Cost of Injury

in the United States

A Report to Congress

1989

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and Associates

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and

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and

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Preface

Injury is now recognized as a major public health problem in the United States. It is the fourth leading cause of all deaths, but among children and adults under age 45, it is the leading cause of death. Injury is costly to the nation in productive life years lost due to premature death and long term disability; in medical resources used for care, treatment, and rehabilitation of injured persons; and in pain and suffering of the injured persons, their families, and friends.

Background

The present report is the third in a series focusing attention on injury as a critical public health issue. *Injury in America,* the 1985 report from the National Academy of Sciences by the Committee on Trauma Research, the National Research Council, and the Institute of Medicine, launched the series. It found that serious, but remediable, inadequacies exist in the understanding of and approach to injury as a health problem, that current data systems are inadequate for planning and evaluating preventive programs, and that high priority should be given to research on the prevention and treatment of injuries and on the rehabilitation of injured persons. Emphasis was placed on the need for a center for injury control within the federal government and for more adequate resources for research on injury.

Following the publication of *Injury in America,* Congress established a three-year pilot program for the study of injury control at the Centers for Disease Control (CDC). The new Division of Injury Epidemiology and Control began efforts in the following areas: research and data collection, professional training, promotion of health department programs, and coordination at federal, state, and local levels among public health workers and others involved in the field.

In 1988, the National Academy of Sciences published *Injury Control,* the second in the series. This report reviewed the status and progress of the injury control programs at CDC. It commended the accomplishments of CDC activities, but concluded that the full intent of the recommendations made in *Injury in America* had not been met because of the lack of resources and the need for an organizational setting to make the program more widely recognizable as the federal focal point for the conduct and coordination of injury control research.

The present Report to Congress, *Cost of Injury in the United States,* is the third in this series of injury reports. The 1987 Supplemental Appropriation Bill of the House of Representatives (100th Cong., 1st sess.) directed that research be conducted by the joint National Highway

Traffic Safety Administration (NHTSA) and CDC Trauma Research Program to evaluate the impact of injury and associated disability on American society. The report accompanying the legislation states:

> This research should identify the effect of injuries on state and local governments, local communities, families and individuals. Eighteen months following enactment of this Act, a report on the results of this research shall be submitted to the House and Senate Committees on Appropriations. In addition, the report shall provide an estimate of the nation's long-term costs of treatment and rehabilitation of injuries, including motor vehicle injuries, and describe the extent to which existing government and non-government programs cover the economic and non-economic costs. The report shall further provide an estimate of the potential savings to all levels of government that could result from the prevention of injuries, including motor vehicle injuries, and their consequences (U.S. House of Representatives, p. 94).

The present report addresses the purpose and objectives of the mandate. It was conducted under grants from NHTSA and CDC by two research organizations: the Institute for Health & Aging, University of California, San Francisco and the Injury Prevention Center, School of Hygiene and Public Health, The Johns Hopkins University (Grant Nos. DTNH22-88-Z-07145 and DTNH22-88-Z-07144).

Organization of the Report

The report contains five chapters on the incidence and cost of injury, a chapter featuring ten case studies of the long-term impact of injury, and recommendations resulting from the study. Following the Summary and an introduction, Chapters One and Two describe in detail the incidence and lifetime cost of injury. Chapter Three explores the sources of payment for costs incurred following injury and estimates transfer payments from public and private sources to injured persons or their survivors. Estimates of the willingness to pay for the reduction of injury are presented in Chapter Four. Chapter Five assesses potential savings from selected injury prevention programs. Chapter Six consists of ten case studies of injured persons in which personal narratives illustrate the long-term impact of injury on individuals, families, and society. Policy implications emerging from the case studies are presented. The recommendations that follow from the conduct of the study focus on the following issues: injury prevention and control, coding and measurement, data needs, and treatment and rehabilitation.

Acknowledgments

This report on the impact of injuries and their associated disabilities on American society represents a truly collaborative effort of the staff of two universities -- the Institute for Health & Aging, University of California, San Francisco (UCSF), and the Injury Prevention Center, School of Hygiene and Public Health, The Johns Hopkins University (JHU). It is the product of research supported by NHTSA and CDC. The study involved a multidisciplinary approach and many experts, all of whom contributed greatly to the production of this report.

The authors wish to express their appreciation for the invaluable guidance, advice, assistance, support, encouragement and coordination provided throughout the project by Barbara Faigin, Project Officer, NHTSA. Several individuals in NHTSA also provided useful data and expert advice in various aspects of the research including Michael Finkelstein, Steven Luchter, Larry Blincoe, and Louis Lombardo. Mark Rosenberg and Stuart Brown, CDC, also provided invaluable guidance and support.

The principal investigators at UCSF and at JHU gratefully acknowledge the professional expertise and assistance of several colleagues and support staff who had major responsibilities for the various components of the study. At UCSF, Sharon Kaufman, anthropologist, conducted the case studies of injured survivors and their families to measure the long-term impact of injury to themselves, their families, and society. Elizabeth McLoughlin, public health and injury control specialist, provided invaluable expertise in the development of injury incidence categories and the recommendations, writing several sections of the report, and carefully reviewing the entire manuscript. Wendy Max, economist, designed the lifetime cost model and was responsible for the estimation of the direct and indirect costs. The authors gratefully acknowledge the professional assistance of several colleagues at UCSF, including Mitchell P. LaPlante for his guidance in the use of several National Center for Health Statistics public use data tapes; Shubha Fanse for computer assistance; Kristin Jacobson and Norton Twite for word processing. Special recognition is given to the outstanding contribution of Scott Hood in development and layout of the tables and figures and for statistical assistance. We are especially grateful to Ida VSW Red for her special expertise and superior editing of the entire manuscript and for assuming full responsibility for overall design and production of the final report.

At The Johns Hopkins University, Gordon Smith was instrumental in developing the incidence categories and rates. David Salkever, Gregory deLissovoy, and Alison Jones were responsible for estimating

the sources of payment. The authors would like especially to acknowledge the contributions of Maureen Fahey, Sharon Edelstein, and Susan Feely. Their expertise in working with large databases and their careful attention to detail was essential in developing the incidence figures and estimates of hospital costs. We are also grateful to Jewel Crum for her assistance in word processing, to Arlene Greenspan for conducting the survey of rehabilitation services administered through state governments, and to Byron Hamilton for providing information from the Uniform Data System for Medical Rehabilitation on source of payment for inpatient rehabilitation.

Two consultants made special contributions to the report. Ted Miller, economist at The Urban Institute, wrote the chapter on willingness to pay and Leon Robertson, Injury Epidemiologist at Nanlee Research and Yale University, wrote the chapter on potential savings from injury prevention.

The authors are indebted to the generosity of the ten participating survivors and their families whose tragedies and triumphs embody the essential subject matter of this report. We thank them for their willingness to share their personal stories. We also thank Joan Leon, Hale Zukos, and Byrd Dunaway from the World Institute on Disability for their assistance in providing background information about government regulations and legal issues in relation to injury and disability, and for preparing a useful annotated bibliography of publications in this area. We appreciate the time spent by health and social service professionals in locating study participants.

We are indebted to several experts in the area of injury prevention and control who carefully reviewed the final manuscript and made important suggestions and comments incorporated in the final report.

Special recognition is given to Professor Susan Baker of the Injury Prevention Research Center, The Johns Hopkins University, and Andrew McGuire of the Trauma Foundation, San Francisco General Hospital. Their leadership in injury epidemiology, prevention, and advocacy, established nationally through decades of work in the field, has guided the development of this report and its recommendations.

We are privileged to have had the opportunity to conduct this important study and to have worked together to produce this report.

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Foreword

Since the end of World War II, more than 6 million U. S. citizens have died from injuries. Such statements remain only numbers unless one can envision over 400 families grieving at a graveside every day of every year. If these injuries could have been prevented, persons who died prematurely would still be alive today. In addition to those who have died from injuries, millions more have been left with severe impairments that will endure for the rest of their lives. Yet this nation has failed to face the extraordinary losses sustained from the problem of injury.

Injury is often viewed as the inevitable price of living in a modern society. This volume provides an estimate of that price as it examines the economic impact resulting from the failure to deal with injury as a major threat to public health. It is only through the systematic examination of the effect of injury on our society that we can fully understand how critical it is to develop a cure for this pervasive killer and crippler.

The researchers reporting in this volume identify, for the first time, the magnitude of the economic effect of injury on the United States. The $158 billion economic cost of injury is compelling, but not nearly as compelling as the case studies. These personal narratives illustrate in human terms the impact of injury on our fellow citizens -- impacts that afflict hundreds of thousands of people each year.

This groundbreaking study makes a number of vital contributions to our appreciation of the scope of the injury problem in this country. For the first time, reliable estimates are presented on the number of fatalities and injuries by cause, an essential step in developing intervention strategies. The information on who pays for injury costs reveals that all sectors of our society are bearing the enormous burden imposed by injury.

The authors also identify strategies that have succeeded in reducing the impact of injury. These strategies have more than paid for themselves and can serve as meaningful examples of how, as a society, we can develop cures for this major public health problem. Failure to fully implement activities with a proven positive savings is a waste of human and financial resources. The savings will accrue to individuals, families, and friends, to all levels of government and the private sector, and to society at large.

