical Database Commission files for fiscal years 1993 and 1994 (the two most recent years available). Although this is a statewide database, E-codes were only reported for an estimated 43 percent of the injury cases and not all hospitals contributed, so the numbers obtained are not an accurate accounting of all bicycle and pedestrian hospitalizations in the State.

State Motor Vehicle Crash Data

To complete the picture, State motor vehicle crash data for all reported crashes involving either a pedestrian or a bicyclist were obtained from each of the participating States--California, New York, and North Carolina. Analysis files were created for each State, containing key variables such as pedestrian/bicyclist age, gender, injury severity, date of crash, and time of day. The datafiles were each examined individually and in conjunction with the hospital and emergency department datafiles to explore issues of reporting and to provide a basis for estimating the relative frequencies of the various categories of pedestrian and bicyclist injury events.

Description of the Data

The tables presented in this section provide an overview of the data obtained from each of the three sources--hospital emergency departments, hospital discharge databases, and State motor vehicle crash files. Additional descriptive tabulations are presented in the body of the report and in the appendices.

Hospital Emergency Department Data

A total of 2,802 pedestrian and bicyclist injury cases were reported by the 8 participating hospitals: 50 percent by the 3 Buffalo sites, 35 percent by the 3 California sites, and 15 percent by the 2 North Carolina sites. Table 2 presents a comparison of the numbers of cases reported by the participating hospital emergency departments and the size of these emergency departments, as measured by their total annual visits. These results suggest relatively higher levels of reporting for Erie County Medical Center and Millard Fillmore Hospital in Buffalo, and for St. John's Medical Center in Oxnard. Certainly, the level of participation by these three hospitals appears to have been strong. However, without more specific information on the numbers and types of injury cases treated at each of the hospitals, it is not possible to draw conclusions about their relative levels of participation or how representative the data are of the total number of treated cases.

The distribution of types of cases reported by the participating hospital emergency departments grouped by State is presented in table 3. Overall, one-third (33 percent) of the reported cases were pedestrian-only events and just over a fourth (27 percent) were bicycle-only events. Motor vehicles were involved in less than a third (30 percent) of the reported incidents. The two North Carolina hospitals reported higher percentages of pedestrian-motor vehicle and bicycle-motor vehicle events, and a much lower percentage of pedestrian-only events. Part of this may be due to the manner in which the data were collected at these sites, particularly at Pitt Table 2.

Table 2. Comparison of reported pedestrian and bicyclist injury cases with total emergency department visits at the eight participating hospitals

	Reported Cases	Estimated Annual Visits
Erie County Medical Center (Buffalo, NY)	475 17.0)[1]	36,000 (12.6)
Millard Fillmore Hospital (Buffalo, NY)	606 (21.6)	25,000 (8.7)
Children's Hospital (Buffalo, NY)	318 (11.4)	45,000 (15.7)
St. John's Medical Center (Oxnard, CA)	672 (24.0)	29,400 (10.3)
Doctors Medical Center (Modesto, CA)	183 (6.5)	40,000 (14.0)
Goleta Valley Hospital (Goleta, CA)	121 (4.3)	9,600} (3.4)
New Hanover Regional Medical Center (Wilmington, NC)	105 (3.8)	53,000 (18.5)
Pitt County Memorial Hospital (Greenville, NC)	322 (11.5)	48,000 (16.8)
Total	2,802	286,000

[1] Percentage of column total.

County Memorial Hospital, where cases were primarily identified from the recorded E-code(s) on a patient's record. As noted earlier, whereas specific E-codes are available for identifying motor vehicle-related events, falls and other non-collision events cannot be as easily identified. Also, the especially high percentage of pedestrian-only events among the New York (Buffalo) cases is probably the result of an unusually cold winter marked by numerous snow and ice storms: just over a third (35 percent) of the pedestrian-only cases reported by the three Buffalo hospitals involved slips on ice or other weather-related falls.

The study also sought information on injury events involving two or more bicycles colliding with one another (bicycle-bicycle) and bicycle collisions with pedestrians (bicycle-pedestrian). Both events were relatively rare, each accounting for only about 1 percent of the reported cases. However, the two event types together accounted for more than 4 percent of the total number of bicycle cases identified.

Table 3. Distribution of pedestrian and bicyclist injury case types by reporting site.

Type of Injury Event	NY	CA	NC	Total
Pedestrian-Motor Vehicle	211 (15.1)[1]	164 (16.8)	147 (34.4)	522 (18.6)
Pedestrian Only	613 (43.8)	275 (28.2)	33 (7.7)	921 (32.9)
Bicycle-Motor Vehicle	121 (8.7)	119 (12.2)	80 (18.7)	320 (11.4)
Bicycle Only	296 (21.2)	339 (34.7)	111 (26.0)	746 (26.6)
Bicycle-Pedestrian	10 (0.7)	9 (0.9)	2 (0.5)	21 (0.8)
Bicycle-Bicycle	14 (1.0)	12 (1.2)	2 (0.5)	28 (1.0)
Other/Uncertain	38 (2.7)	18 (1.8)	47 (11.0)	103 (3.7)
Non-case	96 (6.9)	40 (4.1)	5 (1.2)	141 (5.0)
Total	1399	976	427	2802

[1] Percentage of column total.

Just under 4 percent of the reported cases were identified as "other" or "uncertain" events, with the highest percentage of these being from North Carolina (Pitt County). The majority of these cases arose either from E-codes that could not be directly mapped to a specific category or from cases where hospital personnel simply could not determine whether an individual had been struck by a motor vehicle or not. The latter situation might involve, for example, an injured bicyclist or a drunk pedestrian found lying alongside a roadway. The "other" category includes events such as fingers getting caught in a closing car door, a car running over the foot of a disembarking passenger, a bicyclist riding into the back of a parked vehicle, or other such events that do not fit the usual definition of a pedestrian-motor vehicle or bicycle-motor vehicle collision. Finally, the "non-case" category includes events that, by the case definitions adopted in the current study, were not considered pedestrian or bicyclist events. Examples include a child injured when his sled runs into a lamp post, or a fall from a moped or other motorized two-wheel vehicle.

In addition to the type of event, a second key variable collected for the study was the location where the event occurred, whether on the roadway or in an off-road location such as a sidewalk, driveway, yard, multi-use path, etc. This information is summarized in table 4. Just under half (48 percent) of the reported events occurred in a roadway; 21 percent occurred on a sidewalk; and 9 percent occurred in some type of parking lot. Off-road trails and parks, and private driveways or yards accounted for most of the remaining event locations. The precise location of the event was unknown for just under 10 percent of the reported cases. Whereas roadway locations predominated for events involving a motor vehicle, sidewalks and other off-road locations featured prominently in those events that did not involve a motor vehicle.

Table 4. Distribution of emergency department-reported pedestrian and bicyclist injury cases by location of injury event.

Injury Event Location	Ped-MV	Ped Only	Bike-MV	Bike Only	Ped-Bike	Bike-Bike	Other/ Uncert	Non-case	Total
Roadway	439 84.1)[1]	188 (20.4)	280 (87.5)	347 (46.5)	8 (38.1)	15 (53.6)	39 (37.9)	25 (17.7)	1341 (47.9)
Sidewalk	7 (1.3)	383 (41.6)	15 (4.7)	131 (17.6)	12 (57.1)	3 (10.7)	10 (9.7)	17 (12.1)	578 (20.6)
Driveway, Yard	15 (2.9)	53 (5.8)	0 (0.0)	25 (3.4)	0 (0.0)	1 (3.6)	12 (11.7)	18 (12.8)	124 (4.4)
Parking Lot	33 (6.3)	166 (18.0)	6 (1.9)	17 (2.3)	0 (0.0)	0 (0.0)	18 (17.5)	13 (9.2)	253 (9.0)
Off-road Trail, Park, etc.	2 (0.4)	33 (3.6)	2 (0.6)	76 (10.2)	0 (0.0)	6 (21.4)	5 (4.9)	25 (17.7)	149 (5.3)
Other	3 (0.6)	23 (2.5)	0 (0.0)	15 (2.0)	0 (0.0)	0 (0.0)	3 (2.9)	36 (25.3)	80 (2.9)
Unknown	23 (4.4)	75 (8.1)	17 (5.3)	135 (18.1)	1 (4.8)	3 (10.7)	16 (15.5)	7 (5.0)	277 (9.9)
Total	522	921	320	746	21	28	103	141	2802

[1] Percentage of column total.

Detailed injury event type and event location results based on the hospital emergency department data are contained in chapters 3 and 4 of this report. In addition, appendix C contains additional basic descriptive tables for the emergency department data, including information on the age, gender, race, and disposition status of the injured pedestrians and bicyclists.

Hospital Discharge Data

As noted earlier, computerized hospital discharge data were obtained for each of the three States where emergency department data were collected. For California and New York, these data were available statewide. For North Carolina, where statewide E-coding of hospital discharges is not mandated, two sources of information were examined: computerized data from the North Carolina Trauma Registry and available E-coded data from the North Carolina Hospital Discharge Database. Although the latter is a statewide database, as noted earlier, not all hospitals participated and not all reported injury cases contained a valid E-code for identifying event types. Thus, like the NC Trauma Registry, this data source underestimates the number of hospitalized bicyclists and pedestrians in the State. (See chapter 6 for weighted North Carolina estimates.)

Table 5. Distribution of pedestrian and bicyclist injury cases reported in hospital discharge datafiles.

Injury Event Type	California Hospital (1994)	New York Hospital (1994-95)	NC Trauma Registry (1994-95)	NC Hospital (1994-95)
Pedestrian-MV Road	5884 (49.2)[1]	9796 (45.5)	748 (64.6)	714 (52.1)
Pedestrian-MV Non-road	334 (2.8)	323 (1.5)	44 (3.8)	77 (5.6)
Pedestrian Only Road	1483 (12.4)	6778 (31.5)	- - [2]	- - [2]
Bicycle-MV Road	1235 (10.3)	1645 (7.6)	169 (14.6)	197 (14.4)
Bicycle-MV Non-road	37 (0.3)	61 (0.3)	23 (2.0)	13 (0.9)
Bicycle Only	2886 (24.1)	2622 (12.2)	168 (14.5)	357 (26.1)
Bicycle-Pedestrian	111 (0.9)	325 (1.5)	5 (0.4)	12 (0.9)
Bicycle-Bicycle[2]	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	11,970	21,550	1157	1370

[1] Percentage of column total. [2] No cases identified.

Table 5 summarizes the available hospital discharge data from each State. For California and New York, data were obtained for all cases identified by the E-code listing in table 1. However, the table only includes those pedestrian-only cases that could specifically be identified as occurring on a street or highway. Cases occurring in other locations, or those for which place of occurrence was either missing or unknown, are excluded, since they could also include fall events that would be outside the scope of the study (e.g., falls inside homes or falls occurring at recreational or sports facilities). For North Carolina, no attempt was made to capture pedestrian-only data because the second place of occurrence E-code is not routinely reported. Also, for all States, bicycle-only cases have been grouped into a single category that does not differentiate between roadway and non-roadway events. Again, this is because the place-of-occurrence E-code was not routinely reported for these cases.

Based on the data in table 5, pedestrian-motor vehicle crashes are by far the most frequent injury-causing event, with the vast majority of these occurring in the roadway. Pedestrian-only falls that occur in the roadway are also quite common. For the New York State data, where place of occurrence was routinely coded, pedestrian-only cases made up nearly a third of the database. In California, the percentage was lower, but this is probably an underestimate, since a significant portion of the California cases had missing place-of-occurrence information. Except for the North Carolina Trauma Registry data (which captures more severe injury cases), bicycle-only cases outnumbered bicycle-motor vehicle cases by a factor of nearly two to one.

Additional cross-tabulations of the hospital discharge data are contained in appendix D, with separate tables for bicyclists and pedestrians.

State Motor Vehicle Crash Data

The final data source examined was State motor vehicle crash data. For these data, no attempt was made to identify cases that may not have involved a motor vehicle. The data were used primarily in developing overall projections of pedestrian and bicyclist injuries, and for examining potential underreporting of pedestrian and bicyclist injury events. Table 6 presents the overall case distributions for the data obtained. For New York, more than 70 percent of the pedestrian and 55 percent of the bicycle crashes occurred in one of the five counties defining New York City; and in California, 62 percent of the pedestrian and 51 percent of the bicycle crashes occurred in either the Los Angeles or San Francisco Bay areas. Compared to these two States, North Carolina is much more rural in character.

Additional cross-tabulations of interest for the State crash file data are contained in appendix D.

Table 6. Summary of State pedestrian- and bicyclist-motor vehicle crash data.

Crash Type	California (1995)	New York (1995)	North Carolina (1995)
Pedestrian	17,536 (54.3)[1]	20,640 (68.7)	2,752 (64.3)
Bicycle	14,780 (45.7)	9,390 (31.3)	1,530 (35.7)
Total	32,316	30,030	4,282

[1] Percentage of column total.

The remaining sections of the report provide specific data tabulations that address the primary research questions for this study, namely:

1. What are the frequency and characteristics of bicycle injury events that occur in non-roadway locations and/or those that do not involve a motor vehicle, and how do they differ from bicycle-motor vehicle crashes that occur on the roadway? (chapter 3)

2. What are the frequency and characteristics of pedestrian injury events that occur in non-roadway locations and/or those that do not involve a motor vehicle, and how do they differ from pedestrian-motor vehicle crashes that occur on the roadway? (chapter 4)

3. What role does alcohol play in each of these events? (chapter 5)

4. What are the estimated frequencies of motor vehicle and non-motor vehicle, and roadway and non-roadway events causing injury to pedestrians and bicyclists? (chapter 6)

CHAPTER 3. BICYCLIST INJURY EVENTS

A primary objective of the project was to determine the frequency and characteristics of bicyclist injury events not involving a motor vehicle and/or those occurring in non-roadway locations. Although typically not reported in State motor vehicle crash files, the review of the literature showed that these events are quite common and can result in serious injuries to bicyclists.

Figure. Picture of young child riding bicycle on sidewalk.

The information presented in this chapter draws primarily from the data collected prospectively at the eight participating hospital emergency departments, using the survey form contained in appendix A. Table 7 shows that, overall:

Table 7. Distribution of bicyclist injury cases treated in hospital emergency departments by location and type of event.

Location of Injury Event	Type of Injury Event: Bicycle-MV	Bicycle Only	Total
Roadway	280 (44.7)[1] (92.4)[2]	347 (55.3) (56.8)	627 (68.6)[2]
Non-Roadway	23 (8.0) (7.6)	264 (92.0) (43.2)	287 (31.4)
Unknown	17 (11.2) (--)	135 (88.8) (--)	152 (--)
Total	320 (30.0)[1]	746 (70.0)	1,066

[1] Percentage of row total.
[2] Percentage of column total (excluding unknown cases).

- 70 percent of the reported bicycle injury events did not involve a motor vehicle, including more than half (55 percent) of those that occurred in the roadway.

- Nearly one-third (31 percent) occurred in non-roadway locations, including 8 percent of those that involved a motor vehicle.

The sections below highlight additional information about non-roadway, non-motor vehicle events resulting in injuries to bicyclists. The following four categories of bicycle injury events are examined:

- Bicycle-motor vehicle collisions occurring on the roadway.
- Bicycle-motor vehicle collisions occurring in non-roadway locations.
- Bicycle-only events or falls occurring on the roadway.
- Bicycle-only events or falls occurring in non-roadway locations.

The tables provide information on variable-level distributions within each of these four injury event categories (i.e., column percentages). In some cases figures are included to supplement information contained in the tables. The figures generally examine the distribution of bicycle injury event types within levels of a particular variable (i.e, what would be row percentages in the tables). Figures are also used when the variable contains one primary level of interest (percentage wearing a helmet, percentage involving alcohol, etc.). All tables and figures are based on variable distributions with missing values excluded. Of the 1,066 bicycle event cases documented in table 7,152 or 14 percent occurred in an unknown location, leaving 914 cases available for analysis. Tables with totals of less than 914 reflect missing information for the particular variable examined. For example, table 8 on bicyclist age is based on a total of 901 cases, because there were 13 cases that also had missing age information.

The remainder of this chapter is divided into sections that examine the characteristics of the bicyclists (age, gender, etc.), the locations and times of their crashes, and the injuries that resulted.

Bicyclist Characteristics

Table 8 provides information on the ages of bicyclists involved in each of the four major categories of bicycle injury events. Young children are overrepresented in bicycle-only events, especially those occurring in non-roadway locations: 39 percent of all non-roadway bicycle-only events involved children under 10 years of age, compared to less than 10 percent for bicycle-motor vehicle events occurring on the roadway. In contrast, bicycle collisions with motor vehicles were especially likely to involve adult riders: approximately 45 percent of bicyclists struck by motor vehicles were adults ages 25 or above.

Table 8. Age distribution of bicyclists by type of injury event.

Bicyclist Age	Bicycle-MV Road	Bicycle-MV Non-Road	Bicycle Only Road	Bicycle Only Non-Road	Total
0-9	27 (9.9)[1]	3 (13.6)	82 (23.7)	102 (39.4)	214 (23.8)
10-14	59 (21.5)	5 (22.7)	73 (21.1)	55 (21.2)	192 (21.3)
15-24	66 (24.1)	4 (18.2)	81 (23.4)	48 (18.5)	199 (22.1)
25-44	90 (32.9)	9 (40.9)	73 (21.1)	35 (13.5)	207 (23.0)
45+	32 (11.7)	1 (4.6)	37 (10.7)	19 (7.3)	89 (9.9)
Total	274	22	346	259	901

[1] Percentage of column total.

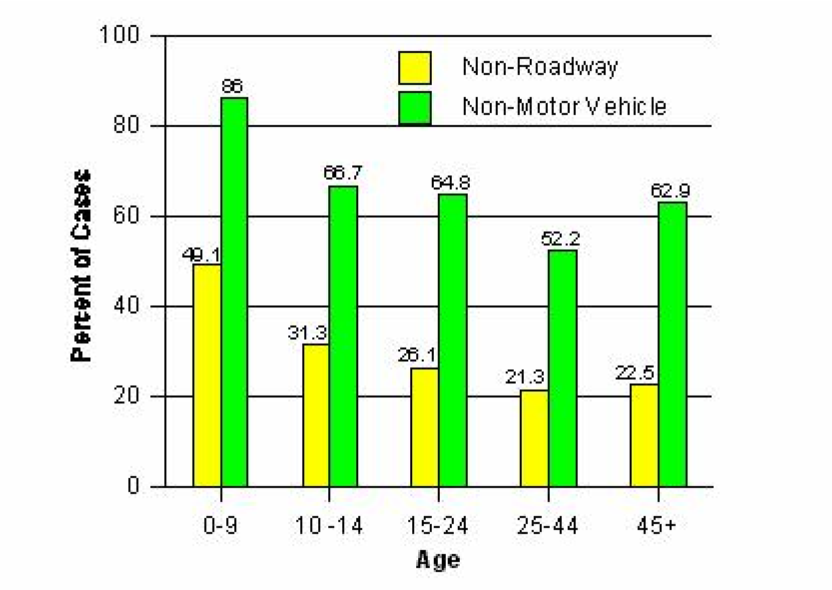

Figure 3. Percentage of bicyclists injured in non-roadway locations or in events not involving a motor vehicle, by age of bicyclist.

Examining the data within age categories (figure 3), nearly half of the children under age 10 and a third of the children ages 10-14 were injured in non-roadway locations. The overwhelming majority of these events did not involve a motor vehicle. For adult bicyclists, the percentages of non-roadway and non-motor vehicle events were lower.

Information on bicyclist gender is presented in table 9 and in figure 4. Males comprised about 82 percent of the bicyclists involved in collisions with motor vehicles and 72 percent of those involved in bicycle-only events. These percentages are not affected by the location of the injury event with respect to the roadway. Figure 4 shows that just over a third (35 percent) of the bicycle injury events for females, and just under a third (30 percent) for males, occurred in non-roadway locations. Females were also more likely than males to be injured in bicycle-only events (75 percent compared to 64 percent).

Table 9. Gender distribution of bicyclists by type of injury event.

Bicyclist Gender	Bicycle-MV Road	Bicycle-MV Non-Road	Bicycle Only Road	Bicycle Only Non-Road	Total
Male	229	19	249	189	686
	(81.8)[1]	(82.6)	(72.4)	(71.9)	(75.4)
Female	51	4	95	74	224
	(18.2)	(17.4)	(27.6)	(28.1)	(24.6)
Total	280	23	344	263	910

[1] Percentage of column total.

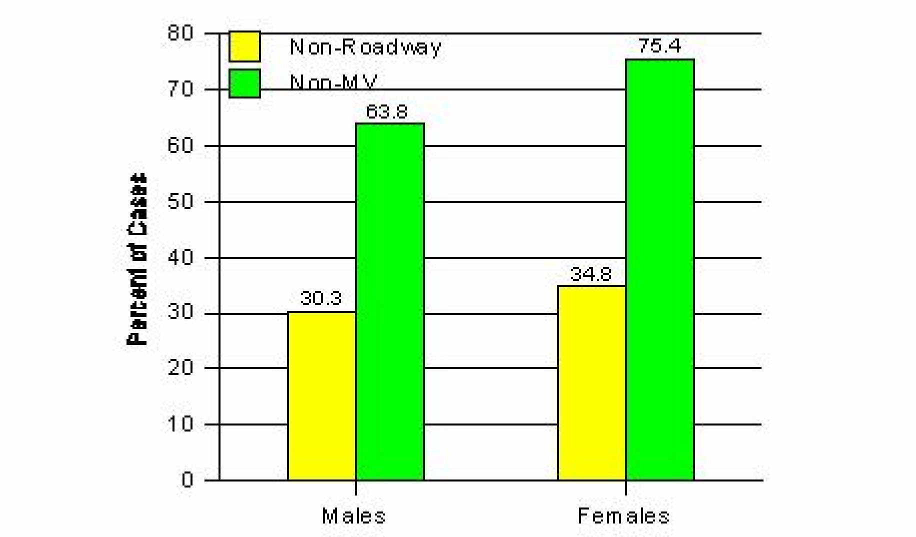

Figure 4. Percentage of bicyclists injured in non-roadway locations or in events not involving a motor vehicle, by gender of bicyclist.

Table 10 contains information on the race of the injured bicyclists. Bicyclists of White or Caucasian background comprised just over half of those injured in bicycle-motor vehicle collisions occurring on the roadway, but nearly three-fourths of both collision and bicycle-only events occurring in non-roadway locations. Nearly a third (30 percent) of the bicyclists injured in motor vehicle collisions occurring on the roadway were Black, and an additional 15 percent were Hispanic. Although it is not possible without adequate exposure data to draw conclusions about overrepresentation of minority populations in specific categories of bicycle-motor vehicle events, it is clear from these data that Black and Hispanic bicyclists are at a higher risk for bicycle-motor vehicle collisions occurring on the roadway, compared to the other types of bicycle injury events. Related to this, figure 5 shows that only a little over half (54 percent) of the injuries to non-White bicyclists did not involve a motor vehicle, compared to 73 percent for White bicyclists. Similarly, non-Whites were less likely to be injured in non-roadway events than were Whites, 22 percent versus 36 percent.

Table 10. Race distribution of bicyclists by type of injury event.

Bicyclist Race	Bicycle-MV Road	Bicycle-MV Non-Road	Bicycle Only Road	Bicycle Only Non-Road	Total
White	142 (51.3)[1]	17 (73.9)	237 (69.5)	195 (75.6)	591 (65.7)
Black	84 (30.3)	3 (13.0)	56 (16.4)	26 (10.1)	169 (18.8)
Hispanic	42 (15.2)	2 (8.7)	30 (8.8)	25 (9.7)	99 (11.0)
Asian	4 (1.4)	0 (0.0)	10 (2.9)	8 (3.1)	22 (2.5)
American Indian	2 (66.7)	0 (0.0)	1 (0.3)	0 (0.0)	3 (0.3)
Other/ Mixed	3 (1.1)	1 (4.4)	7 (2.1)	4 (1.6)	15 (1.7)
Total	277	23	341	258	899

[1] Percentage of column total.