The science of injury control requires that competent researchers objectively assemble and analyze data in order to make progress in the prevention of injury and the treatment and rehabilitation of the injured. This major effort to describe the impact of injury in the United States

helps to chart a path for a new and rapidly growing field. It is a contribution of major importance. The study provides the tools needed to better understand the impact of injury on our society and to take actions that will reduce the tremendous toll of death and disability in our nation. We need no longer accept injury as an inevitable risk of 20th century life.

William H. Foege, M.D.
Executive Director

The Carter Center
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Summary

In 1987, Congress directed that research be conducted by the joint National Highway Traffic Safety Administration (NHTSA) and the Centers for Disease Control (CDC) trauma research program to evaluate the impact of injury and associated disability on the United States. The Institute for Health & Aging of the University of California and The Injury Prevention Center of the Johns Hopkins University conducted the research and prepared this report to Congress.

This study evaluates the magnitude of the impact of injury on individuals, government programs, and society at large in terms of economic cost and of the effects of injury on people's lives. Comprehensive data on incidence, cause, severity, lifetime cost, life year and productivity losses, and source of funds disaggregated by age and sex are presented. The following topics are addressed:

- Number of people in the United States who are injured and number who die due to injury annually;
- Aggregate lifetime and per person cost to society of injury;
- Long-term cost of treatment and rehabilitation of injuries;
- Years of life lost due to the disabling effects of injury and premature death;
- Age groups most affected by injury;
- Number of persons injured from the major causes of injury and associated cost;
- Number of persons fatally injured, hospitalized, and nonhospitalized and associated cost;
- Burden of injury cost by source of payment;
- Valuing pain and suffering;
- Potential savings from preventive intervention strategies;
- Federal government investment in research on prevention and control of injury relative to research dollars spent for the other leading causes of death;
- Life-long consequences of injury to injured persons and their families; and
- Recommendations emerging from the study for the prevention, control, and further research on the incidence and cost of injury.

Recommendations

Injury Prevention and Control

Recommendation: Direct greater resources to the prevention of injuries and the mitigation of their results through the application of existing knowledge and the development and evaluation of new strategies. Establish and fund a Center for Injury Control within CDC to provide a focal point for national injury prevention activities. Provide additional resources to existing agencies that currently pursue the prevention and control of injury resulting from motor vehicles, fires, consumer products, and occupational hazards.

Recommendation: Conduct research and controlled experiments to evaluate the effectiveness and savings of a wide range of injury control interventions and implement programs shown to be cost effective.

Recommendation: Conduct research to evaluate the societal barriers to the application of injury prevention strategies that have been proven to be effective.

Coding and Measurement Issues

Recommendation: Require the use of both cause and nature or type of injury codes for all hospital discharge data systems and for all data bases having the potential of providing national injury estimates. Require a separate field for the cause of injury code.

Recommendation: Standardize coding of injuries by multiple coding of nature and cause of injury for all data bases intended to provide national estimates of injury. Agency needs for specific information can be met by the addition of customized codes.

Recommendation: Ensure compatibility of International Classification of Diseases (ICD) and Abbreviated Injury Scale (AIS) for classifying anatomic description of injury to permit computerized conversion from ICD to AIS for assigning severity scores on national data bases.

Recommendation: Conduct research on the development and evaluation of a valid and useful classification system for impairments that will meet the needs of researchers, program administrators, and rehabilitation specialists.

Data Needs

Recommendation: Develop a national coordinated program of injury surveillance for the quick identification and control of outbreaks of specific injuries and for epidemiologic research on injuries. For this effort, rely on the integration of uniformly collected data derived from multiple sources at both the national and local levels. To compensate for

the time lag inherent in national data bases, states in which the medical examiner and/or hospital discharge data have the necessary quality and currency could monitor their data as an early warning system. Provide resources to achieve these objectives.

Recommendation: Expand core National Health Interview Survey (NHIS) questions relevant to injury to describe the circumstances of injury. In addition, conduct a comprehensive supplement to the NHIS on incidence, medical care, rehabilitation, and disability related to injury. Provide adequate funds for the expansion of the core NHIS questions and for the conduct of a comprehensive injury supplement.

Recommendation: Conduct, with adequate funding, a follow-up survey of respondents to the proposed NHIS Injury Supplement to determine the long-term physical and economic consequences of injury in the general population. Oversample respondents with severe injury resulting in long-term disability.

Recommendation: Develop a series of well-designed, closely coordinated studies of the long-term physical, psychological, and economic consequences of patients treated in several trauma centers throughout the nation.

Recommendation: Conduct, with adequate funding, a national medical expenditure survey periodically, preferably every five years, to provide current expenditure data for the nation.

Recommendation: Implement the recommendations of the National Academy of Sciences Panel on Occupational Safety and Health Statistics of the Committee on National Statistics as soon as possible to provide improved and accurate data on occupational injuries and fatalities.

Recommendation: Require that firearm injuries, in addition to being reportable to the police, be reportable to health departments. Place greater emphasis on coding the type of firearm on the death certificate. Develop a national fatal firearm injury reporting system, comparable to the Fatal Accident Reporting System (FARS), with sufficient data for documenting the firearm problem and designing prevention strategies.

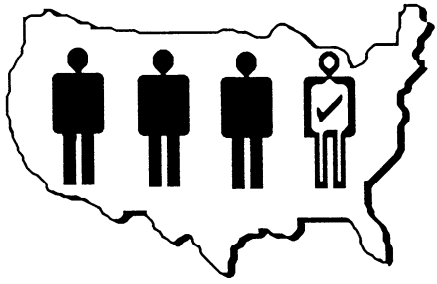
Treatment and Rehabilitation

Recommendation: Conduct collaborative interdisciplinary research to identify and evaluate factors in trauma care that produce optimal results.

Recommendation: Greatly expand research for the development and evaluation of cost-effective model systems of rehabilitation and for the design and production of affordabl.e and reliable assistive devices to serve the needs of people with disabilities. Involve people with disabilities in the decision-making process.

Highlights

*How **many Americans are injured each year?*** About 57 million persons were injured in 1985 -- one in four U.S. residents. Injuries occur to persons of all ages and to both genders, but younger persons and males are most affected.

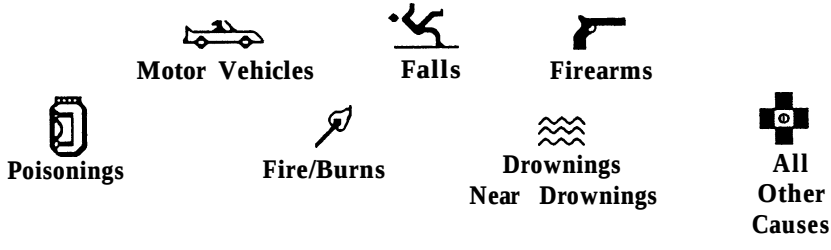


57 Million Persons,
One of Every Four
U.S. Residents,
Injured in 1985

How severe are the injuries? The injury death toll is very high -- 143,000 persons died from injuries in 1985, making injury the fourth leading cause of death in the United States. Hospitalized injuries numbered 2.3 million, and 54 million persons were less severely injured, not requiring hospitalization.

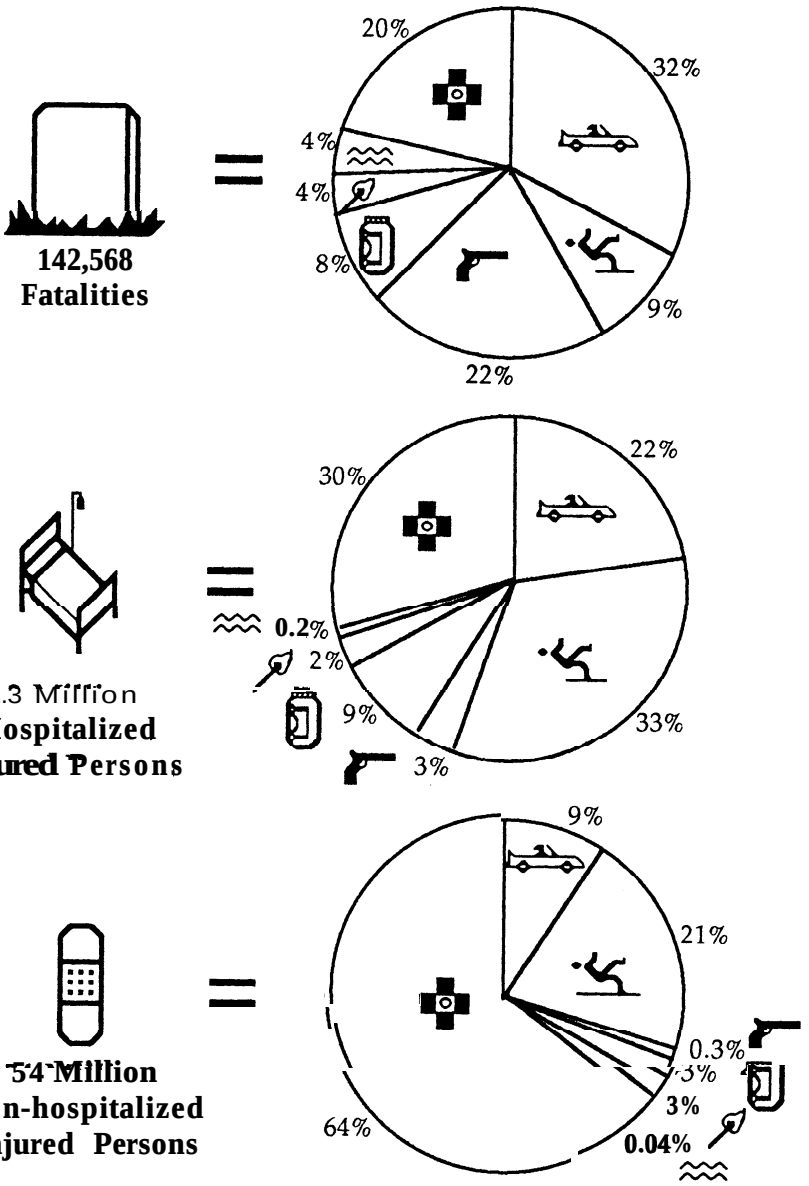
What are the leading injury causes? Falls are the leading cause of injury, accounting for one out of five injuries. Motor vehicle injury, however, is the leading cause of injury death, accounting for one-third of fatal injuries. Falls are the leading cause of nonfatal injury, representing one-third of hospitalized injured persons and one-fifth of nonhospitalized injured persons. All other causes -- injuries due to cutting and piercing instruments or being struck by blunt objects, suffocation, railway and air transportation, etc. -- account for 20 percent of the deaths, 30 percent of hospitalizations, and 64 percent of nonhospitalized injuries.

Leading Causes of Injury



Motor Vehicles the Leading Cause of Injury Death

Falls the Leading Cause of Nonfatal Injury

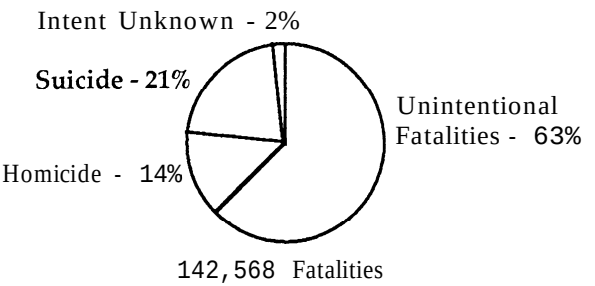


What are the leading causes of hospitalization? Heart disease and injury are the two leading causes of hospitalization (excluding deliveries). During 1987, one of ten discharges and one of six days of care were injury-related.

Who is injured? The young and males are at greatest risk. Four of five injuries are sustained by persons under 45 years of age and the largest number of injuries occurs among those aged 25-44. Three in ten males and one in five females sustain injuries in a year. Males account for 72 percent of injury fatalities, and 56 percent of nonfatal injuries.

How many injury deaths are intentional? More than one-third of all injury deaths result from intentional injuries and, of these, three of five are suicides and two of five, homicides. The remaining two-thirds are due to unintentional causes.

Over One-Third of Injury Deaths Intentional



What is the total lifetime cost of injury? Injury imposes a $158 billion burden on the U.S. economy. This estimate represents the aggregate lifetime cost for the 57 million persons injured in 1985. The human capital approach is used to estimate the lifetime cost of injury. This method values productivity lost or reduced due to injury. By 1988, the total economic cost of injury sustained in 1985 is estimated at $180 billion.

Total Lifetime Cost of Injury

1985 · $158 billion

1988 · $180 billion

What are the first and later year costs of injury? The lifetime cost of injury in the United States takes into account the cost incurred in the first year in which the injury occurs as well as the cost incurred in later years. Of the total lifetime cost of $158 billion, almost three-fourths, $116

billion, is for the first year cost and the remaining $41 billion is estimated to be incurred in later years.

Is the economic toll greater for men or women? The risk of injury is highest among males; they sustain 57 percent of the injuries but account for 68 percent of the cost. Almost three in ten males (28%) living in the United States incur injuries in a year. The total lifetime cost of injury for males is more than double that for females -- $108 billion compared with $50 billion. The relatively higher cost for males reflects their higher labor force participation rate, earnings, and fatality rates.

At what age is the economic toll largest? More injuries occur among adults aged 25-44 than in any other age group, and their lifetime cost is highest at $66 billion, 42 percent of the total cost. Injury to persons aged 15-24 ranks second, accounting for 25 percent of total cost.

How much is spent for medical and nonmedical care of injured persons? Expenditures for medical care amount to $45 billion, 29 percent of the total lifetime cost. Included are amounts spent for hospital and nursing home care, physician services, drugs, appliances, and rehabilitation as well as for nonmedical care directly related to the injury.

What is the value of losses in productivity for injured persons? The morbidity loss for persons disabled as a result of injury amount to 5.1 million years of productive output lost, valued at $65 billion, two-fifths of the total economic cost.

What is the death toll? Injury is the leading cause of death for Americans under 45 years of age. About 143,000 premature deaths from injury occurred in 1985 and an additional 13,000 deaths occurred in later years due to injury sustained in 1985. These premature injury deaths amount to a loss of 5.3 million life years lost, or 34 years per death. These losses to the economy amount to $47.9 billion at a 6 percent discount rate.

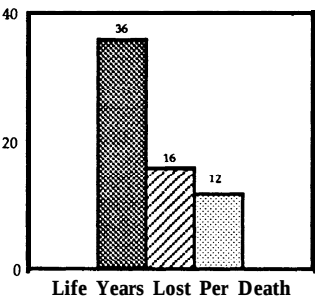
Who pays? Public (federal, state, and local government) funds expended in 1985 amount to $11.6 billion covering 28 percent of the medical expenditure for injury; 72 percent is borne by private sources.

Who bears the burden of disability and survivor benefit payments? These payments, some of which are used for medical care, amount to $53 billion. Of this total, more than one-fourth comes from public programs (Social Security Disability Insurance, Supplemental Security Income, and Veterans Administration).

How much does injury cost the federal government? The federal government pays $8.9 billion for the medical care cost of injured persons, mainly through Medicare and Medicaid. The federal government also pays $13 billion in disability and death benefits under Social Security Disability Insurance, Supplemental Security Income, and the Veterans Administration. Lost tax revenues are excluded.

How does the economic toll of injury compare with that of other leading causes of death? Injury is the fourth leading cause of death, but productivity losses from this cause are far greater than from the three other leading causes of death. Injury deaths represent 36 life years lost per death* and a productivity loss of $334,851 per death. Life years lost per death for the three other leading causes are 12 years for cardiovascular diseases (heart disease and stroke combined) and 16 years for cancer. Cost per death is $51,000 for cardiovascular diseases and $88,000 for cancer.

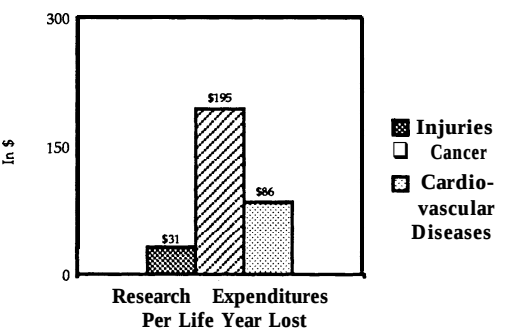
36 Life Years Lost per Injury Death*



"Excludes deaths in later years

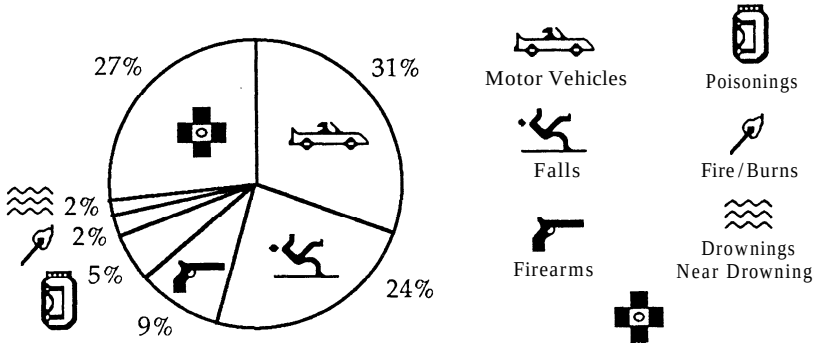
How do injury research expenditures compare with research spending on the other leading causes of death? Comparing federal research expenditures, injury research spending ($160 million) amounts to 11 percent of National Cancer Institute obligations ($1.4 billion) and 17 percent of National Heart, Lung, and Blood Institute obligations ($930 million). A very small amount of research funding is being allocated to injury, a most costly public health problem.

Injury Research Underfunded



Which causes of injury are the most costly ? The greatest economic losses are caused by motor vehicles, accounting for $49 billion, followed by falls ($37 billion), firearms ($14 billion), poisonings ($9 billion), fires and burns ($4 billion), and drownings and near drownings ($2 billion). All other causes of injury total $42 billion altogether.

Motor Vehicle Injuries Most Costly



$158 Billion Lifetime Cost

Can pain and suffering be quantified? The above economic cost, based on the human capital method, does not take into account the cost associated with pain, suffering, and reduced quality of life. An alternative method that incorporates the individual perspective on the value of these aspects of well-being is the willingness-to-pay approach. This method values human life according to the amount individuals spend on injury reduction with potential savings to society. This assessment yields values of $2 million to avoid death. The American public would be willing to pay an estimated $1.1 trillion per year to eliminate all fatal and nonfatal injuries.