Figure 6 presents information on helmet usage by the injured bicyclists. Actual use rates may be higher, since approximately 20 percent of the cases were reported as unknown and these were not subtracted from the totals. Interestingly, the figure shows that helmet use was highest (35 percent) for bicyclists involved in non-collision, non-roadway events. To some extent, the differences in helmet-wearing rates shown in the figure reflect higher percentages of children involved in non-roadway events, coupled with their generally higher helmet-wearing rates. Still, usage was higher for bicyclists injured in non-roadway locations for children as well as for adults:

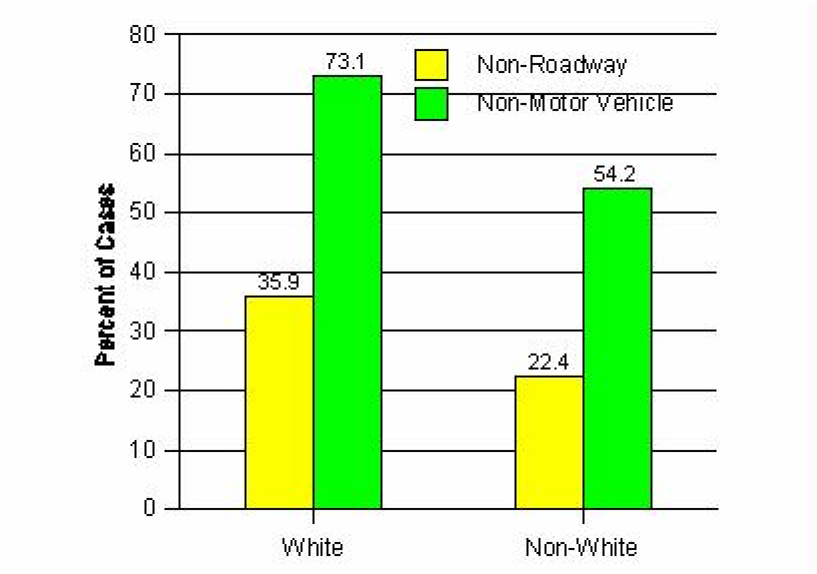

Figure 5. Percentage of bicyclists injured in non-roadway locations or in events not involving a motor vehicle, by race of bicyclist.

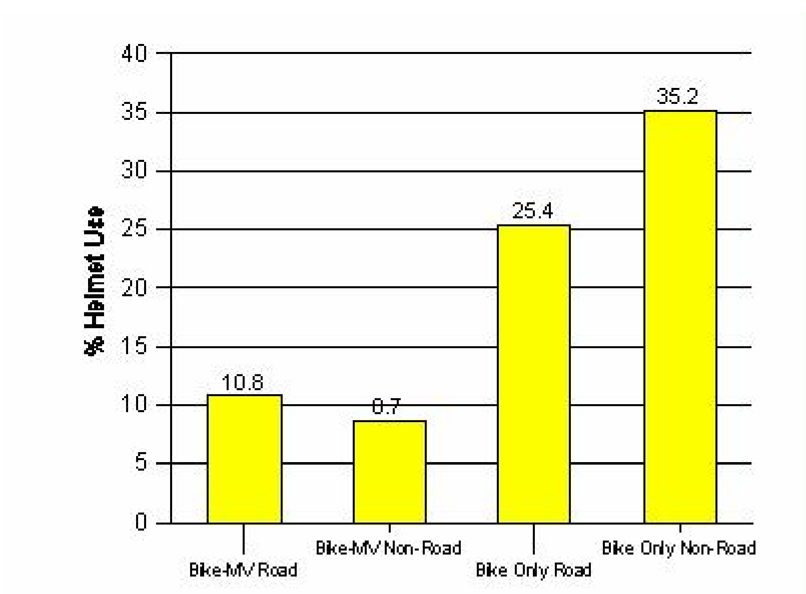

Figure 6. Percentage of bicyclists wearing a helmet by type of bicyclist injury event.

Children < age 15:	33% helmet use on roadway 52% helmet use off roadway
Children age 15:	19% helmet use on roadway 52% helmet use off roadway

Finally, figure 7 shows that bicyclists involved in either collision or non-collision events occurring on the roadway were more likely to have positive test results for alcohol or to be presumed impaired by alcohol. The overall reported frequency of alcohol use was approximately 10 percent for bicyclists struck on the roadway and 3 percent for bicyclists struck in non-roadway locations. Actual levels are likely to be higher, since these percentages are calculated with a substantial number of unknown cases included in the totals. More detailed information on alcohol use for bicyclists as well as pedestrians is presented in chapter 5.

Figure 7. Percentage of bicyclists reported using alcohol by type of bicycle injury event.

Detailed Location and Event Characteristics

In table 7, it was shown that 8 percent of the bicycle-motor vehicle events and 43 percent of the bicycle-only events occurred in non-roadway locations. Table 11 identifies the specific locations where these non-roadway events occurred. Fifteen of the 23 non-roadway bicycle-motor vehicle collisions, or 65 percent, occurred on sidewalks. These typically involved a motor vehicle pulling out of or into a driveway or parking area and crossing over a sidewalk. Most of the remaining non-roadway bicycle-motor vehicle collisions occurred in commercial or other types of parking lots (26 percent).

Table 11. Detailed location of bicycle collisions and falls occurring in non-roadway locations.

Non-roadway Location	Bicycle-MV	Bicycle Only	Total
Sidewalk	15 (65.2)[1]	131 (49.6)	146 (50.9)
Private Driveway or Yard	0 (0.0)	22 (8.3)	22 (7.7)
Public Driveway or Alley	0 (0.0)	3 (1.1)	3 (1.0)
Commercial Parking	4 (17.4)	8 (3.0)	12 (4.2)
Residential Parking	0 (0.0)	3 (1.1)	3 (1.0)
Other Parking	2 (8.7)	6 (2.3)	8 (2.8)
Off-road Trail	1 (4.4)	58 (22.0)	59 (20.6)
Park, Playground, etc.	1 (4.4)	18 (6.8)	19 (6.6)
Other	0 (0.0)	15 (5.7)	15 (5.2)
Total	23	264	287

[1] Percentage of column total.

For the much larger number of non-roadway events that did not involve a motor vehicle, half occurred on sidewalks and 22 percent on off-road trails. The remainder occurred in private or public driveways (9 percent); parks, playgrounds, or other places of recreation (7 percent); and parking lots (6 percent).

In addition to the event types shown in the table, there were 28 incidences of bicycle-bicycle collisions and 21 pedestrian-bicycle collisions. Two-thirds of the bicycle-bicycle collisions occurred on the roadway, and most of the remaining collisions occurred on trails or sidewalks. In contrast, only 40 percent of the pedestrian-bicycle collisions occurred on the roadway, with the remaining 60 percent on sidewalks.

The specific locations of non-roadway bicycle injury events varied for different ages of riders. For the 23 events where a motor vehicle was involved, sidewalk locations predominated for both males and females and for riders under age 15. For riders ages 15 and above, parking lot and trail sites were as frequent as sidewalks. For bicyclists injured in non-roadway bicycle-only events, table 12 shows that sidewalks again predominated for the youngest two age groups. However, half of all non-roadway bicycle-only events that involved riders ages 15 and above occurred on off-road trails or in park locations.

Table 12. Detailed location distribution of non-roadway bicycle-only crashes, by age categories.

Non-Roadway Location	Bicyclist Age 0-9	10-14	15-24	25-44	45+	Total
Sidewalk	72 (70.6)[1]	26 (47.3)	17 (35.4)	11 (31.4)	3 (15.8)	129 (49.8)
Driveway, Yard	14 (13.7)	4 (7.3)	1 (2.1)	0 (0.0)	5 (26.3)	24 (9.3)
Parking Lot	3 (2.9)	2 (3.6)	3 (6.3)	7 (20.0)	2 (10.5)	17 (6.6)
Off-road Trail, Park, etc.	8 (7.8)	16 (29.1)	26 (54.2)	15 (42.9)	9 (47.4)	74 (28.6)
Other	5 (4.9)	7 (12.7)	1 (2.1)	2 (5.7)	0 (0.0)	15 (5.8)
Total	102	55	48	35	19	259

[1] Percentage of column total.

Certainly, young children are much more likely than adults to ride their bicycles on sidewalks, and adults, in turn, may be more likely to ride in parking lots or on off-road trails. Without adequate exposure data, it is again not possible to draw conclusions from the available emergency department data regarding the specific risks associated with bicycling in the various off-road locations identified.

Information on the time of day when the various injury events occurred can be found in table 13. The most frequently cited 4-hour time period is 2-6 p.m., followed by 6-10 p.m. More than two-thirds of the bicycle injury events occurred during these hours. There are only slight variations among the different categories of bicycle injury events. Roadway events are more likely to occur late at night, after 10 p.m., than are non-roadway events. This finding may simply reflect higher nighttime riding exposure on lighted roadways than on unlit paths or trails, as well as fewer children riding at nighttime. And even though only about 6 percent of bicycle collisions and falls occur late at night, this figure itself may represent an increased risk associated with nighttime riding. The few bicycle-motor vehicle collisions occurring in non-roadway locations were overrepresented in the morning and midday time periods, from 6 a.m.-2 p.m.

Table 13. Time-of-day distribution by type of injury event.

Time of Day	Bicycle-MV Road	Bicycle-MV Non-Road	Bicycle Only Road	Bicycle Only Non-Road	Total
6 a.m. - 10 a.m.	19 (8.2)[1]	3 (15.0)	14 (4.8)	10 (4.2)	46 (5.9)
10 a.m. - 2 p.m.	39 (16.7)	7 (35.0)	44 (15.0)	46 (19.3)	136 (17.3)
2 p.m. - 6 p.m.	86 (36.8)	4 (20.0)	114 (38.9)	100 (41.8)	304 (36.7)
6 p.m. - 10 p.m.	71 (28.4)	6 (30.0)	99 (33.8)	74 (31.0)	250 (31.8)
10 p.m. - 2 a.m.	17 (7.3)	0 (0.0)	19 (6.5)	9 (3.8)	45 (5.7)
2 a.m. - 6 a.m.	2 (0.9)	0 (0.0)	3 (1.0)	0 (0.0)	5 (0.6)
Total	234	20	293	239	786

[1] Percentage of column total.

Injury Characteristics

Table 14 presents information on the disposition of the bicycle injury cases reported by the eight participating hospital emergency departments. Overall, 84 percent of the bicyclists were treated and released and 13 percent were hospitalized. This latter percentage is higher than reported elsewhere for emergency department samples of injured bicyclists (see, for example, Baker et al., 1993).

Table 14. Emergency department disposition of bicyclists by type of injury event.

Bicyclist Disposition	Bicycle-MV Road	Bicycle-MV Non-Road	Bicycle Only Road	Bicycle Only Non-Road	Total
Treated & Released	197 (71.6)[1]	20 (90.9)	301 (87.5)	238 (91.5)	756 (83.9)
Admitted	68 (24.7)	2 (9.1)	33 (9.6)	17 (6.5)	120 (13.2)
Fatal	5 (1.8)	0 (0.0)	1 (0.3)	0 (0.0)	6 (0.7)
Transfer/ Other	5 (1.8)	0 (0.0)	9 (2.6)	5 (1.9)	19 (2.1)
Total	275	22	344	260	901

[1] Percentage of column total.

Corresponding figure 8 shows that, among those bicyclists treated and released at the eight hospital emergency departments participating in the study, 71 percent were injured in bicycle- only events. Even among those hospitalized, 42 percent were injured in bicycle-only events, and thus would be unlikely to be reported on State motor vehicle crash files.

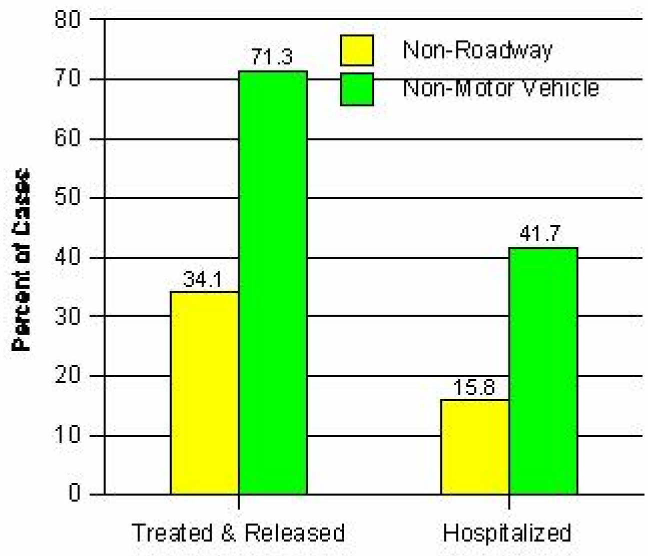

Figure 8. Percentage of non-roadway or non-motor vehicle cases among injured bicyclists who were treated and released and among those hospitalized.

Two codes were used to describe the injuries sustained by the bicyclists treated at the participating hospital emergency departments. One identified the location of the injury (head, face or neck, chest, etc.) and the other the type of injury (laceration, contusion, fracture, etc.). (See second page of data collection form in Appendix A.) Up to five injuries were coded for each case. The data were examined both in terms of the percentage of bicyclists with a given injury type or location, and the percentage of all injuries of a particular type and/or location. For example, 28 percent of all bicyclists suffered one or more injuries to the head, but only 14 percent of all the injuries suffered by all the bicyclists were to the head. Altogether, the 1,066 bicyclists included in the database sustained 1,692 injuries.

Table 15 shows the percentage of bicyclists with one or more injuries in each of the eight body locations identified on the data collection form. Overall, the most frequently injured body locations were the upper and lower limbs (46 percent and 37 percent of all bicyclists, respectively), face or neck (28 percent), and head (22 percent). Bicyclists injured in collisions with motor vehicles were twice as likely to receive lower limb injuries than were those injured in bicycle-only events, and bicyclists struck on the roadway were especially susceptible to injuries to the head and trunk area (including chest, back, and abdomen/pelvis/lower back). These injury patterns probably resulted from the higher speeds of the motorist and bicyclist. The location patterns of injuries resulting from bicycle-only events are virtually the same regardless of whether the event occurred on or off the roadway.

Table 15. Percentage of bicyclists with one or more injuries in specified locations.

Injury Location	Bicycle-MV Road	Bicycle-MV Non-Road	Bicycle Only Road	Bicycle Only Non-Road	Overall
Head	27.9	21.7	19.0	20.5	22.2
Face, neck	29.6	26.1	27.4	28.8	28.4
Chest	12.1	0.0	4.9	2.3	6.2
Back, spine	10.7	4.4	2.6	3.0	5.3
Abdomen, pelvis, lower back	12.5	4.4	4.6	4.9	7.1
Upper limb	40.4	47.8	49.0	48.5	46.2
Lower limb	55.0	56.5	27.7	28.0	36.9
Other	6.1	8.7	5.5	3.0	5.0

Similar information for the types of injuries is contained in table 16. Nearly a third of the bicyclists suffered lacerations or contusions, and 29 percent had one or more broken bones. Differences were again greater between motor vehicle versus non-motor vehicle events than between roadway and non-roadway events. Injuries resulting from collisions with motor vehicles were more likely to involve contusions, sprains or strains, and intracranial and other internal injuries compared with bicycle-only events; they were also less likely to involve lacerations or other open wounds. The likelihood of sustaining a fracture, however, was between 25 and 30 percent for all four populations of bicyclists, regardless of where or how they were injured.

Table 16. Percentage of bicyclists with one or more injuries of specified types.

Injury Type	Bicycle-MV Road	Bicycle-MV Non-Road	Bicycle Only Road	Bicycle Only Non-Road	Overall
Laceration, Open Wound	26.4	17.4	34.6	37.5	32.5
Contusion	43.9	39.1	25.1	23.1	30.6
Fracture	26.8	30.4	29.4	29.2	28.6
Dislocation	2.5	0.0	4.0	2.3	3.0
Sprain, Strain	19.3	17.4	11.2	10.6	13.7
Intracranial	8.2	0.0	4.6	2.3	4.9
Other Internal Injury	3.2	0.0	1.2	0.4	1.5
Superficial Injury	28.2	34.8	25.1	22.7	25.6
Other Injury	11.4	17.4	14.1	10.2	12.4

The final table in this section (table 17) combines information on injury location and type to highlight the most frequently cited injuries for each category of bicyclist. The percentages shown are based on the percentage of all injuries experienced by bicyclists in the event type group, rather than the percentage of bicyclists in the group experiencing a particular injury. Thus, although table 15 showed that 55 percent of bicyclists struck by motor vehicles on the roadway suffered a lower limb injury, table 17 reports that only 29 percent of all injuries to this group of bicyclists were lower limb injuries. Within this category of lower limb injuries, 32 percent were contusions, 22 percent fractures, 20 percent superficial injuries, etc. The column labeled "% All" presents the percentage of all injuries of a specific location and type combination. In a cross-tabulation of injury location by injury type, it is the "cell frequency." It also reflects the probability of the particular location and type combination. For example, if 29 percent of all injuries are to the lower limbs, and 32 percent of these are fractures, then the probability of a fractured lower limb is .29 × .32 = .0928, or 9 percent.

Table 17. Most frequent injuries for each type of bicycle event, categorized by injury location and type.

Bicycle-MV Roadway		Bicycle-MV Non-Roadway		Bicycle Only Roadway		Bicycle Only Non-Roadway	
% Injury Type All[1]		% Injury Type All		% Injury Type All		% Injury Type All	
Lower limb (29%)		Lower limb (33%)		Upper limb (34%)		Upper limb (36%)	
32% contusions	9	53% contusions	17	35% fractures	12	35% fractures	13
22% fractures	6	20% fractures	7	17% superficial	6	26% superficial	9
20% superficial	6	20% superficial	7	15% contusions	5	14% contusions	5
13% laceration	4			14% lacerations	5	12% lacerations	4
11% sprain/strain	3					9% sprain/strain	3
Upper limb (21%)		Upper limb (26%)		Face / neck (23%)		Face / neck (21%)	
26% contusions	5	33% fractures	9	46% lacerations	11	52% lacerations	11
26% superficial	5	33% superficial	9	22% superficial	5	15% superficial	3
20% fractures	4	17% contusions	4	13% fractures	3	11% fractures	2
11% lacerations	2			11% contusions	3	9% contusions	2
Face / neck (16%)				Lower limb (18%)		Lower limb (19%)	
32% lacerations	5			26% superficial	5	30% superficial	6
20% superficial	3			18% contusions	4	30% lacerations	6
17% sprain/strain	3			20% lacerations	4	18% contusions	3
16% fractures	3			8% fractures	2	11% fractures	2
10% contusions	2						
Head (14%)				Head (13%)		Head (16%)	
31% contusions	4			24% lacerations	3	30% contusions	5
26% intracranial	4			21% intracranial	3	27% lacerations	4
16% lacerations	2			18% other	2	21% other	3
14% other	2			15% contusions	2		

[1] Percentage of all injuries occurring to bicyclists in that injury type group.

Table 17 shows that the most common injuries for bicyclists struck by motor vehicles were lower limb contusions and fractures. In contrast, the most common injuries to bicyclists injured in bicycle-only events were upper limb fractures followed by lacerations to the face and neck areas. Bicyclists struck by motor vehicles and those injured in bicycle-only events in the roadway were about equally likely to receive a head injury, including intracranial injuries and concussions (sometimes coded as "head-other"). However, a large proportion of head injuries were the less serious contusions and lacerations. Head and face/neck injuries are not included for the bicycle-motor vehicle, non-roadway category because of the small number of cases and injuries.

A final outcome that is not shown in the table, but can be calculated from the cross-tabulations used to generate it, is the average number of injuries per bicyclist (based on the maximum of five injuries coded per case). These results were:

Bicyclist Injury Type	**Ave. No. of Injuries** 2.3
Bicycle-Motor Vehicle Roadway	2.0
Bicycle-Motor Vehicle Non-Roadway	1.7
Bicycle Only Roadway	1.6
Bicycle Only Non-Roadway	

As expected, bicyclists injured in collisions with motor vehicles experienced more injuries, on average, than those injured in non-collision events, and roadway events generally resulted in more injuries than non-roadway events.

Summary of Results

Results for the bicyclist injury events can be summarized as follows:

Overall

- 70 percent of the reported bicycle injury events did not involve a motor vehicle.
- 31 percent occurred in non-roadway locations.
- 55 percent of bicyclist injuries that occurred on the roadway did not involve a motor vehicle.
- 8 percent of bicycle-motor vehicle collisions occurred in non-roadway locations.

Bicyclist Characteristics

- Children were more likely to be involved in bicycle-only events, while adults were more likely to be involved in bicycle-motor vehicle collisions.
- Overall, about three times as many males were involved in bicycle crashes as females.
- The proportion of female bicyclists was higher in bicycle-only events (28 percent) than bicycle-motor vehicle collisions (18 percent), with the pattern being reversed for males.
- White bicyclists comprised just over half of those injured in bicycle-motor vehicle collisions on the roadway, but three-fourths of both bicycle-motor vehicle and bicycle-only events occurring in non-roadway locations.
- Black and Hispanic bicyclists appeared to be at higher risk of bicycle-motor vehicle collisions on the roadway.
- Bicycle helmet use was highest (35 percent) for bicyclists involved in bicycle-only, non-roadway events.
- Bicyclists involved in either collision or non-collision events occurring on the roadway were more likely to be associated with alcohol use.

Event Characteristics

- Almost two-thirds of the non-roadway bicycle-motor vehicle collisions occurred on sidewalks, generally when the motor vehicle was entering or exiting a driveway or parking lot.
- Most of the rest of the non-roadway bicycle-motor vehicle collisions occurred in parking lots.
- Almost half of the bicycle-only non-roadway events occurred on sidewalks and another one-fourth on off-road trails.
- Two-thirds of the bicycle-bicycle collisions (n=28) occurred on the roadway, with most of the remainder on trails or sidewalks.
- 40 percent of the bicycle-pedestrian collisions (n=21) occurred on the roadway, with the remaining 60 percent on sidewalks.
- Bicycle injury events in non-roadway locations for bicyclists under age 15 were likely to involve sidewalk locations, while the locations for bicyclists ages 15 and above tended toward parking lots, trails, and parks.
- Bicycle roadway events were more likely to occur after 10 p.m. than were non-roadway events.

Injury Characteristics

- Overall, 84 percent of the bicyclists were treated and released, and 13 percent were hospitalized.
- Almost one-fourth of the bicyclists injured in collisions on the roadway were hospitalized, compared to less than 10 percent for the other event categories.
- Bicycle-only injuries sustained on driveways and off-road trails were more likely to require hospitalization than injuries sustained on sidewalks.
- Three-fourths of the bicyclists treated and released were injured in non-roadway, non-motor vehicle events and thus were unlikely to be reported in State traffic records files.
- The most frequently injured body locations were upper limbs (46 percent of bicyclists), lower limbs (37 percent), face or neck (28 percent), and head (22 percent).
- Bicyclists injured in collisions with motor vehicles were twice as likely to receive lower limb injuries than those injured in bicycle-only events.
- Bicyclists struck by a motor vehicle on the roadway were especially susceptible to head and trunk (chest, back, and abdomen/pelvis/lower back) injuries.
- The most frequent injury types were lacerations (33 percent), contusions (31 percent), and fractures (29 percent).
- The likelihood of sustaining a fracture was 25-30 percent, regardless of location or motor vehicle involvement.

CHAPTER 4. PEDESTRIAN INJURY EVENTS

This chapter parallels chapter 3, but focuses on the pedestrian. Information is again derived primarily from cases identified by the eight participating hospital emergency departments, using the data collection form found in appendix A. For the purposes of this study, a pedestrian was defined as a person struck by (or who struck) a motor vehicle, regardless of where the event occurred, or a person injured while walking or otherwise traveling on a public roadway, in a "public vehicular area" (parking lot, public driveway, etc.), or on a transportation-related facility, such as a sidewalk or off-road path generally not open to vehicular traffic.

Figure. Picture of young boy sitting on ground behind a parked vehicle preparing to back up.

(See case definitions listed in figure 2). The intent was to include pedestrian-only events or falls that were transportation related (e.g., tripping on sidewalks or falling over curbs), while excluding those unrelated to personal transport.

Table 18 presents an overall breakdown of the identified cases. Altogether there were a total of 1,443 pedestrians identified, including:

- 36 percent injured in collisions with motor vehicles, and
- 64 percent injured in transportation-related falls or pedestrian-only events.

Information on the location of the injury event with respect to the roadway was available for 1,345 cases, or 93 percent of the total. Of these,

- 47 percent occurred on the roadway, and
- 53 percent in a non-roadway location.

As expected, the large majority (88 percent) of pedestrian-motor vehicle collisions occurred on the roadway; however, nearly four out of every five pedestrian-only events occurred on sidewalks, in parking lots, or in other non-roadway locations.

The distribution of cases among the various cells of table 18 is affected not only by the reporting definitions adopted for the study, but also by the particular geographic locations where the data were collected. In particular, the three participating hospitals in the Buffalo, New York area reported a high percentage of pedestrian-only events occurring as a result of icy weather and slippery roadway conditions during the winter months of 1995-96. During this time, there were a total of 220 icy weather-related pedestrian incidents, representing over a fourth of all pedestrian.

Table 18. Distribution of pedestrian injury cases treated in hospital emergency departments by location and type of event.

Location of Injury Event	Type of Injury Event		Total
	Ped-MV	Ped Only	
Roadway	439	188	627
	(70.0)[1]	(30.0)	(46.6)[2]
	(88.0)[2]	(22.2)	
Non-Roadway	60	658	718
	(8.4)	(91.6)	(53.4)
	(12.0)	(77.8)	
Unknown	23	75	98
	(23.5)	(76.5)	(--)
	(--)	(--)	
Total	522	921	1443
	(36.2)[1]	(63.8)	

[1] Percentage of row total.
[2] Percentage of column total (excluding unknown cases).

incidents reported by the Buffalo area hospitals during the 1-year study period. Only two of these cases involved motor vehicles, and the vast majority, 82 percent, occurred in non-roadway locations. Subtracting these cases from the numbers reported in table 18 would alter the percentages slightly: instead of 36 percent of the cases involving a motor vehicle, 43 percent would involve a motor vehicle, and instead of 47 percent occurring on the roadway, 51 percent would be shown as roadway-related. Given that many U.S. cities experience at least some periods of adverse weather conditions during the winter months, we have opted to retain the "icy weather" cases in the tables presented in this chapter. However, the data were also examined with the icy weather cases omitted, and where significant differences emerged (primarily in the pedestrian-only, non-roadway events), these have been noted in the text.

As in chapter 3, the tables present column percentages that highlight the distribution of variables within four major categories of pedestrian injury events:

- Pedestrian-motor vehicle collisions occurring on the roadway.
- Pedestrian-motor vehicle collisions occurring in non-roadway locations.
- Pedestrian-only events occurring on the roadway.
- Pedestrian-only events occurring in non-roadway locations.

Thus, the tables provide information on, for example, the age distribution of pedestrians struck by motor vehicles on the roadway, which can be compared to the age distributions for the other pedestrian event types. Where a figure is included along with a table, it is generally to highlight the distribution of pedestrian injury event types within levels of a variable (i.e., row percents). An example would be the percentage of pedestrian injury events to children ages 0-4 occurring in non-roadway locations. All tables and figures are based on the total available cases with missing values excluded from the percentages.

Pedestrian Characteristics

Table 19 provides information on the ages of pedestrians treated at the participating hospital emergency departments. Overall, nearly a third (30 percent) were children under the age of 15. Children in this age group made up an even larger share of those struck by motor vehicles--39 percent of those struck on the roadway, and 37 percent of those struck in a non-roadway location. Children under 5 years of age were especially overrepresented in non-roadway motor vehicle collisions. Older adults, in contrast, were overrepresented in pedestrian-only events occurring in non-roadway locations: 38 percent of these events involved adults in the 45-64 or 65+ age groups. For the 45- to 64-year-olds, more than 40 percent of their non-roadway falls occurred in icy weather conditions. With these cases subtracted from the table, the 45-64 age group would no longer be overrepresented in non-roadway pedestrian-only events. The oldest pedestrians, age 65+, would remain overrepresented in non-roadway pedestrian-only events even with the icy weather incidents removed.

Table 19. Age distribution of pedestrians by type of injury event.

Pedestrian Age	Ped-MV Road	Ped-MV Non-Road	Ped Only Road	Ped Only Non-Road	Total
0-4	48	10	4	38	100
	(11.0)[1]	(16.7)	(2.2)	(5.8)	(7.5)
5-9	63	5	12	57	137
	(14.5)	(8.3)	(6.5)	(8.7)	(10.3)
10-14	58	7	34	69	168
	(13.3)	(11.7)	(18.5)	(10.6)	(12.6)
15-24	83	14	48	76	221
	(19.0)	(23.3)	(26.1)	(11.7)	(16.6)
25-44	116	15	46	167	344
	(26.6)	(25.0)	(25.0)	(25.6)	(25.8)
45-64	35	4	22	142	203
	(8.0)	(6.7)	(12.0)	(21.8)	(15.2)
65+	33	5	18	103	159
	(7.6)	(8.3)	(9.8)	(15.8)	(11.9)
Total	436	60	184	652	1332

[1] Percentage of column total.

Figure 9 highlights information on the significance of non-roadway and non-motor vehicle events for pedestrians in each of the seven identified age groups. In general, non-roadway and non-motor vehicle events increased in importance with age. Whereas less than half of the injuries to pedestrians under 10 years of age occurred in a non-roadway location and/or did not involve a motor vehicle, these event types characterized approximately three-fourths of the incidents for adults in the 45-64 and 65+ age groups. With icy weather cases omitted, the same general trends held, although actual percentages of non-roadway and non-motor vehicle events were lower, especially in the upper age groups.

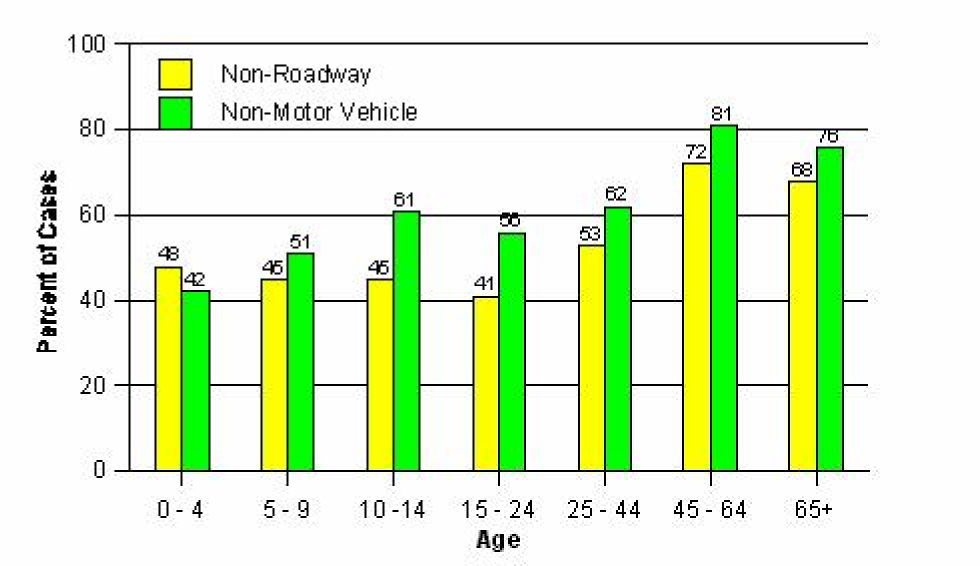

Figure 9. Percentage of pedestrians injured in non-roadway locations in events not involving a motor vehicle, by age of pedestrian.

Gender information is presented in table 20. Overall, as pedestrians, males and females were about equally likely to be injured. However, collisions involving motor vehicles and pedestrian-only events occurring on the roadway were more likely to involve males, whereas pedestrian-only events occurring in non-roadway locations were more likely to involve females. Nearly two-thirds of the pedestrians struck by motor vehicles in the roadway were male. Figure 10, depicting the data within gender categories, shows that females were more likely to be involved in both non-roadway and non-motor vehicle events than were males. Approximately two-thirds of females were injured in non-roadway and/or non-motor vehicle events, compared to only about half of the males. Although the percentage of non-roadway and pedestrian-only events were reduced when icy weather condition cases were omitted from the tables, the observed patterns with respect to gender remained essentially the same.

Table 20. Gender distribution of pedestrians by type of injury event.

Pedestrian Gender	Ped-MV Road	Ped-MV Non-Road	Ped Only Road	Ped Only Non-Road	Total
Male	280	36	109	271	696
	(63.9)[1]	(60.0)	(58.6)	(41.3)	(51.9)
Female	158	24	77	385	644
	(36.1)	(40.0)	(41.4)	(58.7)	(48.1)
Total	438	60	186	656	1340

[1] Percentage of column total.

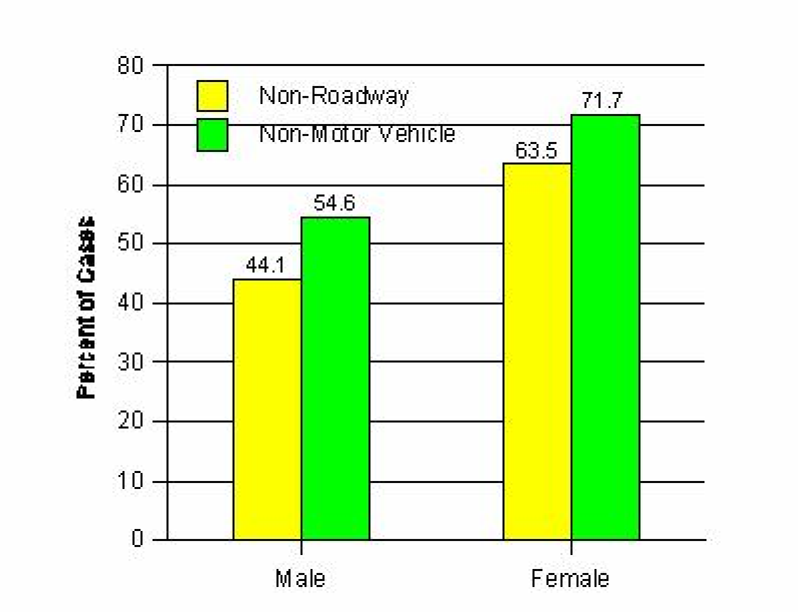

Figure 10. Percentage of pedestrians injured in non-roadway locations or in events not involving a motor vehicle, by gender of pedestrian.

Table 21, with information on race, shows that as was the case with bicyclists, minority populations were overrepresented in pedestrian-motor vehicle collisions occurring on the roadway. Blacks and Hispanics together comprised more than half (51 percent) of these victims. Whites, on the other hand, comprised only 45 percent of those struck by motor vehicles on the roadway; however, they represented three-fourths of those injured in pedestrian-only events. Figure 11 confirms these results, showing that Whites were more than one-and-a-half times as likely to be injured in non-roadway and non-motor vehicle events as non-Whites.

Table 21. Race distribution of pedestrians by type of injury event.

Pedestrian Race	Ped-MV Road	Ped-MV Non-Road	Ped Only Road	Ped Only Non-Road	Total
White	193	37	139	507	876
	(45.0)[1]	(61.7)	(75.5)	(77.8)	(66.1)
Black	159	12	35	91	297
	(37.1)	(20.0)	(19.0)	(14.0)	(22.4)
Hispanic	61	10	7	37	115
	(14.2)	(16.7)	(3.8)	(5.7)	(8.7)
Asian	6	0	2	7	15
	(1.4)	(0.0)	(1.1)	(1.1)	(1.1)
American Indian	2	0	0	1	3
	(0.5)	(0.0)	(0.0)	(0.2)	(0.2)
Other/Mixed	8	1	1	9	19
	(1.9)	(1.7)	(0.5)	(1.4)	(1.4)
Total	429	60	184	652	1325

[1] Percentage of column total.

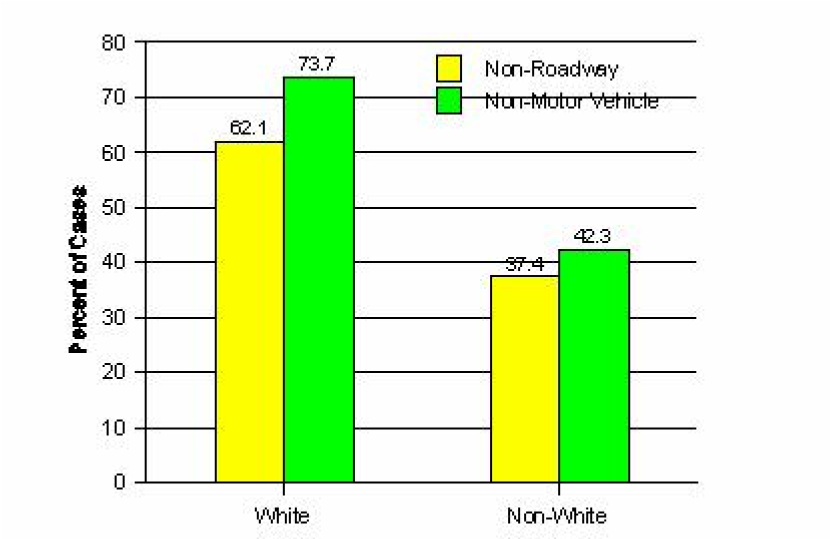

Figure 11. Percentage of pedestrians injured in non-roadway locations or in events not involving a motor vehicle, by race of pedestrian.

Information on alcohol use is shown graphically in figure 12. Overall, approximately 10 percent of the injured pedestrians treated in the hospital emergency departments either tested positive for alcohol or were not tested but presumed to be impaired. For pedestrians injured in motor vehicle collisions occurring on the roadway, this percentage increased to nearly 15 percent. These percentages probably underestimate the level of alcohol use in adults, since children and those with unknown use are included in the totals. More detailed information on the role of alcohol in pedestrian injury events, including additional breakdowns by age and gender, are contained in chapter 5.

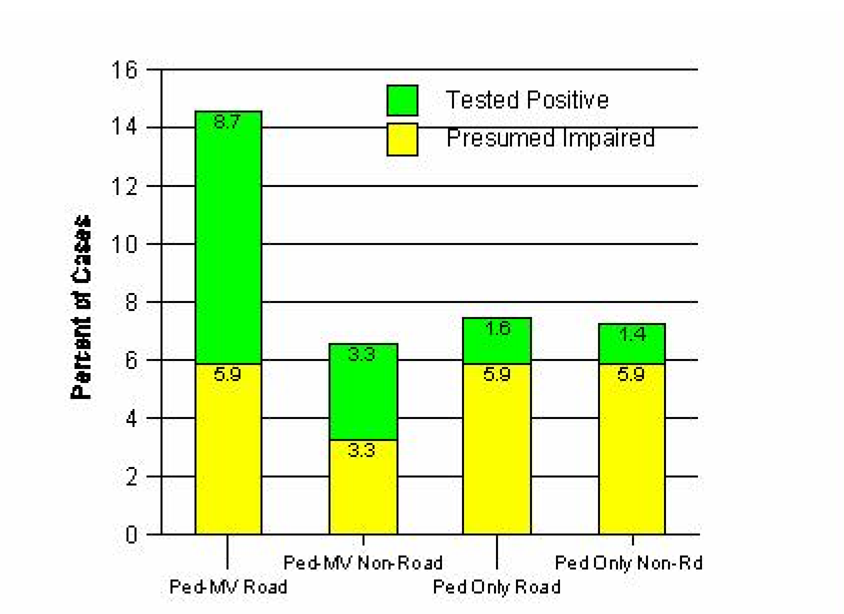

Figure 12. Percentage of pedestrians reported using alcohol by type of pedestrian injury event.

Finally, not all of the reported pedestrian events involved persons engaged in such typical pedestrian activities as crossing a roadway or walking on a sidewalk. Some involved the use of special equipment such as in-line skates, skateboards, or wheelchairs. This was especially true of the pedestrian-only events. Table 22 shows that, of the 188 pedestrian-only events reported as occurring on the roadway, one-fourth involved a pedestrian using in-line skates, and an additional 5 percent involved persons on skateboards. For those injured in falls in non-roadway locations, the corresponding percentages were 12 percent for in-line skates and 3 percent for skateboards. Persons in wheelchairs were involved in less than 1 percent of the events overall, and there was only one case cited that involved a pedestrian pushing a baby stroller. Incidents involving a bicycle (either a regular adult bicycle, child's bicycle, or adult tricycle) primarily resulted from a pedestrian being struck while walking alongside his or her own bicycle, or from the pedestrian tripping and falling while pushing or walking/running alongside a child on a bike.

Table 22. Pedestrian use of special equipment by event type.

Special Equipment	Ped-MV Road	Ped-MV Non-Road	Ped Only Road	Ped Only Non-Road	Total
None	413 (94.1)[1]	57 (95.0)	124 (66.0)	546 (83.0)	1140 (84.8)
Bicycle	10 (2.3)	2 (3.3)	2 (1.1)	2 (0.3)	16 (1.2)
Adult Tricycle	0 (0.0)	0 (0.0)	2 (1.1)	0 (0.0)	2 (0.1)
Wheelchair	3 (0.7)	0 (0.0)	2 (1.1)	5 (0.8)	10 (0.7)
Skates/ Rollerblades	5 (1.1)	1 (1.7)	49 (26.1)	78 (11.9)	133 (9.9)
Skateboard	3 (0.7)	0 (0.0)	9 (4.8)	20 (3.0)	32 (2.4)
Stroller/ Child Carrier	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
Other	4 (0.9)	0 (0.0)	0 (0.0)	7 (1.1)	11 (0.8)
Total	439	60	188	658	1345

[1] Percentage of column total.

Event Characteristics

Table 23 provides information about the detailed location where non-roadway pedestrian events occurred. More than half (55 percent) of the non-roadway pedestrian-motor vehicle collisions occurred in parking lots (commercial, residential, or other); most of the remaining events occurred either in private driveways/yards (22 percent) or on sidewalks (12 percent). In general, adults age 15 and above were more likely to be struck in parking lots, while children under the age of 15 were more likely to be struck in driveways (table 24).

For the much greater number of non-roadway pedestrian-only events, sidewalk locations predominated (58 percent), followed by the various categories of parking lots (25 percent) (table 23). Table 25, with information by age groups, shows that sidewalk locations were particularly common for children under 15 years of age and for senior adults age 65+. For persons ages 15-64, sidewalk locations still predominated, but parking lot locations increased in importance. Nearly half of these parking lot events occurred under icy weather conditions, compared to one out of five for the sidewalk events.

Table 23. Detailed location of pedestrian collisions and falls occurring in non-roadway locations.

Non-roadway Location	Ped-MV Non-Road	Ped Only Non-Road	Total
Sidewalk	7 (11.7)[1]	383 (58.2)	390 (54.3)
Private Driveway or Yard	13 (21.7)	43 (6.5)	56 (7.8)
Public Driveway or Alley	2 (3.3)	10 (1.5)	12 (1.7)
Commercial Parking	15 (25.0)	84 (12.8)	99 (13.8)
Residential Parking	6 (10.0)	8 (1.2)	14 (2.0)
Other Parking	12 (20.0)	74 (11.2)	86 (12.0)
Off-road Trail	1 (1.7)	16 (2.4)	17 (2.4)
Park, Playground, etc.	1 (1.7)	17 (2.6)	18 (2.5)
Other	3 (5.0)	23 (3.5)	26 (3.6)
Total	60	658	718

[1]Percentage of column total.

Time-of-day information is contained in table 26. As was the case with bicycles, the greatest percentage of cases occurred in the 2-6 p.m. and 6-10 p.m. time periods, with a smaller peak from 10 a.m.-2 p.m. For pedestrian-motor vehicle collisions occurring on the roadway, more than a third occurred between 2 and 6 p.m. and an additional 29 percent between 6 and 10 p.m. Compared to roadway events, non-roadway events were more likely to occur earlier in the day, from 10 a.m.-2 p.m. Pedestrian-only events were somewhat overrepresented in the early morning hours, from 6-10 a.m. Otherwise, there were only small differences in time-of-day distributions among the various injury event categories. Although only about 8 percent of pedestrian-motor vehicle collisions occurred late at night, from 10 p.m.-2 a.m., this percentage probably represents an overrepresentation compared to their exposure. Without adequate exposure data, however, no definitive conclusions can be drawn regarding actual risk levels.

Table 24. Detailed location distribution of non-roadway pedestrian- motor vehicle crashes, by age categories.

Non-Roadway Location	Pedestrian Age							Total
	0-4	5-9	10-14	15-24	25-44	45-64	65+	
Sidewalk	0 (0.0)[1]	0 (0.0)	2 (28.6)	3 (21.4)	1 (6.7)	1 (25.0)	0 (0.0)	7 (11.7)
Driveway, Yard	6 (60.0)	2 (40.0)	3 (42.9)	0 (0.0)	2 (13.3)	0 (0.0)	2 (40.0)	15 (25.0)
Parking Lot	4 (40.0)	1 (20.0)	2 (28.6)	10 (71.4)	10 (66.7)	3 (75.0)	3 (60.0)	33 (55.0)
Off-road Trail, Park, etc.	0 (0.0)	1 (20.0)	0 (0.0)	0 (0.0)	1 (6.7)	0 (0.0)	0 (0.0)	2 (3.3)
Other	0 (0.0)	1 (20.0)	0 (0.0)	1 (7.1)	1 (6.7)	0 (0.0)	0 (0.0)	3 (5.0)
Total	10	5	7	14	15	4	5	60

[1] Percentage of column total.

Table 25. Detailed location distribution of non-roadway pedestrian-only crashes, by age categories.

Non-Roadway Location	Pedestrian Age							Total
	0-4	5-9	10-14	15-24	25-44	45-64	65+	
Sidewalk	27	38	48	46	90	62	67	378
	(71.1)[1]	(66.7)	(69.6)	(60.5)	(53.9)	(43.7)	(65.1)	(58.0)
Driveway, Yard	3	8	6	7	5	14	10	53
	(7.9)	(14.0)	(8.7)	(9.2)	(3.0)	(9.9)	(9.7)	(8.1)
Parking Lot	4	4	8	18	56	53	23	166
	(10.5)	(7.0)	(11.6)	(23.7)	(33.5)	(37.3)	(22.3)	(25.5)
Off-road Trail, Park, etc.	3	5	5	2	10	7	0	32
	(7.9)	(8.8)	(7.2)	(2.6)	(6.0)	(4.9)	(0.0)	(4.9)
Other	1	2	2	3	6	6	3	23
	(2.6)	(3.5)	(2.9)	(3.9)	(3.6)	(4.2)	(2.9)	(3.5)
Total	38	57	69	76	167	142	103	652

[1] Percentage of column total.

Table 26. Time-of-day distribution by type of pedestrian injury event.

Time of Day	Ped-MV Road	Ped-MV Non-Road	Ped Only Road	Ped Only Non-Road	Total
6 a.m. - 10 a.m.	31	5	27	87	150
	(9.4)[1]	(10.4)	(15.8)	(13.9)	(12.8)
10 a.m. - 2 p.m.	50	10	28	154	242
	(15.2)	(20.8)	(16.4)	(24.6)	(20.6)
2 p.m. - 6 p.m.	116	13	52	191	372
	(35.2)	(27.1)	(30.4)	(30.6)	(31.7)
6 p.m. - 10 p.m.	97	15	53	138	303
	(29.4)	(31.3)	(31.0)	(22.1)	(25.8)
10 p.m. - 2 a.m.	29	4	10	41	84
	(8.8)	(8.3)	(5.8)	(6.6)	(7.2)
2 a.m. - 6 a.m.	7	1	1	14	23
	(2.1)	(2.1)	(0.6)	(2.2)	(2.0)
Total	330	48	171	625	1174

[1] Percentage of column total.

Injury Characteristics

Table 27 contains information on the disposition of the pedestrians treated at the participating hospital emergency departments. Fifteen of the 1,336 pedestrians, or just over 1 percent, were killed. All of these cases involved pedestrians who were struck by a motor vehicle, and all but one occurred on the roadway.

Since emergency departments usually do not capture cases where someone dies at the scene of a crash, this percentage does not reflect the true mortality associated with pedestrian injury events.

In addition to those killed, nearly one out of five injured pedestrians (19 percent) were admitted to the hospital for further treatment or observation. Not surprisingly, however, this percentage was much higher for pedestrians struck by motor vehicles: nearly 40 percent of pedestrians struck on the roadway were hospitalized, as well as 30 percent of those struck on a sidewalk, in a parking lot, or at another non-roadway location. Figure 13, however, shows that of all pedestrians treated and released from the participating hospital emergency departments, nearly three-fourths (73 percent) were injured in pedestrian-only events and more than 60 percent in non-roadway events. Even among those hospitalized, nearly a fourth were injured in non-motor vehicle or non-roadway events.

Table 27. Emergency department disposition of pedestrians by type of injury event.