Can the economic losses due to injury be reduced? The number of severe injuries could be substantially reduced by greater application of current knowledge. The potential savings, net of the cost of injury control programs, are in the billions of dollars for interventions for which data are available.

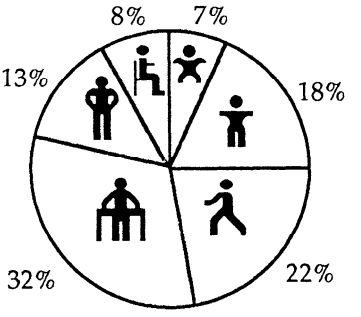
How can the impact of injury on individuals and their families be assessed? An anthropologist interviewed ten people or members of their families about how their lives were changed over a period of **2** to 18 years following severe injury. These case studies describe the struggle to acquire the personal, therapeutic, legal, and financial aid that enables injured people to survive and create lives that are meaningful in terms of work, love, mutual support, recreation, and personal growth.

Findings

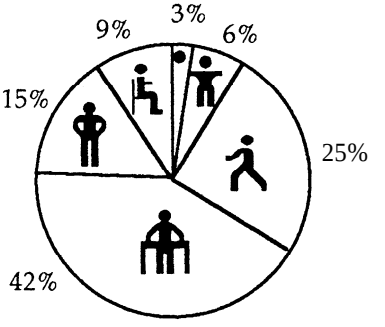
Incidence and Cost

Of the total 56.9 million persons injured in the United States in 1985, almost one-third (18.1 million) are in the 25-44 age group and account for more than two-fifths of the total lifetime cost ($65.8 billion). The second highest number of injuries, more than one-fifth (12.8 million), occurs among persons aged 15-24 and accounts for one-quarter of the total cost ($39.1 billion). About 14 million children under age 15 also suffer from injuries and comprise one-quarter of total injuries and one-tenth of the cost ($13.8 billion). Persons under age 45 sustain almost four-fifths of all injuries and account for three-quarters of the total lifetime cost.

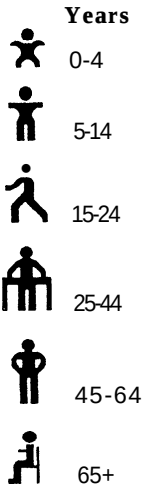
Persons **Aged 25-44 at Highest Risk and Most Costly**



57 Million Injured Persons



$158 Billion Lifetime Cost



Cause of Injury

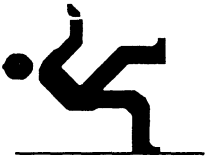
Motor Vehicles

Incidence: Nearly 5.4 million injuries were caused by motor vehicles in 1985. Motor vehicles are the leading cause of injury death (45,923 fatalities) and the second leading cause for hospitalized (523,028) and nonhospitalized (4.8 million) injured persons. The 15-24 age group is at highest risk, and males in this age group are three times more likely to be injured or killed than are females. The elderly rank second in risk of dying of motor vehicle injuries.

Lifetime Cost: Motor vehicle injuries account for 9 percent of total injuries and 31 percent or $48.7 billion in lifetime cost, ranking as the most costly of injury causes. Because of the high number of deaths among young adults, motor vehicle injuries account for over one-third of the mortality cost. Motor vehicle injuries rank second to falls in direct and morbidity costs. About 72 percent of the lifetime cost due to motor vehicles is incurred in the first year after injury.

Per Person Cost: The average lifetime cost per person injured by a motor vehicle is $9,062. The average cost per fatal motor vehicle injury is $352,042, for a hospitalized person, $43,409, and for a person injured but not hospitalized, $1,570.

Falls



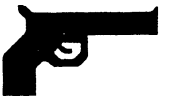
Incidence: Falls are the leading cause of nonfatal injury in the United States, accounting for an estimated 783,000 hospitalizations and **11.5** million persons injured who did not require hospitalization. Falls account for 12,866 deaths. The death rate due to falls among the elderly aged 75 and older is nearly 12 times greater than the rate for all other ages combined, and the risk of hospitalization is nearly seven times as great.

Lifetime Cost: Falls account for $37.3 billion in societal losses due to injury, second to motor vehicle injury. Because of the lengthy hospitalization of elders who fall, direct costs, $14.7 billion, account for 39 percent of the total cost. The mortality cost is relatively low, $1.5

billion, because of the short life expectancy and low earnings of the population at greatest risk. The morbidity cost, $21 billion, is high because falls result in long-term disability, accounting for 57 percent of the total cost.

Per Person Cost: The average lifetime cost per person for a fall injury is $3,033. The average cost per fatal fall is $99,669, the lowest of all causes of injury, reflecting the short life expectancy and low earning power of the elderly population at greatest risk. The average per person cost for hospitalization for a fall injury is $38,174 and for a person injured but not hospitalized, $499.

Firearms



Incidence: Injuries resulting from the use of firearms are the second leading cause of injury death in the United States. In 1985, 31,556 people were shot to death; 39 percent of the deaths were homicide, 56 percent were suicide, and 5 percent were unintentional. The risk of firearm death is highest for the 15-44 age group. Males over age 75, however, have the highest rate of any other age group, due primarily to suicide by firearm. There are an estimated 65,000 hospitalizations for treatment of firearm injuries, and 171,000 persons injured by firearm who did not require hospitalization.

Lifetime Cost: Firearms rank third in the economic toll on society, amounting to $14.4 billion, or 9 percent of the total cost. Firearm injuries account for 5 percent of total injuries, but fatalities at young ages result in a high mortality cost and males are responsible for 86 percent of the cost. Firearm injuries account for $1.4 billion in morbidity cost and 12 billion in mortality cost.

Per Person Cost: The average per person cost of a firearm injury is very high, $53,831, because of the large number of fatal firearm injuries. The average per person cost for a fatality, $373,520, is the highest of any cause of injury. The average cost for hospitalization due to firearm injury is $33,159 and for a person injured but not hospitalized, $458.

Poisonings

Incidence: Poisonings account for 11,894 deaths, 218,500 injured persons hospitalized, and 1.5 million injured persons not requiring

hospitalization. Almost all people who die of poisoning are over age 15, and nearly half of all poisoning deaths are ruled as suicide. Males are 1.9 times as likely to die of poisoning as females. For nonfatal poisoning, the elderly, the very young, a.nd adolescents are at greatest risk. Very young children, aged 0-4 years, account for 21 . percent of all nonhospitalized poisonings.

Lifetime Cost: Poisoning accounts for 3 percent of total injuries and 5 percent, or $8.5 billion, of the total lifetime cost of injury, ranking fourth in cost of injury.

Per Person Cost: The average per person cost of fatal poisoning is $372,691, ranking second to the cost of firearm fatality per person because of the large number of poisoning deaths among adolescents and young adults. The average cost per person hospitalized for poisoning is $17,631 and $171 for those not hospitalized.

Fires and Burns

Incidence: Fire and bum injuries result in 5,671 deaths, 54,400 hospitalizations, and 1.4 million burns not requiring hospitalization. The very young and the elderly are at highest risk for hospitalization due to burns. Males are slightly more at risk for fire and burn injuries than are females, but the gender differential is not as great as for other injuries.

Lifetime Cost: Fire and burn injuries cost $3.8 billion, accounting for 3 percent of total injuries and 2 percent of the total lifetime cost of injury.

Per Person Cost: The average lifetime per person cost for a fire or burn injury is $2,619. The average cost for a hospitalized bum patient is $35,303, twice that for poisonings. The average fire or burn fatality cost is $249,367 and $347 for a nonhospitalized injured person.

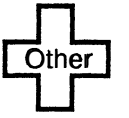
Drownings and Near Drownings

Incidence: In 1985, 6,171 people in the United States drowned. Males are four times as likely to drown as females. Very young children, aged 0-4, are at greatest risk for drownings and hospitalization for near drownings. Young people, aged 15-24, are also at high risk for drownings.

Lifetime Cost: Drownings and near drownings account for $2.5 billion in lifetime cost of injury, less than two percent of the total lifetime cost of injury.

Per Person Cost: Because of the small sample of nonhospitalized injuries due to near drowning and the relatively high proportion of all injuries being fatalities, the average per person cost of near drowning is $64,993. The average fatality cost is $362,292 and for a hospitalized person, $31,408.

Injuries from All Other Causes



Incidence: Injuries from all other causes account for 63 percent of the total number of injuries in the United States in 1985 -- 20 percent of deaths, 30 percent of hospitalizations, and 64 percent of nonhospitalized injuries. Included are injuries due to cutting and piercing instruments or being struck by blunt objects, suffocation, and railway and air transportation (see Appendix A for complete list).

Lifetime Cost: Other injuries account for 27 percent, or $42.4 billion, of the total lifetime cost of injury.

Per ***Person Cost:*** The low average per person cost ($1,187) reflects the large number of persons whose injuries do not require hospitalization, resulting in low medical treatment cost.