Pedestrian Disposition	Ped-MV Road	Ped-MV Non-Road	Ped Only Road	Ped Only Non-Road	Total
Treated & Released	241	40	175	599	1055
	(55.1)[1]	(66.7)	(93.6)	(91.9)	(79.0)
Admitted	174	18	11	49	252
	(39.8)	(30.0)	(5.9)	(7.5)	(18.9)
Fatal	14	1	0	0	15
	(3.2)	(1.7)	(0.0)	(0.0)	(1.1)
Transfer/Other	8	1	1	4	14
	(1.8)	(1.7)	(0.5)	(0.6)	(1.0)
Total	437	60	187	652	1336

[1] Percentage of column total.

Tables 28 and 29 present information on the locations and types of injuries sustained by the pedestrians receiving emergency department treatment. As described in the previous chapter on bicyclists, up to five injuries were coded for each patient, each identified by a location code (head, chest, upper limb, etc.) and a type code (laceration, contusion, fracture, etc.). Tables 28 and 29 report on the number and percentage of pedestrians having one or more injury locations or types. Since patients could have multiple injuries, the column percents total more than 100 percent.

Table 28, with information on injury locations, shows that half (50 percent) of the emergency department patients were treated for lower limb injuries and one-third (33 percent) for upper limb injuries. Lower limb injuries were more common for pedestrians struck by motor vehicles, while upper limb injuries were more common for those injured in pedestrian-only events or falls. Pedestrians struck by a motor vehicle on the roadway also experienced higher rates of injuries to the head, face and neck, and abdomen/pelvis/lower back area. Except for lower percentages of head and face/neck injuries, pedestrians struck by motor vehicles in non-roadway locations experienced injury location frequencies similar to their counterparts who had been struck on the roadway. Likewise, injury patterns were similar for persons injured in pedestrian-only events on the roadway and persons injured in pedestrian-only events in non-roadway locations.

Table 28. Percentage of pedestrians with one or more injuries in specified locations.

Injury Location	Ped-MV Road	Ped-MV Non-Road	Ped Only Road	Ped Only Non-Road	Overall
Head	34.2	16.7	9.0	16.4	21.2
Face, neck	24.4	10.0	18.6	14.7	18.2
Chest	6.6	8.3	2.7	1.8	3.8
Back, spine	6.2	8.3	3.2	4.6	5.1
Abdomen, pelvis, lower back	18.5	13.3	3.7	3.7	9.5
Upper limb	26.0	25.0	38.8	35.7	32.5
Lower limb	61.1	68.3	45.2	41.5	49.6
Other	6.6	5.0	1.1	2.1	3.6

Table 29. Percentage of pedestrians with one or more injuries of specified types.

Injury Type	Ped-MV Road	Ped-MV Non-Road	Ped Only Road	Ped Only Non-Road	Overall
Laceration, Open Wound	21.9	13.3	20.7	14.6	17.8
Contusion	40.8	51.7	20.2	28.7	32.5
Fracture	41.0	25.0	33.5	36.0	36.8
Dislocation	2.1	1.7	3.7	0.8	1.6
Sprain, Strain	9.3	10.0	28.7	25.8	20.1
Intracranial	10.0	1.7	0.0	0.5	3.6
Other Internal Injury	5.2	6.7	0.0	0.3	2.2
Superficial Injury	23.9	18.3	9.6	8.5	14.1
Other Injury	14.8	16.7	2.7	5.5	8.6

More pedestrians suffered fractures (37 percent) than any other single injury type (table 29). Following fractures in order of frequency were contusions (33 percent of pedestrians), sprains or strains (20 percent), and lacerations or other open wounds (18 percent). Pedestrians injured in motor vehicle collisions on the roadway had the highest rate of fractures as well as intracranial (head) injuries. Fractures were also the most frequent outcome, however, for pedestrians injured in pedestrian-only events, followed closely by sprains and strains. As was the case for injury location, motor vehicle involvement appears to play a stronger role in determining the types of injuries that result than does the location of the event with respect to the roadway. In other words, injuries that result from pedestrian-motor vehicle events that occur on the roadway are more similar to injuries that result from pedestrian-motor vehicle events that occur in a non-roadway location than they are to pedestrian-only events, and vice versa.

Finally, table 30 highlights the most frequently cited injuries for each category of injured pedestrian. As in its counterpart table in chapter 3, the percentages in the table are based on the percentage of all injuries experienced, rather than the percentage of pedestrians experiencing a particular injury. As an example, in table 28, 34 percent of all pedestrians struck by a vehicle on the roadway were shown to have incurred an injury to the head; however, in table 30, we see that only 19 percent of all injuries to these same pedestrians were to the head. The "% All" column again shows the percentage of all injuries of a specific location and type combination. (See parallel section in chapter 3 for a more detailed explanation.)

Table 30 shows that, by far, the most common injury types were fractures, contusions, and sprains/strains of the lower leg. Upper limb fractures were also very common for pedestrian-only events (in the Buffalo area, many of these were "slips on ice"). Injuries to the head included a mix of intracranial injuries, contusions, lacerations, and "other" injuries (which could include milder concussions). In general, head and face/neck injuries for pedestrians injured in pedestrian-only events were limited to lacerations, contusions, and more superficial injuries, whereas those occurring to pedestrians struck on the roadway also included fractures (e.g., skull or neck vertebra fractures) and intracranial injuries.

From the cross-tabulations produced to generate table 30, the following average numbers of injuries per event type were calculated:

Pedestrian Injury Type	Ave. No. of Injuries
Pedestrian-MV Roadway	2.3
Pedestrian-MV Non-Roadway	1.8
Pedestrian-Only Roadway	1.3
Pedestrian-Only Non-Roadway	1.3

The results show the expected higher number of injuries for pedestrians struck by motor vehicles, especially those struck on the roadway.

Table 30. Most frequent injuries for each type of pedestrian event, categorized by injury location and type.

Pedestrian-MV Roadway		Pedestrian-MV Non-Roadway		Pedestrian-Only Roadway		Pedestrian-Only Non-Roadway	
% Injury Type	All[1]	% Injury Type	All	% Injury Type	All	% Injury Type	All
Lower limb (34%)	12	Lower limb (44%)	19	Lower limb (38%)	14	Lower limb (35%)	11
36% fractures	11	44% contusions	10	37% sprain/strain	11	33% sprain/strain	11
31% contusions	6	23% fractures	6	29% fractures	5	31% fractures	7
19% superficial	2	15% superficial		14% contusions	5	21% contusions	3
7% sprains/strains				13% superficial		8% superficial	
Upper limb (14%)	4	Upper limb (16%)	6	Upper limb (32%)	12	Upper limb (30%)	14
28% contusions	4	41% contusions	4	39% fractures	6	47% fractures	6
26% fractures	3	24% fractures	3	18% sprain/strain	5	21% contusions	5
24% superficial	2	18% superficial		16% contusions		17% sprain/strain	
12% lacerations							
Head (19%)	4			Face / neck (16%)	10	Head (13%)	7
23% intracranial	4			60% lacerations	3	50% contusions	3
23% contusions	4			18% contusions		23% lacerations	2
19% laceration	3					12% other	1
16% factures	3					10% superficial	
13% other							
Face / neck (13%)	4			Head (7%)	3	Face / neck (13%)	5
29% lacerations	3			47% lacerations	3	41% lacerations	3
20% fractures	2			35% contusions		22% contusions	2
19% superficial	2					15% superficial	
14% contusions	1						
11% sprain/strain							

[1]Percent of all injuries occurring to pedestrians in that injury-type group.

Summary of Results

Results for the pedestrian injury events can be summarized as follows:

Overall

- 64 percent of the reported pedestrian injury events did not involve a motor vehicle.
- 53 percent occurred in non-roadway locations.
- 30 percent of pedestrian injuries that occurred on the roadway did not involve a motor vehicle.
- 12 percent of pedestrian-motor vehicle collisions occurred in non-roadway locations.

Pedestrian Characteristics

- Children under the age of 15 represent 39 percent of the pedestrians struck by motor vehicles on the roadway and 37 percent of those struck in a non-roadway location.
- Less than half of the injuries to pedestrians under 10 years of age occurred in a non-roadway location or did not involve a motor vehicle, but these event types characterized about three-fourths of the incidents in the 45-64 and 65+ age groups.
- Collisions involving motor vehicles and pedestrian-only events occurring on the roadway were more likely to involve males, while pedestrian-only events in non-roadway locations were more likely to involve females.
- White pedestrians comprised just under half of those injured in motor vehicle collisions on the roadway, but three-fourths of those injured in pedestrian-only events.
- Black and Hispanic pedestrians appeared to be at a higher risk of being struck by motor vehicles on the roadway.
- Overall, almost 10 percent of the injured pedestrians either tested positive for alcohol or were presumed to be impaired (15 percent for pedestrians struck by motor vehicles on the roadway).
- Of the pedestrian-only events occurring on the roadway, 26 percent involved persons using in-line skates and an additional 5 percent involved persons on skateboards.
- Overall, persons in wheelchairs were involved in less than 1 percent of the cases.

Event Characteristics

- Just over half of the non-roadway pedestrian-motor vehicle events occurred in parking lots.
- Persons ages 15 and above were more likely to be struck in parking lots, while children under the age of 15 were more likely to be struck in driveways.
- About 60 percent of the non-roadway, pedestrian-only events occurred on sidewalks.
- Sidewalk locations were particularly common for children under age 15 and senior adults age 65+.
- 35 percent of pedestrian-motor vehicle collisions on the roadway occurred between 2 and 6 p.m. and an additional 29 percent between 6 and 10 p.m.
- Non-roadway events were more likely to occur from 10 a.m-2 p.m.
- Pedestrian-only events were somewhat overrepresented in the morning, from 6-10 a.m.

Injury Characteristics

- Overall, 79 percent of the pedestrians were treated and released at the emergency departments and 19 percent were hospitalized.
- Nearly 40 percent of the pedestrians struck on the roadway were hospitalized, as well as 30 percent of those struck on a sidewalk, in a parking lot, or at another non-roadway location.
- Three-fourths of the pedestrians treated and released were injured in pedestrian-only events, and one-fourth of those hospitalized were injured in these events.

- The most frequently injured body locations were lower limbs (50 percent), upper limbs (33 percent), head (21 percent), and face or neck (18 percent).
- Lower limb injuries were more common for pedestrians struck by motor vehicles, while upper limb injuries were more common in the pedestrian-only events.
- Pedestrians struck by motor vehicles on the roadway experienced higher rates of injuries to the head, face or neck, and abdomen/pelvis/lower back area.
- Except for lower percentages of head and face or neck injuries, the injury location distribution was similar for pedestrians struck in non-roadway locations.
- Injury patterns were similar for pedestrian-only events, whether on or off the roadway.
- Most frequent injury types were fractures (37 percent), contusions (33 percent), sprains or strains (20 percent), and lacerations (18 percent).
- Pedestrians struck by motor vehicles on the roadway had the highest rate of fractures, as well as intracranial and other internal injuries.
- Fractures were also the most frequent injury outcome in pedestrian-only events, followed closely by sprains or strains.

CHAPTER 5 - ALCOHOL USE BY INJURED PEDESTRIANS AND BICYCLISTS

The data collection form used to obtain information from injured pedestrians and bicyclists brought to hospital emergency departments contained a question on alcohol involvement. Although different procedures were followed by the hospitals with regard to testing or questioning for alcohol use, and in many instances alcohol use remained unknown, it was felt that an attempt should be made to gather whatever information was available since use of alcohol can be an important factor in pedestrian and bicyclist injury.

Figure. Picture of a man and woman drinking alcohol while walking through traffic.

As shown on the data collection form (appendix A), the response levels pertaining to the question on alcohol involvement were:

- Unknown/no information.
- Presumed not impaired.
- Not tested, but impairment indicated.
- Tested, and results of the testing (blood-alcohol level in mL/dL).

There was also a section on the data collection form pertaining to drug use. However, slightly more than 3 percent of the bicyclists (27 out of 814 with a response available for this variable) and none of the pedestrians brought to the emergency departments were suspected or tested positive for drug use. Thus, no comments pertinent to drug use will be offered for this small sample.

A variety of cross-tabulations were run to examine alcohol use separately for pedestrians and bicyclists. The text that follows covers pedestrian-motor vehicle, pedestrian-only, pedestrian-bicycle, bicycle-motor vehicle, bicycle-only, and bicycle-bicycle events. For these analyses, the "tested nd results" variable level has been dichotomized into two levels, "tested and drinking" and "tested, not drinking," based on the detection of *any* alcohol in the blood. Also, for some of the tables, the two categories, "tested and drinking" and "indicated as impaired," have been combined into a single category described as "had been drinking."

Table 31 shows the overall reported levels of alcohol involvement for the various event types. Highest levels of alcohol involvement were reported for the pedestrian-motor vehicle events: just over 13 percent of the cases were either indicated as impaired or were tested and found to have positive blood-alcohol levels. The corresponding percentage for bicyclists struck by motor vehicles was just over 10 percent. Percentages for "had been drinking" for the other injury event categories were generally in the 6-7 percent range (except for pedestrian-bicycle events, none of which involved alcohol). All of these percentages would be higher if calculated with the "unknowns" excluded from the table. However, the unknowns were left in the calculations, since the hospitals varied in whether they used "unknown" or "presumed not impaired" for young children who ordinarily would not be tested. In the remainder of the chapter, this situation is addressed by also examining tables excluding young children.

Table 31. Distribution of pedestrian and bicyclist injury event types by alcohol use.

Injury Event Type	Unknown	Presumed Not Impaired	Indicated as Impaired	Tested, Not Drinking	Tested and Drinking	Total
Pedestrian-MV	164 (31.4)[1]	243 (46.6)	28 (5.4)	45 (8.6)	42 (8.0)	522 (20.4)[2]
Pedestrian Only	470 (51.0)	364 (39.5)	53 (5.8)	22 (2.4)	12 (1.3)	921 (36.0)
Pedestrian-Bicycle	5 (23.8)	16 (76.2)	0 (0.0)	0 (0.0)	0 (0.0)	21 (0.8)
Bicycle-MV	128 (40.0)	127 (39.7)	19 (5.9)	32 (10.0)	14 (4.4)	320 (12.5)
Bicycle Only	250 (33.5)	397 (53.2)	32 (4.3)	56 (7.5)	11 (1.5)	746 (29.2)
Bicycle-Bicycle	6 (21.4)	20 (71.4)	1 (3.6)	0 (0.0)	1 (3.6)	28 (1.1)
Total	1023 (40.0)	1167 (45.6)	133 (5.2)	155 (6.1)	80 (3.1)	2558

[1] Percentage of row total. [2] Percentage of column total.

Results for Injured Pedestrians

Pedestrian-Motor Vehicle Events

The emergency department database contained information on more than 500 pedestrians who had been struck by motor vehicles. As shown in table 31 above, alcohol use was either unknown or the pedestrians were presumed not impaired in 78 percent of the cases. Overall, 5 percent of the pedestrians were indicated as impaired, and another 8 percent were tested and found to have positive blood-alcohol levels. An additional 9 percent were tested and found not to be impaired.

Table 32, with information on the location of the injury event, shows that 64 of the 68 pedestrians (94 percent) who were either indicated as impaired or who tested positive for alcohol were struck while in the roadway. Of the seven pedestrians struck on sidewalks, two were impaired.

Table 32. Location where injury event occurred by alcohol use for pedestrian-motor vehicle events.

Location of Injury Event	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Roadway	136 (31.0)[1]	196 (44.7)	26 (5.9)	43 (9.8)	38 (8.7)	439 (88.0)[2]
Sidewalk	4 (57.1)	1 (14.3)	2 (28.6)	0 (0.0)	0 (0.0)	7 (1.4)
Trail/Park/etc.	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.4)
Parking Lot	14 (42.4)	18 (54.6)	0 (0.0)	0 (0.0)	1 (3.0)	33 (6.6)
Driveway	4 (26.7)	9 (60.0)	0 (0.0)	1 (6.7)	1 (6.7)	15 (3.0)
Other	0 (0.0)	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	3 (0.6)
Total	159 (31.9)	228 (45.7)	28 (5.6)	44 (8.8)	40 (8.0)	499

[1]Percentage of row total. [2] Percentage of column total.

Reported alcohol use was highest in the 25-44 age group (table 33). More than 15 percent of the injured pedestrians in this age group were indicated as impaired, and an additional 16 percent tested positive for alcohol. Stated differently, about 32 percent of this age group had been drinking. Just over 22 percent of the 45-64 age group had also been drinking (17.5 percent were tested and found to be impaired), but less than 8 percent of the 65+ age group had this result. Overall, about 24 percent of those age 20 and above had been drinking, compared to 14 percent for all age groups combined.

Nearly two-thirds of the pedestrians struck by motor vehicles were male (table 34). Some 16 percent of the males were found to have been drinking, compared to 9 percent of the females. For those age 20 and above, 26 percent of the males and 20 percent of the females had been drinking.

Table 33. Age by alcohol use for pedestrian-motor vehicle events.

Age of Pedestrian	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
0-9	22 (16.4)[1]	103 (76.9)	0 (0.0)	9 (6.7)	0 (0.0)	134 (25.9)[2]
10-14	34 (51.5)	28 (42.4)	0 (0.0)	1 (1.5)	3 (4.6)	66 (12.7)
15-19	23 (36.5)	26 (41.3)	2 (3.2)	7 (11.1)	5 (7.9)	63 (12.2)
20-24	16 (40.0)	13 (32.5)	2 (5.0)	6 (15.0)	3 (7.5)	40 (7.7)
25-44	41 (30.4)	35 (26.0)	21 (15.6)	16 (11.9)	22 (16.3)	135 (26.1)
45-64	13 (32.5)	17 (42.5)	2 (5.0)	1 (2.5)	7 (17.5)	40 (7.7)
65+	13 (32.5)	21 (52.5)	1 (2.5)	3 (7.5)	2 (5.0)	40 (7.7)
Total	162 (31.3)	243 (46.9)	28 (5.4)	43 (8.3)	42 (8.1)	518

[1] Percentage of row total. [2] Percentage of column total.

Table 34. Gender by alcohol use for pedestrian-motor vehicle events.

Gender of Pedestrian	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Male	92 (28.2)[1]	151 (46.3)	21 (6.4)	31 (9.5)	31 (6.5)	326 (62.6)[2]
Female	72 (36.9)	91 (46.7)	7 (3.6)	14 (7.2)	11 (5.6)	195 (37.4)
Total	164 (31.5)	242 (46.5)	28 (5.4)	45 (8.6)	42 (8.1)	521

[1] Percentage of row total. [2] Percentage of column total.

In regard to race, just under half of the pedestrians were White, with 34 percent Black and 15 percent Hispanic (table 35). Nearly 15 percent of the White pedestrians had been drinking, compared to 10 percent for Blacks and 11 percent for Hispanics. For those age 20 and above, these values increased to 24, 18, and 23 percent, respectively.

Table 35. Race by alcohol use for pedestrian-motor vehicle events.

Race of Pedestrian	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
White	85 (35.0)[1]	108 (44.4)	14 (5.8)	14 (5.8)	22 (9.1)	243 (47.7)[2]
Black	55 (31.6)	78 (44.8)	11 (6.3)	24 (13.8)	6 (3.5)	174 (34.1)
Hispanic	18 (24.3)	41 (55.4)	3 (4.1)	7 (9.5)	5 (6.8)	74 (14.5)
Asian	0 (0.0)	7 (87.5)	0 (0.0)	0 (0.0)	1 (12.5)	8 (1.6)
American Indian	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (5.0)	2 (0.4)
Other/ Mixed	2 (22.2)	3 (33.3)	0 (0.0)	0 (0.0)	4 (44.4)	9 (1.8)
Total	161 (31.6)	237 (46.5)	28 (5.5)	45 (8.8)	39 (7.7)	510

[1]Percentage of row total. [2] Percentage of column total.

Examining time of day, about 34 percent of the pedestrians were struck between 2-6 p.m. and another 29 percent between 6-10 p.m. (table 36). Alcohol impairment was more prevalent, however, in late evening and early morning hours. Some 20 percent of those struck between 6-10 p.m. had been drinking, compared to 45 percent for 10 p.m.-2 a.m. and 70 percent for 2-6 a.m. (7 of 10 cases). For age 20 and above, these values increased to 42, 50, and 86 percent (6 of 7 cases), respectively.

Fifty-seven percent of the pedestrians struck by motor vehicles were treated at the hospital emergency department and released, 38 percent were admitted to the hospital, and 3 percent were killed (table 37). The prevalence of alcohol use increased with increasing severity of the injury event: just over 9 percent of those treated and released had been drinking, compared to 18 percent of those admitted and 27 percent of those killed (4 out of 15 cases). For those age 20 and above, these values increased to 19, 28, and 40 percent, respectively. Four of the 15 fatally injured pedestrians had been drinking (1 indicated as impaired and 4 tested and drinking).

Table 36. Time of day by alcohol use for pedestrian-motor vehicle events.

Time of Day	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
6 a.m. - 10 a.m.	13 (34.2)[1]	19 (50.0)	0 (0.0)	4 (10.5)	2 (5.3)	38 (9.6)[2]
10 a.m. - 2 p.m.	24 (37.5)	37 (57.8)	2 (3.1)	1 (1.6)	0 (0.0)	64 (16.2)
2 p.m. - 6 p.m.	54 (40.0)	69 (51.1)	5 (3.7)	0 (0.0)	7 (5.2)	135 (34.2)
6 p.m. - 10 p.m.	37 (32.2)	50 (43.5)	6 (5.2)	5 (4.4)	17 (14.8)	115 (29.1)
10 p.m. - 2 a.m.	9 (27.3)	8 (24.2)	7 (21.2)	1 (3.0)	8 (24.2)	33 (8.4)
2 a.m. - 6 a.m.	1 (10.0)	2 (20.0)	4 (40.0)	0 (0.0)	3 (30.0)	10 (2.5)
Total	138 (35.0)	185 (46.8)	24 (6.1)	11 (2.8)	37 (9.4)	395

[1] Percentage of row total. [2] Percentage of column total.

Table 37. Emergency department disposition by alcohol use for pedestrian-motor vehicle events.

Emergency department Dispos.	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Treated and Released	119 (40.0)[1]	129 (43.3)	17 (5.7)	22 (7.4)	11 (3.7)	298 (57.1)[2]
Admitted	39 (19.8)	99 (50.3)	8 (4.1)	23 (11.7)	28 (14.2)	197 (37.7)
Fatal	3 (20.0)	8 (53.3)	1 (6.7)	0 (0.0)	3 (20.0)	15 (2.9)
Other/ Unknown	3 (25.0)	7 (58.3)	2 (16.7)	0 (0.0)	0 (0.0)	12 (2.3)
Total	164 (31.4)	243 (46.6)	28 (5.4)	45 (8.6)	42 (8.1)	522

[1] Percentage of row total. [2] Percentage of column total.

The tendency for drinking status to be associated with more serious injury is also supported by information on the specific locations and types of injuries sustained. The highest percentages of "had been drinking" were found among those pedestrians with injuries to the head, chest, and back or spine, and for those suffering intracranial or other internal injuries.

Pedestrian-Only Events

Information pertaining to more than 900 pedestrian-only events is also contained in the emergency department database. Persons injured in pedestrian-only events were generally less likely to have been drinking than those struck by motor vehicles. Overall, just under 6 percent of the pedestrians injured in pedestrian-only events were "indicated as impaired," while only a little over 1 percent were tested and found to have a positive blood-alcohol level (see table 31).

Table 38 presents information on alcohol use by the location of the injury event with respect to the roadway. Overall, only 22 percent of the pedestrian-only events occurred on the roadway, while 45 percent occurred on sidewalks and 20 percent in parking lots. Levels of alcohol use were generally highest for those injured on sidewalks, with 9 percent either indicated as impaired or tested and found to have been drinking. In contrast, 7 percent of those injured on the roadway were reported as drinking, and less than 4 percent of those injured in parking lots or driveways were reported as drinking.

Table 38. Location where injury event occurred by alcohol use for pedestrian-only events.