Falls, Highest Incidence - Motor Vehicles, Highest Cost

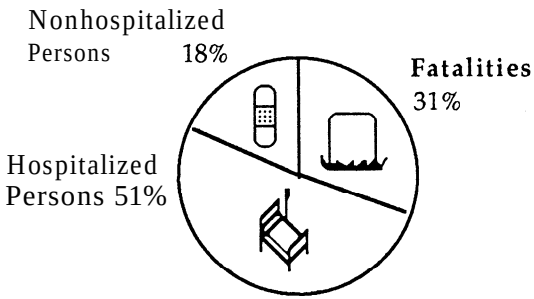
	Injured Persons		cost	
Cause of Injury	Number (000's)	Rate per 100,000	Total (millions)	Per Injured Person
Total	56,859	23,985	$157,615	$2,772
Motor Vehicles	5,372	2,266	48,683	9,062
Falls	12,289	5,184	37,279	3,033
Firearms	268	113	14,410	53,831
Poisonings	1,702	718	8,537	5,015
Fires/ Bums	1,463	617	3,832	2,619
Drownings*	38	16	2,453	64,993
Other	35,726	15,071	42,421	1,187

* Includes Near Drownings

Class **of Injury**

There are three classes of injury reflecting severity: 155,665 deaths (142,568 deaths occurring in 1985 plus 13,097 deaths occurring in later years due to injuries sustained in 1985), 2.3 million hospitalized injuries, and 54.4 million nonhospitalized injuries. The distribution of costs by class of injury reflects the severity of the injuries. Of the $158 billion lifetime cost, 31 percent is the cost of fatalities. More than half the cost (51%) is for injuries involving hospitalization and less than one-fifth (18%) for nonhospitalized injured persons.

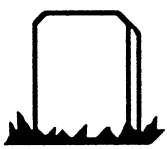
Fatalities Under 1% of All Injuries and 31% of Total Injury Cost



$158 Billion Lifetime Cost

Cost per injured person by class of injury also reflects injury severity. Cost per person fatally injured amounts to $317,189. The cost per injured person hospitalized is $34,116, and per nonhospitalized injured person, the cost is $518.

Fatalities



The risk of death from injury is highest among males. Of the total 155,665 injury fatalities occurring in 1985 and in later years, 72 percent are males and 28 percent are females. The lifetime cost for males,

however, is significantly higher, 81 percent of the total, reflecting higher labor force participation and higher earnings.

Adults in the 25-44 age group account for 34 percent of the deaths due to injury. Since people who die prematurely in this age group are at the height of their productivity, the present value of future earnings lost is high. Productivity losses for this age group comprise half the total cost of fatalities. The cost per fatality for this age group amounts to $482,583.

By contrast, 21 percent of fatalities are persons aged 65 and over, but less than 2 percent of the lifetime cost of fatality is in this age group. The cost per fatality aged 65 and over amounts to only $25,771 because of short life expectancy and low earnings.

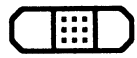
As might be expected, the elderly are at high risk of dying from all diseases, including injury. Thus, the risk of death as a result of injury is highest for adults aged 75 and over. Only 5 percent of the U.S. population is aged 75 and over, but this group accounts for 13 percent of all injuries resulting in death. Adolescents and young adults aged 15-24 rank second in risk of injury severe enough to result in death. Rates are lowest for children aged 5-14.

Hospitalized Injured Persons

About 2.3 million persons sustained injuries severe enough to be hospitalized in 1985 at a total lifetime cost of $80 billion, $34,116 per hospitalized person. Of the 2.3 million hospitalized injured persons, 1.3 million, or 56 percent, are males. The proportion of the total cost for hospitalized injury is higher for males -- 65 percent. Males are apparently involved in more serious injuries that incur higher costs.

Injured persons aged 25-44 are the most costly for hospitalized injuries, comprising 37 percent of the total cost. The 15-24 age group is second costliest for hospitalized injuries. The cost per hospitalized person ranges from $20,661 for the elderly aged 65 and over to $43,169 for adults aged 25-44.

Nonhospitalized Injured Persons



About 54.4 million injured persons, 96 percent of all persons injured in 1985, are not hospitalized. This injury class, although large, involves the least severe injuries. Costs amount to $28.2 billion, 18 percent of the total cost, and $518 per nonhospitalized injured person. Fifty-six percent of the 54.4 million nonhospitalized injured persons are males, and they incur about the same proportion (57%) of the $28.2 billion of nonhospitalized injury.

Nonhospitalized injured adults aged 25-44 are the most costly, comprising 41 percent of the total cost. The 45-64 age group ranks second in cost, accounting for 20 percent of the total. The cost per nonhospitalized injured person, however, is highest for the elderly, amounting to $901 compared to $672 and $791 for those aged 25-44 and 45-64, respectively.

Per Injury Fatality Cost Highest

Class of Injury	Injured Persons (000's)	cost	
		Total (millions)	Per injured Person
Total	56,859	$157,615	$2,772
Fatalities	143	49,374	317,189 *
Hospitalized	2,347	80,063	34,116
Nonhospitalized	54,369	28,178	518

* Based on 155,665 deaths, including 13,097 deaths in later years due to injuries sustained in 1985

Type of Cost Defined

The lifetime cost of injury includes the amounts spent for medical care and nonmedical services for persons injured in 1985, and the value of losses to society due to premature death or inability to work or to keep house. The lifetime cost takes into account the cost incurred the year in which the injury occurred and the cost incurred in each successive year.

Direct cost includes the amount spent for personal health care for persons injured in 1985, including hospital and nursing home care, physician visits, prescription drugs, physical therapy, ambulance and helicopter services, attendant care, and other expenses such as wheel chairs and appliances for injured people. Nonmedical direct costs include expenditures for home modifications, vocational rehabilitation, and overhead and administrative costs for automobile and health insurance. Direct expenditures for medical and nor-medical care amount to $44.8 billion, or 29 percent of the total lifetime cost of injury.

Morbidity cost is the value of goods and services not produced because of injury-related illness and disability. To the degree that injury prevents or deters people from producing goods and services in the marketplace, in the public sector, or in their homes, the value of morbidity losses is a cost borne by the society. Estimates of morbidity cost involve applying average earnings to work years lost and imputing a dollar value to housekeeping services for those unable to perform them. Morbidity cost is valued at $64.9 billion, or 41 percent of the total.

Mortality cost is the value of the lifetime earnings lost by all who are fatally injured and die prematurely. This cost is the product of the number of injury deaths and the expected value of future earnings with gender and age taken into account. This method takes into consideration life expectancy at the age of death, changing patterns of earnings at successive ages, varying labor force participation rates, imputed value for housekeeping services, and a six percent discount rate to convert aggregate earnings over a lifetime to present worth. This is the human capital method. Mortality cost amounts to $47.9 billion, or 30 percent of the total.

Type of Cost Distributed

Direct Cost

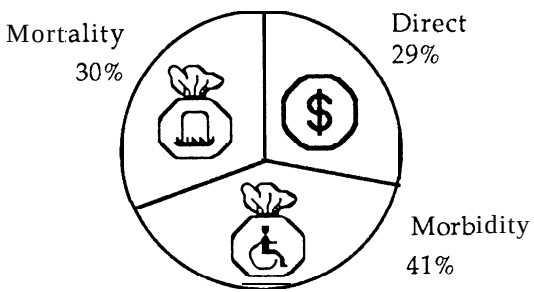
Direct personal medical and nonmedical costs of care for injured persons amount to $44.8 billion. Of this total, $24.5 billion, or 55 percent, is spent for hospital care, including rehabilitation and the cost of professional services provided to hospitalized patients. Physician visits outside of hospitals rank second, estimated at $6.5 billion, or 15 percent of the direct cost. The third highest type of expenditure, $2.5 billion, or 5 percent of the direct cost, is for nursing home care.

Morbidity Cost

Morbidity cost is the value of goods and services not produced because of injury-related illness and disability. Lifetime morbidity cost includes the value of output lost for injured persons who are disabled in later years as a result of injury sustained in 1985. Losses for persons injured and disabled in 1985 amount to 5.1 million life years or 9 life years lost per 100 injured persons. These losses translate to a total morbidity cost of $64.9 billion, or $1,145 per injured person. The greatest losses are for injured persons aged 25-44, followed by those aged 15-24.

The morbidity cost for males is significantly higher than for females, $45 billion compared with $20 billion, respectively. On a per injured person basis, the morbidity cost amounts to $1,407 for males compared with $805 for females, reflecting the higher earnings and higher labor force participation of men.

Disability (Morbidity) Accounts for Two-Fifths of Cost



$158 Billion Lifetime Cost

Mortality Cost

Applying expected lifetime earnings by age and sex to the 155,665 deaths from injury sustained in 1985, including deaths in one or more years after the initial injury, results in a loss of 5.3 million life years, or 34 years per death. These deaths represent a loss of $47.9 billion to the economy at a 6 percent discount rate, or $307,636 per death. For the 111,867 males who died from injuries, an estimated 3.8 million life years are lost, 34 years per death, valued at $39.0 billion, or $349,030 per death. The 43,798 females who died from injuries represent a loss of 1.5 million life years, or 33 years per death. Because of the fewer deaths and lower earnings of females, losses for females are significantly lower than for males, amounting to a total of $8.8 billion, or $201,910 per death. Thus, males account for 72 percent of the injury deaths, 72 percent of the life years lost, and 82 percent of the productivity losses for 1985.

Most people who die of injuries are relatively young -- one-third of the victims are aged 25-44. The total of life years lost for this age group, a function of both age and number of deaths, represents 39 percent of all life years lost to injury. In terms of lost earnings, this age group accounts for 51 percent of the total. By contrast, 38 percent of injury deaths are persons over age 45, accounting for 18 percent of life years lost and 13 percent of productivity lost.

Mortality Cost per Injured Person Highest for 25-44 Age Group

Age and Sex	Cost" (millions)			Cost* per Injured Person		
		Indirect			Indirect	
	Direct	Morbidity	Mortality	Direct	Morbidity	Mortality**
Total	$44,807	$64,920	$47,888	$790	$1,145	$307,636
0 4	1,810	1,384	933	445	340	210,403
5-14	4,026	4,067	1,605	395	399	267,864
15-24	8,934	15,725	14,483	702	1,236	427,278
25-44	12,724	28,680	24,418	706	1,592	473,418
45-64	6,757	11,311	5,903	920	1,540	211,936
65+	10,555	3,752	546	2,407	856	17,095

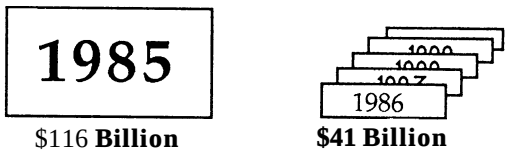
* Discounted at 6 percent

** Based on 155,665 deaths, including 13,097 deaths in later years due to injuries sustained in 1985

First and Later Year Costs

Because many severe injuries result in long-term disability, the lifetime cost of injury takes into account the cost in the first year in which injury occurs as well as the cost incurred in later years. Productivity losses due to premature death are counted as first year costs. Of the total lifetime cost of $158 billion, three-fourths is the first year cost and the remainder is incurred in later years.

Three-Fourths of Lifetime Cost Incurred in First Year



$116 **Billion** **$41 Billion**

Research Investment and Productivity Losses

Injury research expenditures are estimated at $160 million for fiscal year 1987 compared with expenditures for cancer research by the National Cancer Institute of $1.4 billion. The National Heart, Lung and Blood Institute spent $930 million for cardiovascular research in FY 1987. Comparing research investment per life year lost due to these three major causes of death shows that although injury is a large public health problem, it receives a disproportionately small share of research funding. Injury research spending per life year lost is 11 percent of that for cancer and 17 percent of the amount spent for cardiovascular research. Life years lost per injury death (36 years), however, are more than twice the number lost to cancer (16 years) and three times the number lost to cardiovascular diseases (12 years). Mortality cost per injury death ($335,000) is almost four times the cost for cancer ($88,000) and more than six times the cardiovascular disease cost ($51,000).

Source of Payment

Of the total $44.8 billion direct cost, $41.7 billion is distributed by source of payment. The remainder, $3.1 billion, includes amounts spent for ambulance, helicopter, attendant care, and other expenses for which source of payment data are not available.

About 72 percent of the direct cost is borne by private sources (private health insurance, workers' compensation, uninsured care, and other private sources); public sources (federal, state, and local governments) account for 28 percent. Public sources, mainly Medicare,

pay 72 percent of the direct cost for injured persons aged 65 and over. For injured persons under age 65, however, 85 percent of the direct cost comes from private funds, mainly private health insurance.

Of the hospital cost for injured persons, 32 percent comes from public sources, and the remaining 68 percent from private sources, mainly private health insurance. Private sources cover the bulk of expenditures for physician visits, prescription drugs, and physical therapy. For nursing home care, almost one-half of the expenditure comes from public sources, of which 57 percent are federal funds and 43 percent, state and local government funds.

Private Sources Bear the Greatest Injury Burden

	Amount (millions)	Distribution
Total	$41,742	100.0 %
Public	11,598	27.8
Federal	8,860	21.2
State and Local	2,738	6.6
Private	30,144	72.2
Workers' Compensation	6,997	16.8
Private Insurance	14,162	33.9
Uninsured Care	6,932	16.6
Private	2,053	4.9

Transfer Payments

Transfer payments represent a transfer of funds from one payer to another and do not represent new goods or services produced. Insurance settlements, for example, are funds transferred from the insurance company to the injured individual to pay for medical services that are counted in the direct medical cost. The magnitude of transfer payments due to injury is large, amounting to $52.6 billion for 1985 (lost taxes are excluded). Of this total, $23.3 billion (44 percent) consists of disability payments. Auto insurance pays $22.9 billion, or 44 percent, of all transfer payments. Workers' Compensation programs pay $13.1 billion in disability payments and an additional $1.7 billion in survivor benefits. Social Security pays $4.4 billion in disability payments and $2.9 billion in survivor benefits.

Injury Transfer Payments - $52.6 Billion

Program	Total	Public	Private
Total	$52,578	$13,972	$38,606
Veterans Administration	2,560	2,560	
Social Security Disability Insurance	7,340	7,340	
Supplemental Security Income	1,033	1,033	
Workers' Compensation	14,822	3,039	11,783
Private Insurance	3,898		3,898
Automobile Insurance	22,925		22,925

Of the total $52.6 billion, 27 percent is paid from public funds, including Social Security Disability Insurance, Veterans Administration, and Supplemental Security Income. Private funds, 73 percent of total transfer payments, include private disability and life insurance and Workers' Compensation, a federally administered program primarily financed by employers.

Willingness to Pay

The total cost of injury in 1985 amounts to $158 billion, employing the human capital approach that measures the value of lost output due to reduced productivity of individuals killed, injured, or disabled. Willingness to pay, on the other hand, reflects the value placed on health and life by individuals and measures how much people are willing to pay for safer and healthier lives. It incorporates the value of pain, suffering, and loss in quality of life associated with injury.

Based on a review of 29 studies, willingness to pay to save one life ranges from $1.0 million to $3.1 million, with a mean of $1.95 million. To avoid moderate to critical injuries, willingness-to-pay estimates range from $31,000 to $1.5 million. To avoid severe head injuries involving total impairment, quadriplegia, or very severe burns, willingness-to-pay estimates range from $2.6 million to $3.2 million.

Potential Savings from Injury Prevention

The large number of premature deaths and disabilities due to injury and the high economic cost, including large public sector expenditures, highlight the need to reduce the burden of injury in the United States. The application of current knowledge to implement a variety of injury control interventions can substantially reduce the incidence, severity, and accompanying cost of injury. Examples of successful interventions

to prevent injury range from the adoption of automatic braking, signaling and coupling systems for railroads in the nineteenth century to reductions in highway deaths resulting from Federal Motor Vehicle Safety Standards introduced since 1966.

Interventions for which data are available to estimate savings to society are discussed. Many more interventions are identified, but adequate data are not currently available to estimate savings. For the interventions analyzed, the precision of estimates varies depending on research design and generalizability of research findings to the total U.S. population. Although there is some uncertainty in each estimate of injury reduction, there is no doubt that many serious injuries could be prevented or reduced in severity.

Savings for the interventions are estimated on the basis of both the human capital and the willingness-to-pay methods. Employing the two methods shows the range of savings. The human capital method provides the lower level of savings; willingness-to-pay estimates are higher for each intervention.

Air Bag Savings Highest

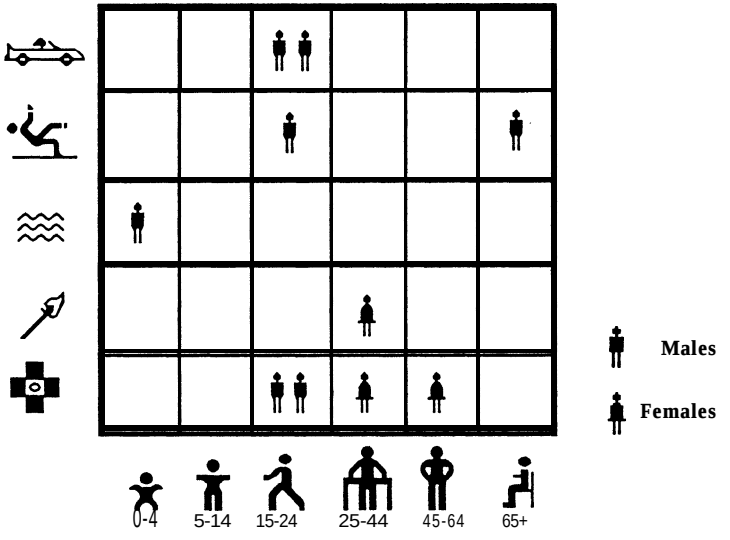
	Savings (millions)	
Intervention	Human Capital	Willingness to Pay
Child pedestrian injury campaign	$58	$180
Bicycle helmet promotion	183	284
Driver education elimination	863	2,230
Minimum licensure at age 37	1,446	4,267
Motorcycle helmet use laws	97	1,200
Reduced ignition of cigarette paper	187	1,100
Air bags	4,650	19,491
Side crash protection	0	1,529
Automatic vehicle lights	0	534

Impact of Injury on Individuals and Families

An anthropological investigation of ten injury survivors and family members defines devastating impacts outside the spectrum of economic cost measurement. Ten case studies describe the struggle to acquire the personal, therapeutic, legal, and financial aid that enables injured persons to survive, meet their basic needs, and create for themselves lives that are meaningful in terms of work, love, mutual support, recreation, and personal growth. Data were collected from five injury survivors, four parents of survivors, one spouse, and one sibling. The subjects present experiences, events, and concerns emerging as central to their lives two to eighteen years after a severe injury occurred. Though small, the California study group represents a range of economic, occupational, and educational backgrounds.