Location of Injury Event	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Roadway	108 (57.5)[1]	56 (29.8)	11 (5.9)	10 (5.3)	3 (1.6)	188 (22.2)[2]
Sidewalk	164 (42.8)	177 (46.2)	28 (7.3)	6 (1.6)	8 (2.1)	383 (45.3)
Trail/Park/etc.	16 (48.5)	15 (45.6)	2 (6.1)	0 (0.0)	0 (0.0)	33 (3.9)
Parking Lot	108 (65.1)	49 (29.5)	4 (2.4)	5 (3.0)	0 (0.0)	166 (19.6)
Driveway	35 (66.0)	16 (30.2)	2 (3.8)	0 (0.0)	0 (0.0)	53 (6.3)
Other	7 (30.4)	11 (47.8)	3 (13.0)	1 (4.4)	1 (4.4)	23 (2.7)
Total	438 (51.8)	324 (38.3)	50 (5.9)	22 (2.6)	12 (1.4)	846

[1] Percentage of row total. [2] Percentage of column total.

Unlike the motor vehicle events, the proportion of adults drinking varied only slightly among the various age groups (table 39). Just under 13 percent of the 20-24 age group had been drinking, compared to just over 13 percent of the 25-44 age group and 11-12 percent of the 45-64 age group. Among those age 65+, only 3 percent were reported to have been drinking. The vast majority of all of these were indicated as impaired rather than tested and drinking. Overall, more than 10 percent of those age 20 and above had been drinking, compared to 7 percent for all ages combined.

Table 39. Age by alcohol use for pedestrian-only events.

Age of Pedestrian	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
0-9	27 (21.4)[1]	97 (77.0)	0 (0.0)	2 (1.6)	0 (0.0)	126 (13.9)[2]
10-14	60 (50.9)	53 (44.9)	1 (0.9)	3 (2.5)	1 (0.9)	118 (13.0)
15-19	49 (61.3)	28 (35.0)	1 (1.3)	2 (2.5)	0 (0.0)	80 (8.8)
20-24	32 (58.2)	14 (25.5)	6 (10.9)	2 (3.6)	1 (1.8)	55 (6.0)
25-44	124 (54.2)	70 (30.6)	26 (11.4)	5 (2.2)	4 (1.8)	229 (25.2)
45-64	100 (57.5)	49 (28.2)	15 (8.6)	5 (2.9)	5 (2.9)	174 (19.1)
65+	73 (57.0)	48 (37.5)	3 (2.3)	3 (2.3)	1 (0.8)	128 (14.1)
Total	465 (51.1)	359 (39.5)	52 (5.7)	22 (2.4)	12 (1.3)	910

[1] Percentage of row total. [2] Percentage of column total.

Although the majority of those injured in pedestrian-only events were female, males were more likely to have been drinking (table 40). More than 10 percent of the males had been drinking, compared to just 4 percent of the females. For those age 20 and above, 18 percent of the males and 5 percent of the females had been drinking.

Overall, 77 percent of this group of pedestrians were White, 14 percent Black, and 6 percent Hispanic (table 41). In general, Blacks and Hispanics were more likely to have been drinking than were Whites: 5 percent of the White group had been drinking, 10 percent of the Black (more than 9 percent indicated as impaired), and 11 percent of the Hispanic (half indicated as impaired and half tested and drinking). Above age 20, these values increased to 9, 17, and 23 percent, respectively.

Table 40. Gender by alcohol use for pedestrian-only events.

Gender of Pedestrian	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Male	208 (48.6)[1]	170 (39.7)	34 (7.9)	5 (1.2)	11 (2.6)	428 (46.7)[2]
Female	261 (53.4)	192 (39.3)	18 (3.7)	17 (3.5)	1 (0.2)	489 (53.3)
Total	469 (51.2)	362 (39.5)	52 (5.7)	22 (2.4)	12 (1.3)	917

[1] Percentage of row total. [2] Percentage of column total.

Table 41. Race by alcohol use for pedestrian-only events.

Race of Pedestrian	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
White	391	256	35	13	7	702
	(55.7)[1]	(36.5)	(5.0)	(1.9)	(1.0)	(77.2)[2]
Black	47	61	12	8	1	129
	(36.4)	(47.3)	(9.3)	(6.2)	(0.8)	(14.2)
Hispanic	17	30	3	1	3	54
	(31.5)	(55.6)	(5.6)	(1.9)	(5.6)	(6.0)
Asian	5	5	0	0	0	10
	(50.0)	(50.0)	(0.0)	(0.0)	(0.0)	(1.1)
American Indian	0	0	0	0	1	1
	(0.0)	(0.0)	(0.0)	(0.0)	(100.0)	(0.1)
Other/	6	5	2	0	0	13
Mixed	(46.2)	(38.5)	(15.4)	(0.0)	(0.0)	(1.4)
Total	466	357	52	22	12	909
	(51.3)	(39.3)	(5.7)	(2.4)	(1.3)	

[1] Percentage of row total. [2] Percentage of column total.

As was the case with pedestrian-motor vehicle events, although the vast majority of the pedestrian-only events occurred during the daytime, the nighttime events were much more likely to involve alcohol (table 42). One-fourth of those injured between 10 p.m. and 2 a.m. had been drinking (23 percent indicated as impaired) and 53 percent (8 out of 15 cases) of those injured between 2 a.m. and 6 a.m. had been drinking (all indicated as impaired).

Table 42. Time of day by alcohol use for pedestrian-only events.

Time of Day	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
6 a.m. - 10 a.m.	73	40	1	1	1	116
	(62.9)[1]	(34.5)	(0.9)	(0.9)	(0.9)	(13.5)[2]
10 a.m. - 2 p.m.	99	88	3	0	2	192
	(51.6)	(45.8)	(1.6)	(0.0)	(1.0)	(22.3)
2 p.m. - 6 p.m.	151	104	9	0	3	267
	(56.6)	(39.0)	(3.4)	(0.0)	(1.1)	(31.1)
6 p.m. - 10 p.m.	95	95	14	1	5	210
	(45.2)	(45.2)	(6.7)	(0.5)	(2.4)	(24.4)
10 p.m. - 2 a.m.	26	19	14	0	1	60
	(43.3)	(31.7)	(23.3)	(0.0)	(1.7)	(7.0)
2 a.m. - 6 a.m.	4	3	8	0	0	15
	(26.7)	(20.0)	(53.3)	(0.0)	(0.0)	(1.7)
Total	448	349	49	2	12	860
	(52.1)	(40.6)	(5.7)	(0.2)	(1.4)	

[1] Percentage of row total. [2] Percentage of column total.

Almost 92 percent of persons injured in pedestrian-only events were treated and released and 7 percent were admitted to the hospital (table 43). There were no fatalities. Six percent of those treated and released had been drinking, compared to 19 percent of those admitted. Pedestrians with injuries to the head were the most likely to have been drinking, but unlike the case with pedestrian-motor vehicle events, pedestrian-only events involving drinking were more likely to be associated with lacerations, dislocations, and other more superficial injuries.

Pedestrian-Bicycle Events

There were 21 collisions involving pedestrians and bicycles (table 31). In all of these cases, the pedestrian alcohol use was either unknown (5 cases) or presumed not impaired (16 cases).

Table 43. Emergency department disposition by alcohol use for pedestrian-only events.

Emergency Dept. Dispos.	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Treated and Released	445 (52.7)[1]	329 (39.0)	43 (5.1)	20 (2.4)	8 (1.0)	845 (91.8)[2]
Admitted	23 (37.1)	25 (40.3)	8 (12.9)	2 (3.2)	4 (6.5)	62 (6.7)
Fatal	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Other/ Unknown	2 (14.3)	10 (71.4)	2 (14.3)	0 (0.0)	0 (0.0)	14 (1.5)
Total	470 (51.0)	364 (39.5)	53 (5.8)	22 (2.4)	12 (1.3)	921

[1] Percentage of row total. [2] Percentage of column total.

Results for Injured Bicyclists

Bicycle-Motor Vehicle Events

A total of 320 cases in the hospital emergency department datafile involved bicyclists who had collided with motor vehicles (table 31). For these bicycle-motor vehicle events, 6 percent were indicated as impaired and 4 percent as testing positive for alcohol (i.e., tested and drinking). Ten percent were tested and found not to have been drinking, and alcohol use was either unknown or the bicyclist was presumed not to be impaired in the remaining 80 percent of the cases. The vast majority of bicycle-motor vehicle collisions occurred on the roadway, including all but one of those where the bicyclist had been drinking (table 44).

Bicyclists of all age groups were reasonably well represented in the data (table 45). Unlike the case with pedestrians, where alcohol involvement peaked with the 25-44 age group, the proportion of bicyclists drinking was reasonably constant for the 20-24, 25-44, and 45+ age groups (all around 14-15 percent). There was also more evidence of drinking by younger bicyclists: nearly 10 percent of the 15-19 age group were reported as drinking, compared to only 1 percent of the pedestrians in this age group. Overall, about 15 percent of those above age 20 had been drinking, compared to 10 percent for all age groups.

Four out of five bicyclists struck by motor vehicles were male (table 46). Some 11 percent of the males had been drinking, compared to 8 percent of the females. For those above age 20, 15 percent of the males and 14 percent of the females had been drinking. These gender differences are less than those found for pedestrians struck by motor vehicles.

Table 44. Location where injury event occurred by alcohol use for bicycle-motor vehicle events.

Location of Injury Event	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Roadway	110 (39.3)[1]	109 (38.9)	17 (6.1)	30 (10.7)	14 (5.0)	280 (92.4)[2]
Sidewalk	9 (60.0)	6 (40.0)	0 (0.0)	0 (0.0)	0 (0.0)	15 (5.0)
Trail/Park/etc.	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Parking Lot	1 (16.7)	2 (33.3)	1 (16.7)	2 (33.3)	0 (0.0)	6 (2.0)
Driveway	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Other	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total	122 (40.3)	117 (38.6)	18 (6.0)	32 (10.6)	14 (4.6)	303

[1] Percentage of row total. [2] Percentage of column total.

Table 45. Age by alcohol use for bicycle-motor vehicle events.

Age of Bicyclist	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
0-9	7 (19.4)[1]	22 (61.1)	1 (2.8)	6 (16.7)	0 (0.0)	36 (11.5)[2]
10-14	30 (46.9)	29 (45.3)	0 (0.0)	4 (6.3)	1 (1.6)	64 (20.5)
15-19	19 (46.3)	16 (39.0)	3 (7.3)	2 (4.9)	1 (2.4)	41 (13.1)
20-24	13 (39.4)	10 (30.3)	3 (9.1)	5 (15.2)	2 (6.1)	33 (10.5)
25-44	37 (36.3)	37 (36.3)	7 (6.9)	13 (12.8)	8 (7.8)	102 (32.6)
45+	18 (48.6)	12 (32.4)	4 (10.8)	2 (5.4)	1 (2.7)	37 (11.8)
Total	124 (39.6)	126 (40.3)	18 (5.8)	32 (10.2)	13 (4.2)	313

[1] Percentage of row total. [2] Percentage of column total.

Table 46. Gender by alcohol use for bicycle-motor vehicle events.

Gender of Bicyclist	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Male	104 (40.0)[1]	103 (39.6)	16 (6.2)	25 (9.6)	12 (4.6)	260 (81.3)[2]
Female	24 (40.0)	24 (40.0)	3 (5.0)	7 (11.7)	2 (3.3)	60 (18.8)
Total	128 (40.0)	127 (39.7)	19 (5.9)	32 (10.0)	14 (4.4)	320

[1] Percentage of row total. [2] Percentage of column total.

Overall, just over half of the bicyclists were White, with 28 percent Black and 15 percent Hispanic (table 47). More than 9 percent of the Whites had been drinking, compared to only 3 percent of the Blacks; however, 26 percent of the Hispanics had been drinking (half were indicated as impaired and half were tested and found to be drinking).

Table 47. Race by alcohol use for bicycle-motor vehicle events.

Race of Bicyclist	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
White	74 (43.8)[1]	68 (40.2)	11 (6.5)	11 (6.5)	5 (3.0)	169 (53.5)[2]
Black	37 (41.6)	33 (37.1)	1 (1.1)	16 (18.0)	2 (2.3)	89 (28.2)
Hispanic	12 (26.1)	19 (41.3)	6 (13.0)	3 (6.5)	6 (13.0)	46 (14.6)
Asian	2 (40.0)	3 (60.0)	0 (0.0)	0 (0.0)	0 (0.0)	5 (1.6)
American Indian	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (50.0)	2 (0.6)
Other/ Mixed	1 (20.0)	3 (60.0)	0 (0.0)	1 (20.0)	0 (0.0)	5 (1.6)
Total	127 (40.2)	126 (39.9)	18 (5.7)	31 (9.8)	14 (4.4)	316

[1] Percentage of row total. [2] Percentage of column total.

Examining time of day, about 36 percent were struck between 2-6 p.m. and another 30 percent between 6-10 p.m. (table 48). Alcohol use was prevalent during these hours, but more so in late evening and early morning hours. About 11 percent of the bicyclists had been drinking during the 2-6 p.m. and 6-10 p.m. periods, but the percentage increased to 39 percent from 10 p.m.-2 a.m. For those above age 20, 21 percent had been drinking from 2-6 p.m. and 15 percent from 6-10 p.m.

Table 48. Time of day by alcohol use for bicycle-motor vehicle events.

Time of Day	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
6 a.m. - 10 a.m.	9 (37.5)[1]	11 (45.8)	0 (0.0)	3 (12.5)	1 (4.2)	24 (8.9)[2]
10 a.m. - 2 p.m.	22 (46.8)	23 (48.9)	0 (0.0)	1 (2.1)	1 (2.1)	47 (17.5)
2 p.m. - 6 p.m.	50 (51.6)	35 (36.1)	8 (8.3)	1 (1.0)	3 (3.1)	97 (36.1)
6 p.m. - 10 p.m.	29 (35.8)	38 (46.9)	4 (4.9)	5 (6.2)	5 (6.2)	81 (30.1)
10 p.m. - 2 a.m.	6 (33.3)	3 (16.7)	3 (16.7)	2 (11.1)	4 (22.2)	18 (6.7)
2 a.m. - 6 a.m.	1 (50.0)	0 (0.0)	1 (50.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total	117 (43.5)	110 (40.9)	16 (6.0)	12 (4.5)	14 (5.2)	269

[1] Percentage of row total. [2] Percentage of column total.

Seventy-two percent of the bicyclists struck by motor vehicles were treated and released, 22 percent were admitted to the hospital, and less than 2 percent were killed (table 49). About 8 percent of those treated and released had been drinking, compared to 15 percent of those admitted for further treatment. One of the five bicyclists killed had also been indicated as impaired.

Table 49. Emergency department disposition by alcohol use for bicycle-motor vehicle events.

Emergency Dept. Dispos.	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Treated and Released	106 (45.9)[1]	89 (38.5)	15 (6.5)	18 (7.8)	3 (1.3)	231 (72.2)[2]
Admitted	15 (21.1)	34 (47.9)	1 (1.4)	11 (15.5)	10 (14.1)	71 (22.2)
Fatal	2 (40.0)	0 (0.0)	1 (20.0)	2 (40.0)	0 (0.0)	5 (1.6)
Other/ Unknown	5 (38.5)	4 (30.8)	2 (15.4)	1 (7.7)	1 (7.7)	13 (4.1)
Total	128 (40.0)	127 (39.7)	19 (5.9)	32 (10.0)	14 (4.4)	320

[1] Percentage of row total. [2] Percentage of column total.

Bicycle-Only Events

Some 746 bicyclists were treated in the participating hospital emergency departments as a result of injuries received from falls or other bicycle-only events not involving a motor vehicle. Of these, just under 6 percent had been drinking (table 31). In addition to roadways, sidewalks and trails were frequent locations for bicycle-only events (table 50). Of the bicyclists injured on the roadway, 9 percent had been drinking; however, only 3 percent of those injured on sidewalks had been drinking and none of those injured on trails had been drinking. Age is clearly a factor in these results, since young children are more likely to ride on sidewalks and trails than adults and are also less likely to be drinking.

Table 50. Location where injury event occurred by alcohol use for bicycle-only events.

Location of Injury Event	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Roadway	136 (39.2)[1]	154 (44.4)	24 (6.9)	26 (7.5)	7 (2.0)	347 (56.8)[2]
Sidewalk	33 (25.2)	90 (68.7)	1 (0.8)	4 (3.1)	3 (2.3)	131 (21.4)
Trail/Park/etc.	24 (31.6)	49 (64.5)	0 (0.0)	3 (4.0)	0 (0.0)	76 (12.4)
Parking Lot	7 (41.2)	8 (47.1)	2 (11.8)	0 (0.0)	0 (0.0)	17 (2.8)
Driveway	7 (28.0)	15 (60.0)	0 (0.0)	3 (12.0)	0 (0.0)	25 (4.1)
Other/ Unknown	5 (33.3)	9 (60.0)	0 (0.0)	1 (6.7)	0 (0.0)	15 (2.5)
Total	212 (34.7)	325 (53.2)	27 (4.4)	37 (6.1)	10 (1.6)	611

[1]Percentage of row total. [2] Percentage of column total.

Information pertaining to bicyclist age is contained in table 51. Over half of the bicyclists were under the age of 15, and a third were under age 10. Alcohol was generally not a factor in the injuries to bicyclists under age 20. However, alcohol was involved in approximately 14-17 percent of the injury events to bicyclists in the 20-24, 25-44, and 45-64 age groups. Overall, nearly 15 percent of those age 20 and above had been drinking, compared to less than 6 percent for all age groups.

Table 51. Age by alcohol use for bicycle-only events.

Age of Bicyclist	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
0-9	37	177	1	22	0	237
	(15.6)[1]	(74.7)	(0.4)	(9.3)	(0.0)	(32.1)[2]
10-14	58	86	0	14	1	159
	(36.5)	(54.1)	(0.0)	(8.8)	(0.6)	(21.5)
15-19	38	30	2	6	0	76
	(50.0)	(39.5)	(2.6)	(7.9)	(0.0)	(10.3)
20-24	24	29	9	6	3	71
	(33.8)	(40.9)	(12.7)	(8.5)	(4.2)	(9.6)
25-44	67	45	15	3	4	134
	(50.0)	(33.6)	(11.2)	(2.2)	(3.0)	(18.1)
45-64	18	15	5	3	2	43
	(41.9)	(34.9)	(11.6)	(7.0)	(4.7)	(5.8)
65+	6	10	0	2	1	19
	(31.6)	(52.6)	(0.0)	(10.5)	(5.3)	(2.6)
Total	248	392	32	56	11	739
	(33.6)	(53.0)	(4.3)	(7.6)	(1.5)	

[1] Percentage of row total. [2] Percentage of column total.

Seventy percent of the bicyclists were male. Nearly 8 percent of the males had been drinking, compared to only 2 percent of the females (table 52). For those age 20 and above, 18 percent of the males had been drinking, and 5 percent of the females had been drinking.

Table 52. Gender by alcohol use for bicycle-only events.

Gender of Bicyclist	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Male	185	256	28	38	11	518
	(35.7)[1]	(49.4)	(5.4)	(7.3)	(2.1)	(70.1)[2]
Female	62	137	4	18	0	221
	(28.1)	(62.0)	(1.8)	(8.1)	(0.0)	(29.9)
Total	247	393	32	56	11	739
	(33.4)	(53.2)	(4.3)	(7.6)	(1.5)	

[1]Percentage of row total. [2] Percentage of column total.

Overall, 71 percent of this group of bicyclists were White, 13 percent Black, and 11 percent Hispanic (table 53). Five to six percent of the Whites had been drinking, compared to 8 percent of Blacks and Hispanics. Above age 20, these values increased to 13, 23, and 24 percent, respectively.

Table 53. Race by alcohol use for bicycle-only events.

Race of Bicyclist	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
White	175 (34.3)[1]	273 (53.4)	20 (3.9)	35 (6.9)	8 (1.6)	511 (70.6)[2]
Black	34 (35.8)	35 (36.8)	6 (6.3)	18 (19.0)	2 (2.1)	95 (13.1)
Hispanic	23 (29.1)	49 (62.0)	6 (7.6)	1 (1.3)	0 (0.0)	79 (10.9)
Asian	5 (23.8)	15 (71.4)	0 (0.0)	0 (0.0)	1 (4.8)	21 (2.9)
American Indian	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
Other/ Mixed	4 (23.5)	11 (64.7)	0 (0.0)	2 (11.8)	0 (0.0)	17 (2.4)
Total	242 (33.4)	383 (52.9)	32 (4.4)	56 (7.7)	11 (1.5)	724

[1] Percentage of row total. [2] Percentage of column total.

Examining time of day, although the greatest number of bicycle-only events occurred from 2-6 p.m., most of those involving alcohol occurred from 6-10 p.m., and the *rate* of alcohol involvement was highest late at night and during the early morning hours (table 54). Ten percent of the bicyclists injured from 6-10 p.m. had been drinking, increasing to nearly 23 percent of those injured from 10 p.m.-2 a.m. For age 20 and above, 47 percent of those injured between 10 p.m. and 2 a.m. had been drinking.

Table 54. Time of day by alcohol use for bicycle-only events.

Time of Day	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
6 a.m. - 10 a.m.	9 (34.6)[1]	16 (61.5)	1 (3.9)	0 (0.0)	0 (0.0)	26 (4.3)[2]
10 a.m. - 2 p.m.	37 (36.6)	63 (62.4)	1 (1.0)	0 (0.0)	0 (0.0)	101 (16.6)
2 p.m. - 6 p.m.	96 (38.7)	145 (58.5)	5 (2.0)	0 (0.0)	2 (0.8)	248 (40.7)
6 p.m. - 10 p.m.	62 (31.0)	117 (58.5)	12 (6.0)	1 (0.5)	8 (4.0)	200 (32.8)
10 p.m. - 2 a.m.	13 (41.9)	11 (35.5)	6 (19.4)	0 (0.0)	1 (3.2)	31 (5.1)
2 a.m. - 6 a.m.	1 (33.3)	1 (33.3)	1 (33.3)	0 (0.0)	0 (0.0)	3 (0.5)
Total	218 (35.8)	353 (58.0)	26 (4.3)	1 (0.2)	11 (1.8)	609

[1] Percentage of row total. [2] Percentage of column total.

Nearly 88 percent of the injured bicyclists were treated and released and 8 percent were admitted to the hospital (table 55). There was one fatality. Contrary to findings for other categories of injury events, those bicyclists who were admitted to the hospital as the result of a fall or other bicycle-only event were not more likely to have been drinking: about 6 percent of those treated and released had been drinking, compared to 3 percent of those admitted. Both percentages more than doubled for bicyclists age 20 and above.

Table 55. Emergency department disposition by alcohol use for bicycle-only events.

Emergency Dept. Dispos.	Unknown	Presumed Not Impaired	Indicated As Impaired	Tested, Not Drinking	Tested and Drinking	Total
Treated and Released	227 (34.8)[1]	335 (51.3)	28 (4.3)	52 (8.0)	11 (1.7)	653 (87.5)[2]
Admitted	15 (23.8)	42 (66.7)	2 (3.2)	4 (6.4)	0 (0.0)	63 (8.5)
Fatal	0 (0.0)	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.1)
Other/ Unknown	8 (27.6)[1]	19 (65.5)	2 (6.9)	0 (0.0)	0 (0.0)	29 (3.9)
Total	250 (33.5)	397 (53.2)	32 (4.3)	56 (7.5)	11 (1.5)	746

[1]Percentage of row total. [2] Percentage of column total.

Bicycle-Bicycle Events

There were 28 instances of one bicycle striking another. Two of the injured bicyclists (7 percent) had been drinking.

Summary of Results

Results for the pedestrian and bicyclist groups can be summarized as follows:

Pedestrian-Motor Vehicle Events

- The vast majority of pedestrians who had been drinking were struck on the roadway.
- Overall, 14 percent had been drinking.
- 32 percent of the 25-44 age group and 22 percent of the 45-64 age group had been drinking.
- Males were more likely to have been drinking than females.
- Alcohol use was more prevalent during the late evening and early morning hours.
- 9 percent of the pedestrians who were treated and released had been drinking, compared to 18 percent of those admitted to the hospital and 27 percent of those killed.

Pedestrian-Only Events

- About 60 percent of the pedestrians who had been drinking were injured on a sidewalk.
- Overall, 7 percent had been drinking.
- 13 percent of the 20-24 and 25-44 age groups had been drinking, and 11 percent of the 45-64 age group had been drinking.

- Males were more likely to have been drinking than females.
- 10 percent of Blacks and 11 percent of Hispanics had been drinking, compared to 6 percent of Whites.
- Alcohol use was more prevalent during the late evening and early morning hours.
- 6 percent of the pedestrians who were treated and released had been drinking, compared to 19 percent of those admitted to the hospital.