The case studies illustrate the following injuries: automobile crash, motorcycle crash, near drowning, diving into shallow water, contact sport, brutal beating, fall following an illness, fall in the workplace, and crush following malfunctional workplace equipment. The studies represent the following residual disabilities: quadriplegia, ventilator-dependent quadriplegia, brain damage, severe central nervous sys tern damage, facial disfigurement, amputated and deformed fingers, functionless hand and arm, and general weakness and inability to walk.

Ten Personal Narratives



Case Study Findings

Money is central to the well-being of the injured person and family. The cost of severe injury goes far beyond initial medical treatment and includes housing, disability-related equipment, long-term rehabilitation, education, and vocational training. For most individuals, the ability to financially survive a catastrophic injury depends on winning a large legal settlement in addition to having good private insurance coverage. It is realistic to be continually fearful of the cost of potential medical complications, follow-up surgical procedures, and future rehabilitation, housing, education, or job-training requirements. Needs do not stop with medical stabilization; they continue for years or for a lifetime.

Consequences of severe injury have a far-reaching impact that goes beyond economic cost. Profound disability affects all aspects of injured persons' existence for the rest of their lives. Disability disrupts, changes, and dominates family life forever. One family member, usually the mother or spouse, becomes the primary caregiver and devotes her life to the well-being of the injured person, calling on all the personal and community resources of which she is aware.

Government benefits are determined on an either/or basis: disabled or employable, sick or healthy, indigent or ineligible for funds. Such inflexible criteria may not fit individual needs or unusual situations. Federal regulations are insensitive to the fact that many severely disabled people want to work and are capable of doing so. SSI and Medicaid have complex and variable eligibility criteria and are designed to provide benefits to the disabled at or below the poverty level. Services for the disabled are not consistently available across the country.

A severe injury renders individual access to medical and social services, work, and housing questionable. Study subjects needed to negotiate for years with health care, legal, and insurance institutions in order to secure **a** place for themselves in society following injury. Access to long-term rehabilitation, psychological support, appropriate attendant services, housing, medication, equipment, and employment opportunities all had to be negotiated -- indeed, fought for -- within the regulations and policies of particular agencies and institutions.

All individuals interviewed illustrate characteristic American values. In spite of their great need for the resources of society, injured persons exhibit a determination to be self-reliant and independent in the face of profound challenges. Family members maintain responsibilitv toward injured persons with disabilities regardless of the emotional and financial burden of the commitment.

Introduction

The impact of injury on society is enormous in terms of the economic cost, the public and private burden of the cost, and the devastating effect on the lives of injured persons and their families. The cost of years of life lost from premature death due to injury and from productive work losses due to disability is higher than from any other single cause of death, including heart disease and cancer. Expenditures for research on injury causation, prevention, and control nevertheless continue to be dwarfed by research expenditures for other health problems. This report evaluates the magnitude of the impact on individuals, government programs, and society at large in terms of economic cost and of the effects of injury on people's lives. To evaluate these impacts, data are needed on the extent of the problem -- the number, causes, and severity of injuries in the United States -- as a basis for measuring the economic and human toll. Such measurements have been made by other researchers. Nevertheless, comprehensive data on incidence, cost, life years lost, source of funds, cause, and severity disaggregated by age and sex are not available in one document. Likewise, the long-term costs of treatment, rehabilitation, and lost productivity are rarely quantified.

This report documents and evaluates each area presented in a set of statistical tables and figures. The incidence of injury runs into millions of persons, and the cost into billions of dollars. These data are especially valuable when they furnish clues to a more efficient attack on specific aspects of the injury problem. But estimates do not measure the full impact of the injury epidemic in the United States. Nor do they express the personal and economic hardships faced by individuals and their families in the wake of a severe disabling injury. The case studies presented herein provide a measure of that impact.

While it is exceedingly difficult to quantify all aspects of the burden imposed on society by injury, it is important to translate this burden to economic terms in order to facilitate decision-making. The continued rise in health care expenditures and the growing pressures for cost containment may constrain the amount of limited resources available to provide the health care needed by Americans.

The question then arises: just where should health care priorities be placed? The solution is to place priorities where there is likely to be the greatest improvement in welfare or well-being as measured by the magnitude of the economic and social burden of health problems. This means giving priority to the areas placing the greatest burden on society. For example, injury research expenditures by all federal agencies amounted to $160 million in 1987, about one-tenth of the National

Cancer Institute expenditures and one-sixth of the National Heart, Lung, and Blood Institute expenditures. Life years lost per injury death, however, are more than twice the number for cancer (36 years compared with 16 years) and three times those for cardiovascular diseases (12 years). Moreover, the mortality cost per injury death ($335,000) is almost four times the cost for cancer ($88,000) and more than 6 and 1/2 times the cost for cardiovascular diseases ($51,000). There is, therefore, a clear case for allocating significantly increased funds to prevention, treatment, and research on injury in proportion to the burden placed on society.

The economic burden of injury is also used to make program policy decisions, to prepare and deliver testimony, and to support agency budgets. The importance of relieving the severe consequences of injury can be weighed against the need to allocate funds to other social, public health, and medical care problems.

Dimensions of the Injury Problem

Injuries are costly -- in dollars, in pain, in grief, in lives. Substantial resources are used in the care, treatment, and rehabilitation of injured persons. The lives lost are among the young whose productivity is lost to society. The burden on public resources is large. The potential for reducing the number and severity of injuries and thus saving public and private funds is great. Finally, the long-term impact of injury on injured persons and their families is also significant. This study examines and documents all of these dimensions of the problem.

Incidence of Injury *(Chapter 1)*

One of four persons is injured annually in the United States. A total of 57 million persons incurred an injury in 1985. Over 142,000 residents of the United States were fatally injured, occasionally making headlines when several people died at once. More commonly, however, injury deaths, approximately 390 a day, occur in isolation or in pairs, caused by motor vehicle crashes, falls, firearms, poisonings, fires and burns, drownings, and other causes. Injury is the fourth leading cause of death, after heart disease, cancer, and stroke. For children and young adults under age 45, injury is the leading cause of death.

Each year, 2.3 million residents of the United States are hospitalized as a result of injury, and 54 million seek some form of medical care for injuries. Injury is also a leading cause of disability; Americans spent 127 million days in bed due to injuries in 1987.

Nonfatal injuries cause pain and suffering, permanently damage bodies and brains, and affect job opportunities and families. As trauma

care systems improve, more severely injured people survive, most frequently with inadequate financial resources to meet enormous needs.

Economic Cost of Injury (Chapter 2)

From the moment -- and it is often merely seconds -- required to sustain an injury, costs accrue. Emergency medical services; hospital, physician and rehabilitation charges; and loss of work and income are the most obvious costs of injuries. The life years lost due to illness, disability, and premature death are also costly to the nation. The life years lost annually add up to more than 10 million.

The total lifetime cost of the 57 million persons injured in 1985 in the United States is enormous, estimated at $158 billion. This estimate is based on the human capital approach to cost-of-illness measurement. This method takes into account all the medical care and related resources used for care, treatment, and rehabilitation of injured persons. Also included is the value of medical care resources used and earnings forgone because of illness, disability, and premature death due to injury. Included is an imputed value for housekeeping services. However, several important injury effects are not measured, such as pain and suffering, reduced productivity of family members and caregivers, and the value of volunteer services. Legal and court costs and property damage are also not included because this report focuses on the cost of injury and excludes the costs associated with the damage caused by the event resulting in injury.

Source of Payment *(Chapter 3)*

The effort to define the range of effects of injury on individuals and society requires information on who bears the cost burden of injury. Much of that burden is due to the large expenditures for medical care paid by various types of payers -- federal, state, and local governments, private insurance, workers' compensation, and individuals. Federal payments for medical care of injured persons amount to $8.9 billion for 1985. In addition, the magnitude of transfer payments is assessed. Transfer payments represent a transfer of funds from public and private sources to injured persons or their survivors. Included are benefit payments made by government programs (e.g., Veterans Administration, Social Security, and Workers' Compensation) and private insurance. In 1985, the federal budget included payments of $12.8 billion for disability and death benefits. These program costs can be saved through reductions in the number and severity of injuries.

Willingness to Pay (Chapter 4)

Another approach to injury loss measurement is the willingness-to-pay method, which bases the value of human life on the amount an individual would be willing to pay for a safer and healthier life by reducing the probability of illness or death. This approach incorporates all aspects of individual well-being including the value of pain and suffering. Although several measurement issues need to be studied further, values estimated by this approach have been used for cost-benefit analysis in several government and private contexts. The value of life estimate using this technique is about $2 million compared to an average injury fatality cost of almost $350,000 using the human capital approach.

Potential Savings from Injury Prevention (Chapter 5)

During the past three decades, there have been reductions in fatalities and injuries, most notably from motor vehicle crashes. The potential exists, however, for even further reduction with appropriate allocation of research funding. This chapter addresses the issue with a view toward estimating potential savings based on specific injury prevention strategies. As with any assessment involving humans interacting with the physical forces of the environment, there are degrees of uncertainty in the reduction impact that would result from implementation of specific intervention actions. An assessment of several programs is presented for the reduction of injuries based on injury costs developed for this study by both human capital and willingness-to-pay methods. The results of this assessment suggest that action can be taken to further reduce injuries. However, more research is needed to better identify the most effective strategies for reducing injuries and their high costs.