Bicycle-Motor Vehicle Events

- Virtually all of the bicyclists who had been drinking were struck on the roadway.
- Overall, 11 percent had been drinking.
- About 15 percent of the 20-24, 25-44, and 45-64 year groups had been drinking (10 percent of the 15-19 age group had been drinking).
- Overall, males were more likely than females to have been drinking, but above age 20, there was no difference in the male-female percentage.
- 9 percent of Whites, 3 percent of Blacks, and 26 percent of Hispanics had been drinking.
- Alcohol use was more prevalent during the late evening and early morning hours.
- 8 percent of the bicyclists who were treated and released had been drinking, compared to 15 percent of those admitted to the hospital.

Bicycle-Only Events

- Over 80 percent of bicyclists who had been drinking were injured on the roadway.
- Overall, 6 percent had been drinking.
- 14 to 17 percent of the 20-24, 25-44, and 45-64 age groups had been drinking, but only 5 percent of the 65+ age group had been drinking.
- Males were more likely than females to have been drinking.
- Five percent of Whites and 8 percent of Blacks and Hispanics had been drinking.
- Alcohol use was more prevalent during the late evening and early morning hours.
- Six percent of the injured bicyclists who were treated and released had been drinking, compared to 3 percent of those admitted to the hospital.

CHAPTER 6 - INJURY ESTIMATES FROM THE COMBINED DATA

In this chapter, information from the emergency department database is combined with statewide hospital discharge and motor vehicle crash data to estimate overall numbers of pedestrians and bicyclists being injured. Two approaches are examined, the first relying on the percentage of emergency department cases hospitalized and overall number hospitalized, and the second on the percentage of emergency department cases identified in police crash files and overall number of police-reported cases. Both approaches are described below. A final discussion section highlights some of the constraints of trying to project overall numbers of injured pedestrians and bicyclists.

Figure. Photo of young boy riding a bicycle on a street past a parked car.

Estimates Based on Hospitalization Data

This first approach is the one that was followed in Stutts et al. (1990) to estimate the total number of bicyclists being treated annually in North Carolina hospital emergency departments. For this study, data on injured bicyclists were collected from 10-15 hospital emergency departments spread out geographically across the State during the late spring and summer of 1985 and again in 1986. Of the 649 cases identified, 17.3 percent were injured in collisions with motor vehicles and 6.1 percent were hospitalized. Based on a 1980 survey of pediatric hospital discharges that showed 800 children hospitalized in the state for bicycle-related injuries, it was estimated that more than 13,000 children received treatment in North Carolina hospital emergency departments for injuries incurred while bicycling.

For the current study, emergency department data were collected from hospitals in three States (California, New York, and North Carolina) over a 1-year time period. E-coded hospital discharge data were also obtained from these same States. Table 56 summarizes information on the percentage of bicycle and pedestrian emergency department cases in each State that were hospitalized as a result of their injuries.

Table 56. Percentage of emergency department cases requiring hospitalization, by type of injury.

Injury Type	Percent Hospitalized		
	CA	NY	NC
Bicycle-Motor Vehicle	19.7%	10.0%	45.0%
Bicycle Only	5.5%	9.4%	15.9%
Pedestrian-Motor Vehicle	31.1%	25.6%	62.6%
Pedestrian Only	7.4%	6.0%	18.2%

The percentages vary greatly among the States, with North Carolina showing by far the highest percentage hospitalized. This probably reflects the fact that both of the two North Carolina hospitals that participated in the study were located in smaller communities serving large rural areas. Pitt County Memorial Hospital, which contributed about three-fourths of the cases, is located in a community with a population of about 50,000, but the hospital is also a major trauma center, drawing patients from a 10-

county region in the rural northeastern part of the State. Crashes occurring in rural areas are more likely to involve higher vehicle speeds, to occur at nighttime, and to involve alcohol--all factors that can exacerbate the level of injury for the parties involved. In contrast, the New York State cases all came from a single large urban area (Buffalo), while the California cases came from three hospitals that served smaller metropolitan and suburban areas.

Along with this emergency department data, Table 57 summarizes available information on the number of hospitalized pedestrians and bicyclists in each of the three States. The data reflect the most recent year available from each State. The California and New York State totals represent the actual number of hospitalizations as recorded in statewide hospital discharge datafiles (see chapter 2 and appendix D). For North Carolina, the numbers represent a weighted estimate based on available data from the North Carolina Medical Database Commission for fiscal year 1994 (October 1, 1993 - September 30, 1994). The numbers reported by the Commission were weighted by a factor of 2.3 to adjust for statewide underreporting of E-codes (i.e., only 43.4 percent of the cases on file that had an injury diagnosis also had a recorded E-code), and by a factor of 2.2 to adjust for underreporting by the hospitals (i.e., only 68 of the State's 152 accredited hospitals contributed to the file). Due to problems in identifying pedestrian-only events with the available E-coded data, no counts are presented for this category.

Table 57. Number of injured bicyclists and pedestrians hospitalized, based on available statewide hospital discharge data.

Injury Type	Number Hospitalized		
	CA	NY	NC*
	(1994)	(1995)	(FY 94)
Bicycle-Motor Vehicle	1,272	875	623
Bicycle Only	2,886	1,301	1,127
Pedestrian-Motor Vehicle	6,218	5,147	2,4

* Numbers are weighted to adjust for underreporting of E-codesand incomplete hospital participation.

Based on the information shown in these two tables, it was possible to estimate the total number of bicyclists and pedestrians receiving emergency department treatment in each State by dividing the number of hospitalized cases (from table 57) by the proportion of such cases hospitalized (from the corresponding cell in table 56). For example, to estimate the total number of bicycle-motor vehicle cases treated in California hospital emergency departments, 1,272 was divided by .197, producing the annual estimate of 6,457 cases. Table 58 shows the results of these calculations for each State.

Table 58. Estimated number of bicyclists and pedestrians receiving hospital emergency department treatment, based on data in tables 56 and 57.

Injury Type	Estimated Annual Emergency Department Cases		
	CA	NY	NC
Bicycle-Motor Vehicle	6,457	8,750	1,384
Bicycle Only	52,473	13,840	7,088
Pedestrian-Motor Vehicle	19,994	20,105	3,962

These numbers probably *underestimate* the total numbers of pedestrians and bicyclists treated in hospital emergency departments, because the percentages hospitalized (from table 56) are higher than expected. Baker et al. (1993), for example, have reported that nationally, 10.4 percent of bicycle-motor vehicle cases, 2.0 percent of bicycle-only cases, and 4.0 percent of all bicycle cases treated in emergency departments are hospitalized. If the first two percentages are applied to the counts of bicycle hospitalizations in table 57, the bicycle projections are increased as follows:

	CA	NY	NC
Bicycle-MV	12,231	8,413	5,990
Bicycle Only	144,350	65,050	56,350

These numbers appear unrealistically high, however, at least in the case of bicycle-only events. Based on these numbers, our three States alone would account for 266,000, or nearly half, of the widely accepted figure of 550,000 annual bicycle-related injuries estimated by the Consumer Product Safety Commission's NEISS data.

It is likely that the true percentages of hospitalized cases lie somewhere between the estimates produced by the current study and those reported by Baker et al. (1993). Two factors are crucial in deriving such estimates: (1) a representative sampling of hospital emergency departments, and (2) a complete count (or representative sampling) of cases attending that hospital. For the current study, the participating hospital emergency departments represented a cross-section of larger and smaller hospitals that were located in different regions of the country and that served various sizes of communities. However, they were not chosen to typify their respective States. To produce more valid statewide estimates, a better approach would have been to select a larger number of hospitals from only one or two States (as was done for the Stutts et al. (1990) study).

The second requirement for valid estimates of the percentage of hospitalized cases is complete reporting within a hospital. In particular, it is important that hospital emergency departments capture less severe injury cases at the same rate as more severe injury cases, and that they capture "bicycle only" and "pedestrian only" events to the same extent as their more readily identified motor vehicle counterparts. How well the current study accomplished this goal is difficult to assess. The New York and California hospital emergency departments had similar ratios of bicycle-only to bicycle-motor vehicle cases (2.4 for New York and 2.8 for California), and although New York had a higher ratio of pedestrian-only cases (2.9 versus 1.9 for California), this might be expected due to the large number of "slips on ice" cases. With these cases omitted, the New York ratio drops to 1.9, the same as for California. The ratios for North Carolina are considerably lower, 1.4 for bicycle only versus bicycle-motor vehicle, and 0.22 for pedestrian only versus pedestrian-motor vehicle. Since in North Carolina the majority of cases were identified retrospectively from E-coded emergency department records, it is unlikely that bicycle-only cases were missed unless they were incorrectly E-coded. However, it seems clear that the New York State and California hospital emergency departments captured a broader array of pedestrian-only events than what could be identified using the E-coded hospital records.

Given this lack of certainty in the study data, a different approach that does not rely on estimates of the proportion of cases hospitalized was examined. The results of applying this second approach to the study data are described below.

Estimates Based on Matched Emergency department and Crash Data

The second approach examined for making statewide projections of injured bicyclists and pedestrians utilized the emergency department data collected in conjunction with police-reported motor vehicle crash data. Since the police-reported data contains virtually no crashes not involving a motor vehicle, the initial focus of this exercise was on pedestrian- and bicycle-motor vehicle injury cases.

A key piece of information needed with this approach was the percentages of emergency department cases that were also identified in the State motor vehicle crash files. Since no names, addresses, social security numbers, or other unique identifiers were available either for the emergency department data or the State crash data, the process of "matching" cases was carried out based on the following variables that were available in both files:

- Date and time of injury event.
- Age and sex of bicyclist/pedestrian (and for NC, date of birth and race).
- Location (city and county) of injury event.

Using these variables, the goal was to identify those cases in the emergency department files that were also found in the State motor vehicle crash files. To carry out the matching, a listing was generated of pedestrian and bicyclist cases identified in each of the State crash files, containing the values for the above variables and ordered by the date of the injury event. To reduce the number of potential matches needing to be checked, the crash file listings were restricted to cases occurring in counties that might reasonably be serviced by one of the participating hospital emergency departments. For example, for North Carolina, only counties in the eastern part of the state were included in the crash file listing, while for New York State, the counties were restricted to those in the Buffalo area (Erie, Cattaraugus, and Niagara).

The process then became one of checking case-by-case to determine whether each reported emergency department case was duplicated in the State crash file listing. For those cases where a match was uncertain, the hard copy of the emergency case report was checked for additional information that might facilitate a decision. For example, in some cases, the narrative might provide an approximate age if no exact age was available, or note that the time of the injury event was only approximate. Cases were coded at four levels: match, probable match, possible match, and no match. For a definite match to occur, the crash date, victim age and sex, county or city, and approximate time would all need to be in agreement. A probable match might have one of these items (usually the time or location, but not age) in disagreement or missing, while possible matches would generally have two or more "disagreements" or missing pieces of information.

Table 59 summarizes the results of the matching process for the emergency department data collected in each of the three participating States. The percentages shown are based on the number of actual plus probable matches, but exclude the very small number of "maybe" matches recorded. Since probable matches are included, these percentages probably overestimate the percentage of emergency department cases that were also reported in the State motor vehicle crash files. The table shows that 43-45 percent of the California cases, 43-56 percent of the New York State cases, and 67-68 percent of the North Carolina cases were matched. Pedestrians had a somewhat higher match rate than bicyclists for the New York State data.

Table 59. Percentage of cases reported by participating hospital emergency departments identified in State crash files.

Injury Type	CA	NY	NC
Bicycle-Motor Vehicle	43.3%	42.5%	66.7%
Pedestrian-Motor Vehicle	45.0%	56.3%	67.9%*

* Includes seven cases identified by police as bicyclists.

The higher matching rate for the North Carolina cases may, to some extent, reflect the more rural nature of the sample and the generally more serious level of injuries sustained. However, it should be noted that even in the earlier study of bicycle emergency department injuries reported in Stutts et al. (1990), 60 percent of the bicycle-motor vehicle cases were matched. Another interesting aspect of the North Carolina matching was that 7 of the 91 pedestrian-motor vehicle cases identified in the emergency department file were matched to *bicycle-motor vehicle* crashes in the crash file. Thus, it appears that at least in some instances, hospital emergency department personnel may not be aware that the patient being treated is a bicyclist. If these cases had been counted as "non-matches" (i.e., if only the pedestrian crash listing had been checked), the percentage matched would have dropped from 67.9 to 62.7 percent. (The "cross-file" matching was possible with the North Carolina cases since date of birth was available as a matching variable, providing added confidence in the matching process. No attempt was made to match the California and New York pedestrian cases to their State's bicycle crash listing.)

The second piece of information needed to produce statewide emergency department estimates was the actual number of police-reported bicyclists and pedestrians injured in motor vehicle crashes. These data are reported in table 60 for 1995 only. Almost all of the cases involved some level of injury.

Table 60. Number of police-reported pedestrians and bicyclists injured, based on 1995 State motor vehicle crash file data.

Injury Type	CA	NY	NC
Bicycle-Motor Vehicle	14,780	9,390	1,530
Pedestrian-Motor Vehicle	17,536	20,640	2,752

Finally, table 61 presents the projected statewide hospital emergency department visits, calculated by dividing the total number of police-reported cases by the proportion of emergency department cases matched to the State crash files. For example, to obtain the estimate of 34,134 bicyclists treated in California hospital emergency departments, 14,780 police-reported cases (from table 60) was divided by .433, the proportion of emergency department cases matched (from table 59).

Table 61. Estimated number of bicyclists and pedestrians receiving emergency department treatment, based on data in tables 59 and 60.

Injury Type	CA	NY	NC
Bicycle-Motor Vehicle	34,134	22,094	2,294
Pedestrian-Motor Vehicle	38,968	36,661	4,389

To also obtain an estimate of the total number of injured bicyclists and pedestrians, including those injured in falls and other non-collision events, the numbers in table 61 can be divided by the proportion of bicycle (or pedestrian) events reported by the participating hospital emergency departments in each State that involved a motor vehicle collision. For example, 26.0 percent of the bicycle injury cases reported by the three participating California hospitals involved a motor vehicle, so that the projected number of all bicycle injury cases would be 34,134 / .260, or 131,285, and the number of bicycle-only injuries would be 131,285 minus 34,134, or 97,151. Table 62 shows the percentages of emergency department reported cases involving a motor vehicle, and table 63 the projected total bicycle and pedestrian injuries treated in hospital emergency departments in each State.

Table 62. Percentage of emergency department bicycle and pedestrian cases that involved a collision with a motor vehicle.

Injury Type	Percent Involving Motor Vehicle		
	CA	NY	NC
Bicycle	26.0	29.0	41.9
Pedestrian	37.4	25.6	81.7

The estimates reported in table 63 are substantially higher than their counterparts in table 58. They may also be closer to reality, at least for California and New York State. (The North Carolina projections are too low, due to the higher severity of the cases reported and the higher frequency of motor vehicle involvement.) Comparing numbers of actual reported hospital cases in table 57 with the estimated emergency department cases in table 63, if one assumes that the emergency department estimates are correct, then the numbers hospitalized represent 2-3 percent of the bicycle-only cases, approximately 4 percent of the bicycle-motor vehicle cases, and 14-16 percent of the pedestrian-motor vehicle cases for California and New York State. These numbers are well within expectations. The New York data shows an unusually high number of estimated pedestrian-only cases, but again this is probably due to the prominent role that "slips on ice" played in the Buffalo emergency department database. In contrast, the North Carolina emergency department data contained very few pedestrian-only cases, and this is reflected in the statewide estimates.

Table 63. Overall estimates of bicycle and pedestrian emergency department cases.

Injury Type	Estimated Annual Emergency department Cases		
	CA	NY	NC
Bicycle-Motor Vehicle	34,134	22,094	2,294
Bicycle Only	97,151	54,092	3,181
Pedestrian-Motor Vehicle	38,968	36,661	4,389
Pedestrian Only	65,225	106,546	983

Discussion

Estimating the total number of injured pedestrians and bicyclists is clearly no simple task, whether at the local, State, or national level. For the current analyses, use was made of both hospital discharge and statewide motor vehicle crash data. Ultimately, however, the success of either approach depends on the quality of the emergency department data obtained and, in particular, the completeness of case ascertainment. To the extent that less serious injury cases or events not involving a motor vehicle are missed, the resulting estimates will underestimate the true extent of the problem. This may have occurred with the North Carolina data, which had higher percentages hospitalized and lower percentages of pedestrian-only (but not bicycle-only) cases.

Other factors, however, may help to explain the results. In the original study by Stutts et al. (1990) based on North Carolina hospital emergency department data, the estimating procedure based on the percentage of cases hospitalized and overall numbers hospitalized (the first of the two approaches described in this chapter) appears to have "worked," producing bicycle injury estimates in line with available national data from the National Electronic Injury Surveillance System (NEISS). There were two key differences between that study and the current study. One is that, at the time of the original study, there happened to be available in North Carolina a reliable source of statewide hospital discharge data (albeit only for children under 20 years of age). In contrast, the hospital data available for the current study was incomplete, and a variety of assumptions had to be made to produce adjusted estimates that could be used in the analyses. (The New York State and California hospital data, in contrast, required no such adjustments.)

Perhaps a more important difference between the two studies, however, rests in the selection of hospital emergency departments and, in particular, on the number of hospitals participating. In the original study, a total of 10 hospitals participated in the emergency department data collection in 1985 and 15 hospitals participated the following year. Even though this was a convenience sample of hospitals interested in and willing to participate in the study, the end result was a quite varied sampling of small, medium, and large hospitals spread out geographically across the State and representing urban as well as more rural areas. In contrast, 75 percent of the North Carolina cases for the current study came from one hospital, which happens to be a large Level I trauma center serving a largely rural section of the State. Thus, it is not surprising that the data might capture a larger proportion of serious injury cases, or that it might not represent the State in other characteristics as well.

To a lesser extent, these weaknesses in the North Carolina emergency department data may be present in the California and New York State data as well. Without some reliable data for comparison, however, it is not possible to draw conclusions. In retrospect, it would have been desirable to have had a larger and more representative sampling of hospital emergency departments participating in each of the States. However, available funds were not sufficient for such a large-scale study.

Finally, it is interesting to draw perspective from numbers that have been reported nationally concerning injured pedestrians and bicyclists. Two obvious sources for information on events that involve a motor vehicle are the Fatal Accident Reporting System (FARS) and the General Estimates System (GES). According to FARS data, 830 bicyclists were killed in collisions with motor vehicles in 1995, including 136 in California, 50 in New York, and 35 in North Carolina (NHTSA, 1996). For pedestrians, the corresponding numbers were 5,585 overall, 825 in California, 412 in New York, and 188 in North Carolina. Information on injured bicyclists and pedestrians, based on GES data, is only available at the national level: an estimated 61,000 bicyclists and 84,000 pedestrians were injured in collisions with motor vehicles (NHTSA, 1996).

These numbers, based on police crash reports, only reflect the "tip of the iceberg" as far as injuries to pedestrians and bicyclists are concerned. However, there are few alternative sources of information to draw upon. Bicyclist fatalities based on death certificate data from the National Center for Health Statistics are typically about 8 percent higher than the FARS counts, due primarily to the inclusion of non-motor vehicle-related bicyclist deaths (Baker et al., 1993). The NEISS data, based on a stratified sample of hospital emergency departments, produces annual estimates of approximately 580,000 injured bicyclists. There are no comparably broad data sources for information on injured pedestrians, in part because pedestrian injuries not involving a motor vehicle are typically lumped into the immense category of "falls."

In summary, very little data exist for providing even a broad framework for interpreting the results of attempts such as reported here to estimate the overall magnitude and scope of the bicyclist and pedestrian injury problem. The final chapter provides a brief overview of key findings from the study and offers some recommendations for future research.

CHAPTER 7 - CONCLUSIONS AND RECOMMENDATIONS

Project Overview

The current study was carried out for the Federal Highway Administration (FHWA) to develop information on the range of events causing injury to pedestrians and bicyclists. Traditional information sources such as FARS and State motor vehicle crash files primarily capture information on pedestrian and bicyclist injury events that: (1) involve a motor vehicle and (2) occur on a public roadway.

Figure. Picture of elderly woman walking on sidewalk.

Many more pedestrians and bicyclists, however, are injured as the result of falls that do not involve a motor vehicle and in locations (sidewalks, trails, parking lots, etc.) other than the roadway, but over which FHWA and local transportation departments may have some jurisdiction. While seldom reported by law enforcement officers, these cases frequently result in hospital emergency department visits. Thus, the current study used emergency department data to provide more complete information on these other types of events.

Eight hospitals in three States (California, New York, and North Carolina) participated in the study. Each collected information on injured pedestrians and bicyclists treated in their emergency department over approximately a 1-year time period, using a special two-page survey form. The form placed particular emphasis on the location of the injury event and whether or not a motor vehicle was involved. A total of 2,802 cases were reported, 2,558 of which met the study criteria for a bicyclist or pedestrian. In addition to the emergency department data, hospital discharge and motor vehicle crash data were obtained from each of the three participating States and examined in conjunction with the emergency department data.

The results presented in this report were primarily descriptive tabulations that addressed the following research questions:

- What are the frequency and characteristics of bicycle injury events that occur in non-roadway locations and/or those that do not involve a motor vehicle, and how do they differ from bicycle-motor vehicle crashes that occur on the roadway? (chapter 3)
- What are the frequency and characteristics of pedestrian injury events that occur in non-roadway locations and/or those that do not involve a motor vehicle, and how do they differ from pedestrian-motor vehicle crashes that occur on the roadway? (chapter 4)
- What role does alcohol play in each of these events? (chapter 5)
- What are the estimated frequencies of motor vehicle and non-motor vehicle, and roadway and non-roadway events causing injury to pedestrians and bicyclists? (chapter 6)

Study Findings and Recommendations

Chapters 3, 4, and 5 each contain summaries of key findings that will not be repeated here. Each of the chapters expands on the injury matrix introduced in chapter 1. This matrix (see figure 1) categorized events according to their place of occurrence (roadway or non-roadway) and whether or not a motor vehicle was involved. For bicyclists, the distribution of cases based on the obtained hospital emergency department data is shown in table 64. These results suggest that statewide crash files, which are limited primarily to events that involve a motor vehicle and those that occur on the public roadway, are likely to capture less than a third of bicyclist injury cases serious enough to require emergency department treatment. In reality, they capture far fewer, since the results reported in chapter 6 showed that anywhere from 40 to 60 percent of the bicycle-motor vehicle cases were not reported in official State files.

Table 64. Distribution of **bicyclist** injury cases by place of occurrence and motor vehicle involvement status.

Place of Occurrence	Motor Vehicle	Non-Motor Vehicle	Overall
Roadway	30.6%	38.0%	68.6%
Non-Roadway	2.5%	28.9%	31.4%
Overall	33.1%	66.9%	100.0%

Table 65 shows the distribution of pedestrian injury cases identified by the participating hospital emergency departments. These results are similar to those for bicyclists, but with a smaller percentage of the pedestrian-only or "fall" events (i.e., non-motor vehicle) occurring in the roadway, and a correspondingly larger percentage occurring on sidewalks, in parking lots, and at other non-roadway locations. Again, less than a third of the injury events serious enough to require emergency department treatment involved a motor vehicle traveling on the roadway. Furthermore, the results of chapter 6 showed that 35 to 55 percent of these events may go unreported.

Table 65. Distribution of **pedestrian** injury cases by place of occurrence and motor vehicle involvement status.

Place of Occurrence	Motor Vehicle	Non-Motor Vehicle	Overall
Roadway	32.6%	14.0%	46.6%
Non-Roadway	4.5%	48.9%	53.4%
Overall	37.1%	62.9%	100.0%

Tables 64 and 65 are based on the total sample of reported emergency department cases. However, even among the subset of those injured seriously enough to require hospitalization, non-motor vehicle and non-roadway events continued to play a prominent role. Sixteen percent of hospitalized bicyclists were injured in non-roadway locations and 42 percent were injured in events that did not involve a motor vehicle. For hospitalized pedestrians, the corresponding percentages were 26 percent non-roadway, 24 percent non-motor vehicle.

These findings lend strong support to previous research (summarized in chapter 2) carried out in this country, as well as in Australia, New Zealand, and a number of European countries, showing that reliance on official road accident statistics greatly underestimates the number of injured bicyclists and pedestrians. In light of the U.S. goal of increasing levels of bicycling and walking, they also reinforce the need for continued and strengthened efforts toward creating a safer environment for these non-motorized transportation modes. These efforts need to move beyond the roadway and beyond thinking about bicyclists and pedestrians only as they interact with motor vehicles. Sidewalks and trails need to be viewed as important transportation facilities in their own right, parking lots need to be built with pedestrians and bicyclists in mind, and all facilities accommodating non-motorized transportation need to be well designed and well maintained.

In addition to documenting the role of non-motor vehicle and non-roadway events resulting in injury to pedestrians and bicyclists, the descriptive tables and figures contained in this report provided insight into the nature of these events and potential countermeasures that could improve pedestrian and bicyclist safety. Although the conclusions that can be drawn from a descriptive analysis are limited, the following areas stand out and may warrant further investigation:

- Alcohol was a significant contributing factor in both pedestrian and bicyclist injury events, especially those involving a motor vehicle. Nearly a third of pedestrian-motor vehicle crash victims ages 25-44, and 22 percent of those ages 45-64, were reported to have been drinking. For bicyclists, 15 percent of adults age 20 and above had been drinking. Alcohol use was more prevalent among males and during the late evening and early morning hours. It was also associated with a higher rate of hospitalization. Future public education efforts should target the dangers of drinking and walking and drinking and bicycling as well as drinking and driving.
- Sidewalks were a frequent site of bicyclist and pedestrian injury events not involving motor vehicles. Although the vast majority of both bicycle-motor vehicle and pedestrian-motor vehicle collisions occurred on the roadway, 43 percent of the bicycle-only events occurred off the roadway, and half of these were on sidewalks. For pedestrians, 78 percent of non-collision events occurred off the roadway and over half (58 percent) of these were on sidewalks. Young children were particularly overrepresented in sidewalk injury events, as were senior pedestrians age 65+.
- Equipment such as in-line skates and skateboards can make being a pedestrian particularly hazardous. Of the nearly 200 pedestrian-only events that occurred in the roadway, one-fourth involved the use of in-line skates and an additional 5 percent involved persons on skateboards. Off-road, the situation was not much safer: 12 percent of the injured pedestrians were using in-line skates and 3 percent were using skateboards. These percentages are combined for all ages and would be higher for teens or young adults. While education efforts might help to alert young people to the dangers of these activities, a better alternative might be to provide a safer environment for skating, such as a network of well-maintained off-road trails.
- In climates where winter months are accompanied by snow and ice, off-road locations such as sidewalks, parking lots, and driveways can be especially hazardous for pedestrians. In Buffalo, New York, which experienced considerable snow and ice during the winter of 1995-96, over a fourth of all pedestrian injuries reported by the hospitals *during the entire year of data collection* were icy weather related. The vast majority of these injury events occurred off the roadway and did not involve a motor vehicle. In addition to clearing roadways and making them safe for motor vehicle travel, sidewalks, driveways, and parking lots need to be made as safe as possible for pedestrian travel. Too often, roadways are cleared at the expense of sidewalks, and little, if anything, is done to help pedestrians negotiate parking lots once they arrive at their destinations. Middle-aged adults were more susceptible to icy weather-related falls than were either young persons or older adults, perhaps due to their greater exposure.
- For this sample of injured bicyclists, reported helmet use was highest among children under 15 years of age, and among those injured in bicycle-only events occurring off the roadway. However, emergency department personnel were unable to determine helmet use in about 20 percent of the cases, and may have relied on self-reports or observations of head/face injuries in many instances. Assessing helmet use is clearly a difficult task in an emergency department setting. And in the absence of any exposure or control data, it is not an appropriate data source for evaluating the effectiveness of helmets in preventing or lessening the severity of head injuries.
- An incidental but intriguing result was the discovery that 7 of the 91 pedestrian-motor vehicle cases identified in the two North Carolina emergency department files were matched to *bicycle-motor vehicle* crashes in the State crash file. This suggests that emergency department personnel may not always be aware that the individual they are treating was riding a bicycle at the time he or she was struck. As a result, hospital-based sources may overestimate the number of pedestrian-motor vehicle cases, while underestimating the number of bicyclist-motor vehicle cases. Further research (e.g., a follow-up telephone survey of individuals identified in hospital or emergency department records as pedestrians) could help to clarify the issue.

Two final comments are in order. The current study was not very successful in producing firm projections of the overall numbers of injured pedestrians and bicyclists. Possible reasons for this are outlined in the discussion section of chapter 6, and include the limited sampling of hospitals within the selected States and the difficulty in defining and capturing information on pedestrian-only events. However, the difficulties experienced in this study also underscore the desirability of establishing routine linkages between hospital and motor vehicle crash databases, and for requiring E-coding of hospital inpatient as well as outpatient (emergency department) cases. Linked together, police and hospital databases can provide more complete information on a much broader range of pedestrian and bicyclist injury events. Efforts such as CODES (Crash Outcome Data Evaluation System) initiated by the National Highway Traffic Safety Administration are making this possibility a reality in a number of States.

The current study was also limited in that no exposure data were collected for analysis in conjunction with the pedestrian and bicyclist injury data. Relevant exposure data has been a long-standing need in the area of non-motorized safety research. In the absence of such data, it is not possible to draw definitive conclusions regarding the level of risk associated with specific locations, behaviors, etc. The safety of riding a bicycle on the sidewalk, for example, or walking in a parking lot, is best assessed if information is available on the total numbers of individuals bicycling on sidewalks or walking in parking lots, i.e., those who are uninjured as well as injured. One of the few studies to collect such information was carried out by the Consumer Products Safety Commission (Rodgers, 1993). Information on injured bicyclists was collected from cases reported to a national sample of hospital emergency departments, and exposure data from a national telephone survey. Combining the two sources of information, the Commission was able to conclude, for example, that the risk of injury for children riding bicycles in the street was about eight times greater than riding on bicycle paths, and nearly two times greater than riding on sidewalks.

What this study *has* provided is information on the numbers of bicyclists and pedestrians being injured, the types and locations of events that cause these injuries, the nature of the injuries, and some details on the characteristics of these events and the persons injured. In doing so, it has broadened the usual definition of pedestrian and bicyclist, at least from the traditional highway safety perspective, and has encouraged a more comprehensive approach to creating a safer environment and promoting greater use of these non-motorized transportation modes.

APPENDIX A - Data Abstraction Form

Data Collector ID (initials) ___ ___ ___

Date Data Collected __ __/__ __/__ __

Case No. __ __ __ __

Hospital Code __ __

Data Abstraction Form for
UNC Pedestrian and Bicyclist Injury Study

Case Identification

Type of Event:
0. Unsure/Unk.
1. Pedestrian
2. Bicyclist

Date Injured:
__ __/__ __/__ __
month day year

Time Injured:
__ __ : __ __ a.m. p.m.
☐ Check if approx.

Location of Injury Event:
City/Town ______________
(Leave blank if outside limits)
County ______________

Patient Characteristics

Date of Birth:
__ __/__ __/__ __
month day year

Gender:
0. Unknown
1. Male
2. Female

Race:
0. Unknown
1. White
2. Black
3. Hispanic
4. Asian
5. Amer. Indian
6. Other/Mixed

Injury Event Characteristics

Place Where Injury Occurred:
0. Unknown
1. On a roadway (Includes travel lanes, shoulder median, crosswalk, etc. Also includes any driveway, alley, parking lot, etc. where it intersects a roadway.)
2. On a sidewalk or path alongside a roadway
3. On a public trail or other path not along a roadway
4. In a commercial/retail parking area (shopping mall, convenience store, gas station, etc.)
5. In a residential parking area (apartments, housing development, etc.)
6. In other parking area (public parking lot, school, park, church, etc.)
7. In a public driveway, alley, or other entrance way (Event must occur entirely off-road.)
8. At a park, playground, ballfield, or other public off-road location
9. In a private driveway or yard (Code only if event occurs entirely off-road.)
10. Other or uncertain (Please give as detailed a description as possible.) ______________
____

Motor Vehicle Involvement:
0. Unknown
1. Yes - person struck, or was struck by, a motor vehicle (either on foot or or while riding) [Code even if hit & run]
2. No - no motor vehicle involved (fall from bicycle, ped struck by bicycle, ped tripped on curb, etc.)
3. Motor vehicle involved, but no contact made (car runs bicyclist off road, car causes ped to step back and trip on curb, etc.)
4. Other/uncertain (please describe) ______________________________

Figure. Appendix A - page 1.

Alcohol Involvement:
0. Unknown / no information
1. Presumed not impaired
2. Not tested, but impairment indicated
3. Tested
Test results ___ ___ ml/dl
99=N/A

Drug Involvement:
0. Unknown / no information
1. Presumed no drug use
2. Not tested, but suspected use
3. Tested positive for drugs
4. Tested negative for drugs
5. Tested, but results unknown

Bicyclist Helmet Use:
0. Unknown or N/A
1. Helmet used
2. Helmet used, but worn incorrectly or improper helmet
3. No helmet used

Equipment:
0. None (pedestrian only)
1. Bicycle
2. Child's bike - tricycle, big wheel, pedal scooter, etc.
3. Adult tricycle
4. Wheelchair
5. Skates/rollerblades
6. Skateboard
7. Baby stroller, backpack, etc.
8. Other ___________

Injury Characteristics

Location:		Type:	
0. Unknown	5. Abdomen / pelvis / lower back	0. Unknown	5. Sprain / strain
1. Head	6. Upper limb	1. Laceration / open wound	6. Intracranial
2. Face / neck	7. Lower limb	2. Contusion (skin intact)	7. Other internal inj.
3. Chest	8. Other (describe)	3. Fracture	8. Superficial injury
4. Back / spine		4. Dislocation	9. Other (describe)

	Loc.	Type	Description
Injury 1	____	____	______________________________
Injury 2	____	____	______________________________
Injury 3	____	____	______________________________
Injury 4	____	____	______________________________
Injury 5	____	____	______________________________

Glasgow Coma Score
___ ___
(99=Unknown)

Patient Disposition:
0. Unknown
1. Treated and released
2. Admitted
3. Admitted to OR
4. Admitted to ICU
5. Admitted to floor
6. Transferred to other facility: ______________
7. Fatal
8. Other ______________

Narrative Description of Injury Causing Event / Other Comments:

____

____

Follow-up Contact?
1. Not necessary
2. Yes - phone
3. Yes - other
4. No - no consent
5. No - phone # unk.
6. No - no response
7. No - refused
8. Other

Date Treated at ER __ __ / __ __ / __ __
Patient ID# ______________

Figure. Appendix A - page 2.

APPENDIX B - Data Collection Guidelines for Pedestrian and Bicyclist Injury Study

CASE IDENTIFICATION

In identifying cases for this study, it is important to remember that we are interested in pedestrians and bicyclists injured in both motor vehicle and non-motor vehicle collisions or falls, occurring either on the roadway, in other public areas open to vehicular traffic (parking lots, service stations, sidewalk, etc.), or, in some cases, on private property (driveways, yards, etc.). The following case definitions should apply:

Bicyclist: Any person riding or being carried on a bicycle or other two- or three-wheeled vehicle operated solely by pedals.

Includes:
bicycle
tricycle
big wheel
pedal scooter

Excludes:
mopeds
other motor-assisted bicycles
motorized scooters

If a person is walking or pushing a bicycle at the time of the injury event, or standing or kneeling beside a bicycle (e.g., repairing a flat tire), the individual should be coded as a pedestrian rather than a bicyclist.

Examples of bicyclist injury cases that should be included in the database include the following:

Example 1. A 22-year-old college student is injured when struck by a motor vehicle while riding his bicycle to campus.

Example 2. A 3-year-old riding a "big wheel" is injured when her mother runs over her while backing a car out of the driveway of her house.

Example 3. A 9-year-old boy falls from his bike and breaks his arm while riding on a dirt path behind his house.

Example 4. A 50-year-old bicyclist swerves and loses his balance trying to avoid a vehicle that has turned in front of him at an intersection. The vehicle leaves the scene of the accident without stopping.

Example 5. A 15-year-old girl is injured when the bike she is riding collides with a car in the parking lot of the neighborhood grocery store.

Example 6. A 12-year-old boy loses his balance and falls practicing "wheelies" in the road in front of his house.

Example 7. A bike racer is injured when struck by a truck's side mirror as it passes him on the left.

Example 8. A 5-year-old is practicing riding his new two-wheel bike on the sidewalk, and crashes into a mailbox.

Example 9. A cyclist competing in a race on an off-road course is injured when he crashes into another cyclist.

Examples of injury cases that should not be included in the bicycle database are:

Example 1. A person struck by a car while walking a bicycle across a busy intersection. (This would be coded as a pedestrian and not a bicycle case.)

Example 2. Someone injured while riding a moped. (A moped is motor driven.)

Example 3. Individuals injured while riding, or otherwise in contact with, a bicycle inside a residence or building.

Example 4. Persons injured while repairing, carrying, loading onto a vehicle, or otherwise handling a bicycle, but not actually riding it at the time of the injury.

Pedestrian: Any person traveling from one location to another, not in or upon a motor vehicle or other road vehicle. Also includes persons working or playing in roadways or other areas generally open to vehicular traffic.

Includes:

(1) all persons injured as a result of being struck by a motor vehicle, regardless of where the collision took place.

(2) other persons injured as the result of a fall or other mishap while walking, running, standing, working, playing, lying, etc. on a public street or highway *or* in a public vehicular area (PVA). A PVA is any area that is generally open to and used by the public for vehicular traffic, including entrances to public buildings, parking lots and garages, service stations, stores, restaurants, businesses, etc.

(3) persons injured on other public transportation-related pathways not generally open to vehicular traffic, including, but not limited to, public walkways, alleyways, multi-purpose trails, etc.

Excludes:

(1) persons injured on private property unless a motor vehicle is involved.

(2) persons injured on public property not serving a transportation function (playgrounds, ballfields, parks, etc.), unless a motor vehicle is involved.

(3) any injury incurred while inside a building, residence, or other structure, with the exception of parking garages and like facilities.

Examples of pedestrian injury cases that should be included in the database are:

Example 1. A 6-year-old darts out into the street and is struck by a passing motorist.

Example 2. A child playing in the driveway to his house is run over by a backing vehicle.

Example 3. A 60-year-old trips on a curb and falls while crossing the street.

Example 4. A 22-year-old jogger is struck by a bicyclist on a multi-use path.

Example 5. A woman pushing a grocery cart in the parking lot of a grocery store is struck by a motor vehicle exiting a parking space.

Example 6. A rollerblader loses control and falls while exercising on a greenway trail.

Example 7. A shopper trips on a curb while walking to her car parked in the mall parking lot.

Example 8. A child is struck by an ice cream truck that has pulled into a ballfield.

Examples of cases that should not be included in the pedestrian database are:

Example 1. An elderly woman trips and falls in her driveway while walking to her mailbox. (The injury event has occurred on private property and no motor vehicle is involved.)

Example 2. A child is injured playing on a school playground. (The event has occurred on property not serving a transportation function, and no motor vehicle is involved.)

Example 3. A jogger sprains an ankle while running on a track at the local park. (The event has occurred on property not serving a transportation function, and no motor vehicle is involved.)

Example 4. A man shoveling snow slips and falls on the sidewalk in front of his house. (The man is not a pedestrian traveling from one location to another, and his injury is not roadway-related.)

Example 5. A worker repairing a pothole in the road is injured using a piece of heavy equipment. (The person's injury is not roadway-related.)

APPENDIX C - Hospital Emergency Department Data Descriptive Tables

Table 66. Distribution of emergency department-reported pedestrian and bicyclist injury cases by age of victim.

Age	Ped-MV	Ped Only	Bike-MV	Bike Only	Ped-Bike	Bike-Bike	Other/ Uncert	Non-Case	Total
0-4	62	45	8	57	4	1	15	13	205
	(12.0)[1]	(4.9)	(2.6)	(7.7)	(19.1)	(3.4)	(14.6)	(9.4)	(7.4)
5-9	72	81	28	180	7	3	9	14	394
	(13.9)	(8.9)	(8.9)	(24.4)	(33.3)	(10.7)	(8.7)	(10.1)	(14.2)
10-14	66	118	64	159	3	2	11	25	448
	(12.7)	(13.0)	(20.4)	(21.5)	(14.3)	(7.1)	(10.7)	(18.0)	(16.2)
15-24	103	135	74	147	3	5	25	27	519
	(19.9)	(14.8)	(23.6)	(19.9)	(14.3)	(17.9)	(24.3)	(19.4)	(18.7)
25-44	135	229	102	134	2	14	17	40	673
	(26.1)	(25.2)	(32.6)	(18.1)	(9.5)	(50.0)	(16.5)	(28.8)	(24.3)
45-64	40	174	32	43	0	3	10	13	315
	(7.7)	(19.1)	(10.2)	(5.8)	(0.0)	(10.7)	(9.7)	(9.4)	(11.4)
65+	40	128	5	19	2	0	16	7	217
	(7.7)	(14.1)	(1.6)	(2.6)	(9.5)	(0.0)	(15.5)	(5.0)	(7.8)
Total	518	910	313	739	21	28	103	139	2771

[1] Percentage of column total.

Table 67. Distribution of emergency department-reported pedestrian and bicyclist injury cases by gender of victim.

Gender	Ped-MV	Ped Only	Bike-MV	Bike Only	Ped-Bike	Bike-Bike	Other/ Uncert	Non-Case	Total
Male	326	428	260	518	14	16	48	89	1699
	(62.6)[1]	(46.7)	(81.3)	(70.1)	(66.7)	(57.1)	(47.1)	(63.1)	(60.9)
Female	195	489	60	221	7	12	54	52	1090
	(37.4)	(53.3)	(18.8)	(29.9)	(33.3)	(42.9)	(52.9)	(36.9)	(39.1)
Total	521	917	320	739	21	28	102	141	2789

[1] Percentage of column total.

Table 68. Distribution of emergency department-reported pedestrian and bicyclist injury cases by race of victim.

Race	Ped-MV	Ped Only	Bike-MV	Bike Only	Ped-Bike	Bike-Bike	Other/ Uncert	Non-Case	Total
White	243	702	169	511	15	18	62	103	1823
	(47.6)[1]	(77.2)	(53.5)	(70.6)	(71.4)	(64.3)	(61.4)	(74.6)	(66.4)
Black	174	129	89	95	4	2	27	26	546
	(34.1)	(14.2)	(28.2)	(13.1)	(19.0)	(7.1)	(26.7)	(18.8)	(19.9)
Hispanic	74	54	46	79	2	5	11	7	278
	(14.5)	(5.9)	(14.6)	(10.9)	(9.5)	(17.9)	(10.9)	(5.1)	(10.1)
Asian	8	10	5	21	0	3	1	2	50
	(1.6)	(1.1)	(1.6)	(2.9)	(0.0)	(10.7)	(1.0)	(1.4)	(1.8)
American Indian	2	1	2	1	0	0	0	0	6
	(0.4)	(0.1)	(0.6)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.2)
Other/	9	13	5	17	0	0	0	0	44
Mixed	(1.8)	(1.4)	(1.6)	(2.3)	(0.0)	(0.0)	(0.0)	(0.0)	(1.6)
Total	510	909	316	724	21	28	101	138	2747

[1] Percentage of column total.

Table 69. Distribution of emergency department-reported pedestrian and bicyclist injury cases by time of day injury occurred.

Time of Day	Ped-**MV**	Ped **Only**	Bike-**MV**	Bike **Only**	Ped-**Bike**	Bike-**Bike**	Other/ Uncert	Non-Case	Total
6 a.m.-10 a.m.	38	116	24	26	0	0	5	3	212
	(9.6)[1]	(13.5)	(8.9)	(4.3)	(0.0)	(0.0)	(9.4)	(15.0)	(9.4)
10 a.m.-2 p.m.	64	192	47	101	6	8	8	3	429
	(16.2)	(22.3)	(17.5)	(16.6)	(28.6)	(30.8)	(15.1)	(15.0)	(19.0)
2 p.m.-6 p.m.	135	267	97	248	7	7	16	10	787
	(34.2)	(31.0)	(36.1)	(40.7)	(33.3)	(26.9)	(30.2)	(50.0)	(34.9)
6 p.m.-10 p.m.	115	210	81	200	8	11	17	4	646
	(29.1)	(24.4)	(30.1)	(32.8)	(38.1)	(42.3)	(32.1)	(20.0)	(28.7)
10 p.m.-2 a.m.	33	60	18	31	0	0	7	0	149
	(8.4)	(7.0)	(6.7)	(5.1)	(0.0)	(0.0)	(13.2)	(0.0)	(6.6)
2 a.m.-6 a.m.	10	15	2	3	0	0	0	0	30
	(2.5)	(1.7)	(0.7)	(0.5)	(0.0)	(0.0)	(0.0)	(0.0)	(1.3)
Total	395	860	269	609	21	26	53	20	2253

[1] Percentage of column total.

Table 70. Distribution of emergency department-reported pedestrian and bicyclist injury cases by case disposition.

Emerg. Dept. Disposition	Ped-MV	Ped Only	Bike-MV	Bike Only	Ped-Bike	Bike-Bike	Other/ Uncert	Non-Case	Total
Treated &	298	845	231	653	18	24	82	120	2271
Released	(57.3)[1]	(92.6)	(74.0)	(88.7)	(90.0)	(85.7)	(81.2)	(87.6)	(82.1)
Admitted	197	62	71	63	2	4	18	14	431
	(37.9)	(6.8)	(22.8)	(8.6)	(10.0)	(14.3)	(17.8)	(10.2)	(15.6)
Transfer/	10	6	5	19	0	0	1	3	44
Other	(1.9)	(0.7)	(1.6)	(2.6)	(0.0)	(0.0)	(1.0)	(2.2)	(1.6)
Fatal	15	0	5	1	0	0	0	0	21
	(2.9)	(0.0)	(1.6)	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)	(0.8)
Total	520	913	312	736	20	28	101	137	2767

[1] Percentage of column total.

APPENDIX D - Hospital Discharge Data Descriptive Tables

Table 71. Pedestrian age distribution in hospital datafiles.

	California Hospital				New York State Hospital				North Carolina Trauma Registry		
Age of Pedestrian	**Ped-MV Road**	**Ped-MV Non-rd.**	**Ped Only**	**Total**	**Ped-MVRoad**	**Ped-MV Non-rd.**	**Ped Only**	**Total**	**Ped-MVRoad**	**Ped-MV Non-rd.**	**Total**
0-4	615(89.3)[1] (10.5)[2]	58 (8.4) (17.4)	16 (2.3) (1.1)	689 (9.0)[2]	646 (65.1) (6.6)	23 (2.3) (7.1)	323 (32.6) (4.8)	992 (5.9)	81 (89.0) (11.6)	10 (11.0) (23.3)	91 (12.3)
5-9	779(95.2) (13.2)	18 (2.2) (5.4)	21 (2.6) (1.4)	818 (10.6)	962 (88.0) (9.8)	22 (2.0) (6.8)	109 (10.0) (1.6)	1093 (6.5)	67 (95.7) (9.6)	3 (4.3) (7.0)	70 (9.4)
10-14	382 (86.0) (6.5)	18 (4.1) (5.4)	44 (9.9) (3.0)	444 (5.8)	886 (81.9) (9.0)	18 (1.7) (5.6)	178 (16.5) (2.6)	1082 (6.4)	60 (93.6) (8.6)	4 (6.3) (9.3)	64 (8.6)
15-19	325 (87.4) (5.5)	13 (3.5) (3.9)	34 (9.1) (2.3)	372 (4.8)	659 (80.8) (6.7)	22 (2.7) (6.8)	135 (16.5) (2.0)	816 (4.8)	51 (96.2) (7.3)	2 (3.8) (4.7)	53 (7.1)
20-24	350 (88.2) (6.0)	20 (5.0) (6.0)	27 (6.8) (1.8)	397 (5.2)	584 (70.6) (6.0)	20 (2.4) (6.2)	223 (27.0) (3.3)	827 (4.9)	41 (93.2) (5.9)	3 (6.9) (7.0)	44 (5.9)
25-44	1671 (83.1) (28.4)	79 (3.9) (23.7)	262 (13.0) (17.7)	2012 (26.1)	2557 (63.4) (26.1)	82 (2.0) (25.4)	1394 (34.6) (20.6)	4033 (23.9)	247 (96.1) (35.3)	10 (3.9) (23.3)	257 (34.6)
45-64	90 (73.5) (15.3)	53 (4.3) (15.9)	271 (22.1) (18.3)	1224 (15.9)	1722 (49.9) (17.6)	47 (1.4) (14.6)	1679 (48.7) (24.8)	3448 (20.4)	93 (92.1) (13.3)	8 (7.9) (18.6)	101 (13.6)
65-74	405 (58.5) (6.9)	24 (3.5) (7.2)	263 (38.0) (17.7)	692 (9.0)	847 (43.1) (8.7)	37 (1.9) (11.5)	1082 (55.0) (16.0)	1966 (11.6)	32 (97.0) (4.6)	1 (3.0) (2.3)	33 (4.5)
75+	457 (43.4) (7.8)	51 (4.8) (15.3)	545 (51.8) (36.8)	1053 (13.7)	933 (35.3) (9.5)	52 (2.0) (16.1)	1655 (62.7) (24.4)	2640 (15.6)	27 (93.1) (3.9)	2 (6.9) (4.7)	29 (3.9)
Total	5884 (76.4)[1]	334 (4.3)	1483 (19.3)	7701	9796 (58.0)	323 (1.9)	6778 (40.1)	16,897	699 (94.2)	43 (5.8)	742

[1] Percentage of row total. [2] Percentage of column total.

Table 72. Pedestrian gender distribution in hospital datafiles.

Gender of Pedestrian	California Hospital Ped-MV Road	California Hospital Ped-MV Non-rd.	California Hospital Ped Only	California Hospital Total	New York State Hospital Ped-MV Road	New York State Hospital Ped-MV Non-rd.	New York State Hospital Ped Only	New York State Hospital Total	North Carolina Trauma Registry Ped-MV Road	North Carolina Trauma Registry Ped-MV Non-rd.	North Carolina Trauma Registry Total
Female	2177 (68.2)[1] (37.0)[2]	136 (4.3) (40.7)	877 (27.5) (59.1)	3190 (41.4)[2]	3968 (49.8) (40.5)	141 (1.8) (43.6)	3852 (48.4) (56.8)	7961 (47.1)	223 (93.3) (31.8)	16 (6.7) (37.2)	239 (32.1)
Male	3707 (82.2) (63.0)	198 (4.4) (59.3)	606 (13.4) (40.9)	4511 (58.6)	5828 (65.2) (59.5)	182 (2.0) (56.4)	2926 (32.7) (43.2)	8936 (52.9)	478 (94.7) (68.2)	27 (5.4) (62.8)	505 (67.9)
Total	5884 (76.4)[1]	334 (4.3)	1483 (19.3)	7701	9796 (58.0)	323 (1.9)	6778 (40.1)	16,897	701 (94.2)	43 (5.8)	744

[1] Percentage of row total. [2] Percentage of column total.

Table 73. Pedestrian race distribution in hospital datafiles.

Pedestrian Race	California Hospital Ped-MV Road	California Hospital Ped-MV Non-rd.	California Hospital Ped Only	California Hospital Total	New York State Hospital Ped-MV Road	New York State Hospital Ped-MV Non-rd.	New York State Hospital Ped Only	New York State Hospital Total	North Carolina Trauma Registry Ped-MV Road	North Carolina Trauma Registry Ped-MV Non-rd.	North Carolina Trauma Registry Total
White	2346 (65.3)[1] (40.2)[2]	183 (5.1) (55.2)	1064 (29.6) (72.2)	3593 (47.0)[2]	5058 (50.1) (56.0)	237 (2.4) (77.2)	4793 (47.5) (74.0)	10,088 (63.8)	350 (92.6) (50.7)	28 (7.4) (65.1)	378 (51.6)
Black	833 (86.1) (14.3)	21 (2.2) (6.3)	113 (11.7) (7.7)	967 (12.7)	2128 (72.0) (23.6)	31 (1.1) (10.1)	799 (27.0) (12.3)	2958 (18.7)	300 (95.9) (43.5)	13 (4.2) (30.2)	313 (42.7)
Native American	--	--	--	--	27 (64.3) (0.3)	3 (7.1) (1.0)	12 (28.6) (0.2)	42 (0.3)	4 (100.0) (0.6)	0 (0.0) (0.0)	4 (0.6)
Asian or Pacific Islander	479 (84.2) (8.2)	23 (4.0) (7.0)	67 (11.8) (4.6)	569 (7.4)	351 (64.1) (3.9)	12 (2.2) (3.9)	185 (33.8) (2.9)	548 (3.5)	4 (80.0) (0.6)	1 (20.0) (2.3)	5 (0.7)
Hispanic	2074 (86.9) (35.5)	97 (4.1) (29.2)	216 (9.1) (14.7)	2387 (31.2)	--	--	--	--	--	--	--
Other	106 (82.8) (1.8)	8 (6.3) (2.4)	14 (11.0) (1.0)	128 (1.7)	1467 (67.3) (16.2)	24 (1.1) (7.8)	689 (31.6) (10.6)	2180 (13.8)	32 (97.0) (4.6)	1 (3.0) (2.3)	33 (4.5)
Total	5838 (76.4)[1]	332 (4.3)	1474 (19.3)	7644	9031 (57.1)	307 (1.9)	6478 (41.0)	15,816	690 (94.1)	43 (5.9)	733

[1] Percentage of row total. [2] Percentage of column total.

Table 74. Pedestrian length-of-stay (days) distribution in hospital datafiles.

Length of Stay (days) in Hospital	California Hospital				New York State Hospital				North Carolina Trauma Registry		
	Ped-MV Road	Ped-MV Non-rd.	Ped Only	Total	Ped-MV Road	Ped-MV Non-rd.	Ped Only	Total	Ped-MV Road	Ped-MV Non-rd.	Total
1	1457 (80.4)[1] (24.8)[2]	77 (4.2) (23.1)	278 (15.3) (18.7)	1812 (23.5)[2]	1510 (64.9) (15.4)	77 (1.8) (12.7)	776 (33.3) (11.4)	2327 (13.8)	157 (95.7) (22.9)	7 (4.3) (17.1)	164 (22.6)
2-4	1895 (70.9) (32.2)	133 (5.0) (39.9)	646 (24.2) (43.6)	2674 (34.7)	3013 (55.6) (30.8)	99 (1.8) (30.7)	2304 (42.5) (34.0)	5416 (32.1)	168 (89.8) (24.5)	19 (10.2) (46.3)	187 (25.7)
5-9	1233 (16.0) (21.0)	75 (4.4) (22.5)	407 (23.7) (27.4)	1715 (22.3)	2126 (51.0) (21.7)	81 (1.9) (25.1)	1966 (47.1) (29.0)	4173 (24.7)	153 (95.0) (22.3)	8 (5.0) (19.5)	161 (22.2)
10+	1299 (86.6) (22.1)	49 (3.3) (14.7)	152 (10.1) (10.3)	1500 (19.5)	3147 (63.2) (32.1)	102 (2.1) (31.6)	1732 (34.8) (25.6)	4981 (29.5)	208 (96.7) (30.3)	7 (3.3) (17.1)	215 (29.6)
Total	5884 (76.4)[1]	334 (4.3)	1483 (19.3)	7701	9796 (58.0)	323 (1.9)	6778 (40.1)	16,897	686 (94.4)	41 (5.6)	727

[1] Percentage of row total. [2] Percentage of column total.

Table 75. Pedestrian disposition from hospital distribution in hospital datafiles.

Disposition from Hospital	California Hospital				New York State Hospital				North Carolina Trauma Registry		
	Ped-MV Road	Ped-MV Non-rd.	Ped Only	Total	Ped-MV Road	Ped-MV Non-rd.	Ped Only	Total	Ped-MV Road	Ped-MV Non-rd.	Total
Home / Routine Discharge	4131 (79.5)[1] (70.2)[2]	242 (4.7) (72.5)	823 (15.8) (55.5)	5196 (67.5)[2]	*(Data not obtained by project)*				385 (93.0) (56.0)	29 (7.0) (69.1)	414 (56.8)
Other Treatment Facility	1106 (67.4) (18.8)	53 (3.2) (15.9)	481 (29.3) (32.4)	1640					98 (100.0) (14.3)	0 (0.0) (0.0)	98 (13.4)
Other [3]	347 (64.7) (5.9)	23 (4.3) (6.9)	166 (31.0) (11.2)	536 (7.0)					112 (92.6) (16.3)	9 (7.4) (21.4)	121 (16.6)
Died	300 (91.2) (5.1)	16 (4.9) (4.8)	13 (4.0) (0.9)	329 (4.3)					92 (95.8) (13.4)	4 (4.2) (9.5)	96 (13.2)
Total	5884 (76.4)[1]	334 (4.3)	1483 (19.3)	7701					687 (94.2)	42 (5.8)	729

[1] Percentage of row total. [2] Percentage of column total.

[3] Home health, detoxification center, psychiatric, unknown disposition.

Table 76. Bicyclist age distribution in hospital discharge datafiles.

Age of Bicyclist	California Hospital (1994)				New York State Hospital (1994-1995)				North Carolina Trauma Registry (1994-1995)			
	Bike-MV Road	**Bike-MV Non-rd.**	**Bike Only**	**Total**	**Bike-MV Road**	**Bike-MV Non-rd.**	**Bike Only**	**Total**	**Bike-MV Road**	**Bike-MV Non-rd.**	**Bike Only**	**Total**
0-9	182 (25.5)[1] (14.7)[2]	9 (1.3) (24.3)	522 (73.2) (18.1)	713 (17.2)[2]	174 (25.4) (10.6)	7 (1.0) (11.5)	503 (73.5) (19.2)	684 (15.8)	38 (40.0) (24.1)	6 (6.3) (26.1)	51 (53.7) (31.5)	95 (27.7)
10-14	250 (32.2) (20.2)	4 (0.5) (10.8)	522 (67.3) (18.1)	776 (18.7)	337 (36.4) (20.5)	18 (1.9) (29.5)	576 (62.1) (21.9)	927 (21.4)	45 (52.9) (28.5)	5 (5.9) (21.7)	35 (41.2) (21.6)	85 (24.8)
15-19	111 (31.8) (9.0)	3 (0.9) (8.1)	235 (67.3) (8.1)	349 (8.4)	241 (46.3) (14.7)	6 (1.2) (9.8)	274 (52.6) (10.4)	521 (12.0)	15 (48.4) (9.5)	6 (19.4) (26.1)	10 (32.3) (6.2)	31 (9.0)
20-24	104 (36.1) (8.4)	2 (0.7) (5.4)	182 (63.2) (6.3)	288 (6.9)	159 (50.2) (9.7)	4 (1.3) (6.6)	154 (48.6) (5.9)	317 (7.3)	14 (50.0) (8.9)	0 (0.0) (0.0)	14 (50.0) (8.6)	28 (8.2)
25-44	403 (32.6) (32.6)	14 (1.1) (37.8)	820 (66.3) (28.4)	1237 (29.8)	490 (42.3) (29.8)	18 (1.6) (29.5)	625 (55.2) (23.8)	1133 (26.2)	35 (52.2) (22.2)	4 (6.0) (17.4)	28 (41.8) (17.3)	67 (19.5)
45-64	112 (19.8) (9.1)	1 (0.2) (2.7)	452 (80.0) (15.7)	565 (13.6)	173 (33.6) (10.5)	7 (1.4) (11.5)	335 (65.1) (12.8)	515 (11.9)	10 (30.3) (6.3)	2 (6.1) (8.7)	21 (63.6) (13.0)	33 (9.6)
65+	73 (31.7) (5.9)	4 (1.7) (10.8)	153 (66.5) (5.3)	230 (5.5)	71 (30.7) (4.3)	1 (0.4) (1.6)	159 (68.8) (6.1)	231 (5.3)	1 (25.0) (0.6)	0 (0.0) (0.0)	3 (75.0) (1.9)	4 (1.2)
Total	1235 (29.7)[1]	37 (0.9)	2886 (69.4)	4158	1645 (38.0)	61 (1.4)	2622 (60.6)	4328	158 (46.1)	23 (6.7)	162 (47.2)	343

[1] Percentage of row total. [2] Percentage of column total.

Table 77. Bicyclist gender distribution in hospital discharge datafiles.

Gender of Bicyclist	California Hospital (1994)				New York State Hospital (1994-1995)				North Carolina Trauma Registry (1994-1995)			
	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total
Female	214 (24.3)[1] (17.3)[2]	10 (1.1) (27.0)	658 (74.6) (22.8)	882 (21.2)[2]	257 (26.9) (15.6)	8 (0.8) (13.1)	690 (72.3) (26.3)	955 (22.1)	36 (43.4) (22.6)	5 (6.0) (21.7)	42 (50.6) (25.9)	83 (24.1)
Male	1021 (31.2) (82.7)	27 (0.8) (73.0)	2228 (68.0) (77.2)	3276 (78.8)	1338 (41.2) (84.4)	53 (1.6) (86.9)	1932 (57.3) (73.7)	3373 (78.0)	123 (47.1) (77.4)	18 (6.9) (78.3)	120 (46.0) (74.1)	261 (75.9)
Total	1235 (29.7)[1]	37 (0.9)	2886 (69.4)	4158	1645 (38.0)	61 (1.4)	2622 (60.6)	4328	159 (46.2)	23 (6.7)	162 (47.1)	344

[1] Percentage of row total. [2] Percentage of column total.

Table 78. Bicyclist race distribution in hospital discharge datafiles.

Bicyclist Race	California Hospital (1994)				New York State Hospital (1994-1995)				North Carolina Trauma Registry (1994-1995)			
	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total
White	719 (26.1)[1] (58.5)[2]	23 (0.8) (63.9)	2013 (73.1) (70.1)	2755 (66.6)[2]	814 (31.7) (53.1)	39 (1.5) (67.2)	1713 (66.8) (71.4)	2566 (64.3)	86 (41.0) (54.4)	16 (7.6) (69.6)	108 (46.5) (67.1)	210 (61.4)
Black	130 (43.6) (10.6)	3 (1.0) (8.3)	165 (55.4) (5.7)	298 (7.2)	365 (49.8) (23.8)	10 (1.4) (17.2)	358 (48.8) (14.9)	733 (18.4)	64 (55.2) (40.5)	6 (5.2) (26.1)	46 (39.7) (28.6)	116 (33.9)
Native American	--	--	--	--	6 (75.0) (0.4)	0 (0.0) (0.0)	2 (25.0) (0.1)	8 (0.2)	1 (50.0) (0.6)	0 (0.0) (0.0)	1 (50.0) (0.6)	2 (0.6)
Asian or Pacific Islander	59 (36.4) (4.8)	0 (0.0) (0.0)	103 (63.6) (3.6)	162 (3.9)	46 (51.1) (3.0)	1 (1.1) (1.7)	43 (47.8) (1.8)	90 (2.3)	2 (50.0) (1.3)	0 (0.0) (0.0)	2 (50.0) (1.2)	4 (1.2)
Hispanic	302 (34.8) (24.6)	8 (0.9) (22.2)	559 (64.3) (19.5)	869 (21.0)	--	--	--	--	--	--	--	--
Other	19 (37.3) (1.6)	2 (3.9) (5.6)	30 (58.8) (1.1)	51 (1.2)	303 (51.0) (19.8)	8 (1.4) (13.8)	283 (47.6) (11.8)	594 (14.9)	5 (50.0) (3.2)	1 (10.0) (4.4)	4 (40.0) (2.5)	10 (2.9)
Total	1229 (29.7)[1]	36 (0.9)	2870 (69.4)	4135	1534 (38.0)	58 (1.4)	2399 (60.6)	3991	158 (46.2)	23 (6.7)	161 (47.1)	342

[1] Percentage of row total. [2] Percentage of column total.

Table 79. Bicyclist length-of-stay (days) distribution in hospital discharge datafiles.

Length of Stay (days) in Hospital	California Hospital (1994)				New York State Hospital (1994-1995)				North Carolina Trauma Registry (1994-1995)			
	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total
1	401 (25.4)[1] (32.5)[2]	10 (0.6) (27.0)	1166 (73.9) (40.4)	1577 (37.9)[2]	401 (32.5) (24.4)	18 (1.5) (29.5)	814 (66.0) (31.0)	1233 (28.5)	38 (42.7) (24.2)	4 (4.5) (18.2)	47 (52.8) (30.3)	89 (26.6)
2-4	439 (27.1) (35.6)	15 (1.0) (40.5)	1166 (71.9) (40.4)	1620 (39.0)	645 (36.8) (39.2)	19 (1.1) (31.2)	1091 (62.2) (41.6)	1755 (40.6)	51 (38.4) (32.5)	11 (8.3) (50.0)	71 (53.4) (45.8)	133 (39.8)
5-9	221 (35.6) (17.9)	7 (1.1) (19.0)	393 (63.2) 13.6)	621 (15.0)	337 (39.5) (20.5)	17 (2.0) (27.9)	500 (58.5) (19.1)	854 (19.7)	36 (56.3) (22.9)	6 (9.4) (27.3)	22 (34.5) (14.2)	64 (19.2)
10+	174 (51.2) (14.1)	5 (1.5) (13.5)	161 (47.3) (5.5)	340 (8.2)	262 (53.9) (16.0)	7 (1.4) (11.5)	217 (44.7) (8.3)	486 (11.2)	32 (66.7) (20.4)	1 (2.1) (4.6)	15 (31.3) (9.7)	48 (14.4)
Total	1235 (29.7)[1]	37 (0.9)	2886 (69.4)	4158	1645 (38.0)	61 (1.4)	2622 (60.6)	4328	157 (47.0)	22 (6.6)	155 (46.4)	334

[1] Percentage of row total. [2] Percentage of column total.

Table 80. Bicyclist disposition from hospital distribution in hospital discharge datafiles.

Disposition from Hospital	California Hospital (1994)				New York State Hospital (1994-1995)				North Carolina Trauma Registry (1994-1995)			
	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total	Bike-MV Road	Bike-MV Non-rd.	Bike Only	Total
Home / Routine Discharge	982 (27.2)[1] (79.5)[2]	33 (0.9) (89.2)	2592 (71.9) (89.8)	3607 (86.8)[2]	*(Data not obtained by project)*				94 (38.2) (59.1)	20 (8.1) (87.0)	132 (53.7) (81.5)	246 (71.5)
Other Treatment Facility	150 (47.3) (12.1)	2 (0.6) (5.4)	165 (52.1) (5.7)	317 (7.6)					20 (69.0) (12.6)	1 (3.5) (4.4)	8 (27.6) (4.9)	29 (8.4
Other [3]	55 (32.0) (4.5)	2 (1.2) (5.4)	115 (66.9) (4.0)	172 (4.1)					31 (56.4) (19.5)	2 (3.6) (8.7)	22 (40.0) (13.6)	55 (16.0)
Died	48 (77.4) (3.9)	0 (0.0) (0.0)	14 (22.6) (1.0)	62 (1.5)					14 (100.0) (8.8)	0 (0.0) (0.0)	0 (0.0) (0.0)	14 (4.1)
Total	1235 (29.7)[1]	37 (0.9)	2886 (69.4)	4158					159 (46.2)	23 (6.7)	162 (47.1)	344

[1] Percentage of row total. [2] Percentage of column total.

APPENDIX E - State Motor Vehicle Crash File Data Descriptive Tables

Table 81. Bicyclist and pedestrian age distributions in 1995 State motor vehicle crash files.

Age[1]	California		New York		North Carolina	
	Bicyclist	Pedestrian	Bicyclist	Pedestrian	Bicyclist	Pedestrian
0-4	1333	1451	725	709	271	134
	(9.4)[2]	(8.6)	(7.9)	(3.6)	(17.7)	(4.9)
5-9		2197		2176		220
		(13.0)		(10.9)		(8.0)
10-14	2994	1899	1894	2309	401	255
	(21.0)	(11.2)	(20.7)	(11.6)	(26.2)	(9.3)
15-19	1838	1472	1800	1782	188	324
	(12.9)	(8.7)	(19.6)	(8.9)	(12.3)	(11.8)
20-24	1558	1169	1186	1539	143	244
	(10.9)	(6.9)	(12.9)	(7.7)	(9.3)	(8.9)
25-44	4875	4772	2835	6086	358	960
	(34.3)	(28.3)	(30.9)	(30.5)	(23.4)	(34.9)
45-64	1312	2456	603	3272	108	345
	(9.2)	(14.5)	(6.6)	(16.4)	(7.1)	(12.5)
65-74	325	781	123	1093	59	96
	(2.3)	(4.6)	(1.3)	(5.5)	(4.0)	(3.5)
75+		688		979		174
		(4.1)		(4.9)		(6.3)
Total[3]	14,235	16,885	9166	19,945	1528	2752

[1] Lowest and highest age categories collapsed for bicyclists.
[2] Percentage of column total.
[3] Excludes cases with missing age information.

Table 82. Bicyclist and pedestrian gender distributions in 1995 State motor vehicle crash files.

Gender	California		New York		North Carolina	
	Bicyclist	Pedestrian	Bicyclist	Pedestrian	Bicyclist	Pedestrian
Female	2740	7000	1346	8671	247	913
	(18.7)[1]	(40.0)	(14.3)	(42.0)	(17.1)	(36.1)
Male	11,934	10,488	8044	11,969	1194	1617
	(81.3)	(60.0)	(85.7)	(58.0)	(82.9)	(63.9)
Total[2]	14,674	17,488	9390	20,640	1441	2530

[1] Percentage of column total.
[2] Excludes cases with missing gender information.

Table 83. Time-of-day distribution for bicyclist and pedestrian crashes in 1995 State motor vehicle crash files.

Time of Day	California		New York		North Carolina	
	Bicyclist	Pedestrian	Bicyclist	Pedestrian	Bicyclist	Pedestrian
6 a.m. - 10 a.m.	2147	2443	851	2779	109	281
	(14.6)[1]	(14.0)	(9.2)	(13.8)	(7.2)	(10.5)
10 a.m.- 2 p.m.	3108	3011	1739	3984	267	486
	(21.1)	(17.2)	(18.9)	(19.7)	(17.6)	(18.1)
2 p.m. - 6 p.m.	5710	5785	3268	6345	632	757
	(38.7)	(33.1)	(35.5)	(31.4)	(41.7)	(28.2)
6 p.m. - 10 p.m.	3126	4597	2442	4645	417	762
	(21.2)	(26.3)	(26.5)	(23.0)	(27.5)	(28.3)
10 p.m. - 2 a.m.	507	1241	711	1775	74	306
	(3.4)	(7.1)	(7.7)	(8.8)	(4.9)	(11.4)
2 a.m. - 6 a.m.	144	424	204	676	15	96
	(1.0)	(2.4)	(2.2)	(3.3)	(1.0)	(3.6)
Total[2]	14,742	17,501	9215	20,204	1514	2688

[1] Percentage of column total.
[2] Excludes cases with missing time-of-day information.

Table 84. Bicyclist and pedestrian injury severity distributions for crashes in 1995 State motor vehicle crash files.

Injury Severity	California		New York		North Carolina	
	Bicyclist	Pedestrian	Bicyclist	Pedestrian	Bicyclist	Pedestrian
Fatal	139	834	5	179	35	199
(K)	(0.9)[1]	(4.8)	(0.1)	(0.9)	(2.4)	(7.7)
Serious	786	2183			230	609
(Class A)	(5.3)	(12.4)			(16.0)	(23.5)
Moderate	7401	7409	(Different Coding Scheme Used)		602	846
(Class B)	(50.1)	(42.3)			(41.8)	(32.7)
Minor	4773	6415			487	921
(Class C)	(32.3)	(36.6)			(33.8)	(35.6)
No Injury	1681	695			85	13
(0)	(11.4)	(4.0)			(5.9)	(0.5)
Total[2]	14,780	17,536	9215	19,945	1439	2588

[1] Percentage of column total.
[2] Excludes cases with missing injury information.

Table 85. Bicyclist- and pedestrian-reported alcohol use in 1995 State motor vehicle crash files.

Alcohol Use	California		New York		North Carolina	
	Bicyclist	Pedestrian	Bicyclist	Pedestrian	Bicyclist	Pedestrian
None	12,281 (87.8)[1]	12,753 (81.6)	Information not available		1123 (87.5)	1331 (73.5)
Drinking, Impaired	361 (2.6)	827 (5.3)			10 (0.8)	68 (3.8)
Drinking, Not Impaired	260 (1.9)	180 (1.2)			112 (8.7)	315 (17.4)
Drinking, Impair. Unk.	235 (1.7)	618 (4.0)			1 (0.1)	8 (0.4)
Impairment Hit / Run	856 (6.1)	1257 (8.0)			--	--
Not Stated/ Unknown	787 (--)	1901 (--)			284 (--)	1030 (--)
Total[2]	14,780	17,536			1530	2752

[1] Percentage of column total.

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