Long-Term Impact of **Injury on Individuals, Families, and Society** (Chapter 6)

The lives of persons injured and their families are significantly affected by severe injuries that result in long-term disability. These impacts are outside the spectrum of economic cost measurement. Although previous case study research has been conducted on the changes that occur in peoples' lives due to debilitating injury, more detailed information, collected in a systematic fashion, is needed before general conclusions can be drawn from the broad array of injury consequences. The approach taken is an anthropological investigation of 10 injury cases to define the range of the debilitating and often devastating outcomes. The case studies describe many barriers that

people with disabilities from injury must overcome in order to create meaningful and valuable lives.

Recommendations

The estimated number of persons injured and lifetime cost of injury in the United States are the best estimates based on existing data. The present study utilizes information from numerous sources, but in many cases estimates are necessarily made on the basis of limited data. The recommendations address four major issues.

Injury Prevention and Control: Direct greater resources to the prevention of injury. Conduct research and controlled experiments to evaluate the effectiveness and savings of injury control interventions and to evaluate the societal barriers to application of injury prevention strategies.

Coding and Measurement: Require all hospital discharge data systems to use both cause and nature of injury codes. Standardize the coding of injuries. Make International Classification of Diseases (ICD) and Abbreviated Injury Scale (AIS) systems for classifying injuries compatible. Conduct research to develop a classification system for impairments.

Data Needs: Develop a coordinated national program of injury surveillance and provide sufficient resources to implement it. Expand core National Health Interview Survey (NHIS) injury questions and conduct a comprehensive injury supplement. Conduct longitudinal studies. Periodically conduct a national medical care expenditure survey to obtain injury cost data. Improve data on occupational injuries and fatalities and on firearm injuries.

Treatment and Rehabilitation: Conduct interdisciplinary collaborative studies on trauma care and expand research on model rehabilitation systems.

Chapter 1

Incidence of Injury

Essential to developing estimates of the economic cost of injury are data on incidence by major age, sex, and cause categories. Estimates of numbers and rates of injury are presented in this report for three mutually exclusive classes that reflect severity of injury: 1) injury resulting in death, including those occurring in and outside a hospital or other institution, 2) injury resulting in hospitalization **with survival to** discharge, and 3) injury requiring medical attention without hospitalization or injury resulting in one or more days of self-reported restricted activity without medical attention. Injury not severe enough to result in either medical attention or one or more days of restricted activity is excluded from the definition. Estimates of incidence and economic cost reported herein are for 1985, the most recent year for which reliable data for each class of injury are available.

Within each class of injury (fatal, hospitalized, and nonhospitalized), incidence estimates were developed for each of seven age groups (O-4; 5-14; 15-24; 25-44; 45-64; 65-74; 75 years and over), two sex groups, and seven categories of cause (motor vehicles, falls, firearms, poisonings, fires and burns, drownings and near drownings, and other). Injuries were classified by cause regardless of intent. For example, deaths classified as caused by firearms include those related to both the intentional and the unintentional use of firearms. For deaths and hospitalizations, estimates were also developed by the presumed intent of the injury, categorized as intentional, unintentional, or intent unknown. Sufficient data were not available, however, to produce comparable estimates of nonhospitalized injuries by intent. Specifics regarding the methods used in developing the incidence figures within each class of injury are detailed in the methods section at the end of the chapter.

Overview

In 1985, injuries resulted in 142,568 deaths (plus an additional 13,097 deaths that occurred in later years resulting from injuries sustained in 1985), 2.3 million persons hospitalized, and 54.4 million nonhospitalized injured persons in the United States (Table 1). This translates into **a** total of 56.9 million persons injured or 24 persons injured per year for every 100 U.S. civilian residents (the number of persons in the U.S. is shown by age and sex in Appendix Table C-l). Almost one in four people in this country sustains an injury during a year. Many of these injuries are fatal

or serious enough to require hospitalization and are associated with long-term disability.

Table

Number and Rate of Injured Persons by Sex, Age, and Class of Injury, 1985

Age and Sex	Total		Fatalities*		Hospitalized		Nonhospitalized	
	Number (000's)	Rate per 100,000 Persons	Number	Rate per 100,000 Persons	Number	Rate per 100,000 Persons	Number (000's)	Rate per 100,000 Persons
Total	56,859	23,986	142,568	60.1	2,346,735	990.0	54,369	22,936
0-4	4,071	22,621	4,363	24.2	112,434	624.8	3,954	21,972
5-14	10,189	30,039	4,962	14.6	205,047	604.5	9,979	29,420
15-24	12,750	32,892	29,412	75.9	464,078	1,197.2	12,257	31,619
2544	18,063	24,769	47,824	65.6	678,318	930.1	17337	23,773
4564	7,369	16,417	25,601	57.0	376,837	839.5	6,967	15,520
65-74	2,385	14,006	11,877	69.8	179,958	1,056.9	2,193	12,879
75+	2,032	17,616	18,529	160.7	330,062	2,862.0	1,683	14,593
Male	32,116	28,018	102,804	89.7	1321,573	1,152.9	30,692	26,776
04	2,457	26,682	2,570	27.9	65,293	709.1	2,389	25,945
5-14	5,984	34,457	3357	19.3	138,008	794.6	5,843	33,643
15-24	8,027	41,686	23,095	120.0	318,412	1,653.7	7,685	39,912
2544	10,945	30,551	37,612	105.0	454,053	1267.4	10,453	29,178
45-64	3,463	16,166	18,693	87.2	201,620	941 .l	3243	15,138
65-74	711	9,497	7,751	103.7	65,056	869.2	638	8,524
75+	530	13,038	9,726	239.4	79,131	1,947.l	441	10,851
Female	24,742	20,209	39,764	32.5	1,025,162	837.3	23,677	19,339
04	1,614	18,365	1,793	20.4	47,141	536.4	1,565	17,808
5-14	4,205	25,403	1,605	9.7	67,039	405.0	4,136	24,988
15-24	4,723	24,207	6,317	32.4	145,666	746.6	4,571	23,428
2544	7,118	19,186	10,212	27.5	224,265	604.5	6,884	18,554
45-64	3,907	16,650	6,908	29.4	175,217	746.7	3,725	15,874
65-74	1,673	17,533	4,126	43.3	114,902	1,204.l	1,554	16,285
75+	1,502	20,106	8,803	117.9	250,931	3,359.6	1,242	16,629

* Excludes 13,097 deaths occurring in later years due to injuries incurred in 1985

Of the total 56.9 million persons injured in the United States in 1985 almost one-third (18.1 million) occurs in the 25-44 age group. The second highest number of injuries, more than one-fifth (12.8 million), occurs among persons aged 15-24. About 14 million children under age 15 also suffer from injuries and comprise one-quarter of the total injured

population. Thus, persons under age 45 sustain almost four-fifths of all the injuries in the United States.

The risk of injury is highest among males; they sustain 56 percent of all injuries. Almost three of ten males (28%) incur injuries. Among females, the risk is lower -- one of five sustains injuries during a year. For both males and females, the largest number of injuries occurs among those aged 25-44. The risk is highest, however, among younger males than for any other sex or age group -- 42 percent of adolescent and young males aged 15-24 sustain injuries during a single year. Motor vehicle injuries are the leading cause of death for both males and females, whereas falls are the leading cause of nonfatal injury. These patterns by age, sex, and cause of injury are described below in more detail by class of injury.

Age and Sex Patterns

The largest number of injuries in each class is among males. Nearly three-quarters (72%) of injury deaths and over one-half (56%) of nonfatal injuries occur among males (Figure 1). Adults in the 25-44 age group account for 34 percent of deaths due to injury; 29 percent of injured persons hospitalized and 32 percent of the less severely injured nonhospitalized persons are in this age group. Adolescents and young adults aged 15-24 rank second in number of injuries for each class of injury. Ranking third in number of fatalities and hospitalizations are persons aged 45 to 64. Children aged 5-14 rank third in number of nonhospitalized injuries (Figure 2). Unlike other leading causes of death and hospitalization (such as cancer and heart disease), nearly 80 percent of the injuries resulting in death or hospitalization occur among persons less than 65 years of age; nearly two-thirds occur among persons less than 45 years of age.

The risk or rate of injury presents a different picture (Figure 3). Although the number of deaths and hospitalizations due to injury for the elderly aged 75 and over are lower than the number in the three younger age groups (15-24, 25-44, and 45-64), the risk of both death and hospitalization as a result of injury is highest for adults aged 75 and older (161 and 2,862 per 100,000 U.S. civilian residents for deaths and hospitalizations, respectively). Their fatality and hospitalization injury rates are nearly three times as high as the rates for all ages combined. The elderly aged 75 and older comprise only 5 percent of the U.S. population but account for 14 percent of all injuries resulting in death or hospitalization. Adolescents and young adults aged 15-24 rank second in risk of injury severe enough to result in death or hospitalization (76 and 1,197 per 100,000, respectively). Rates are lowest for children in the 5-14 age group.

Figure 1

Distribution of Injured Persons by Sex and Class of Injury, 1985

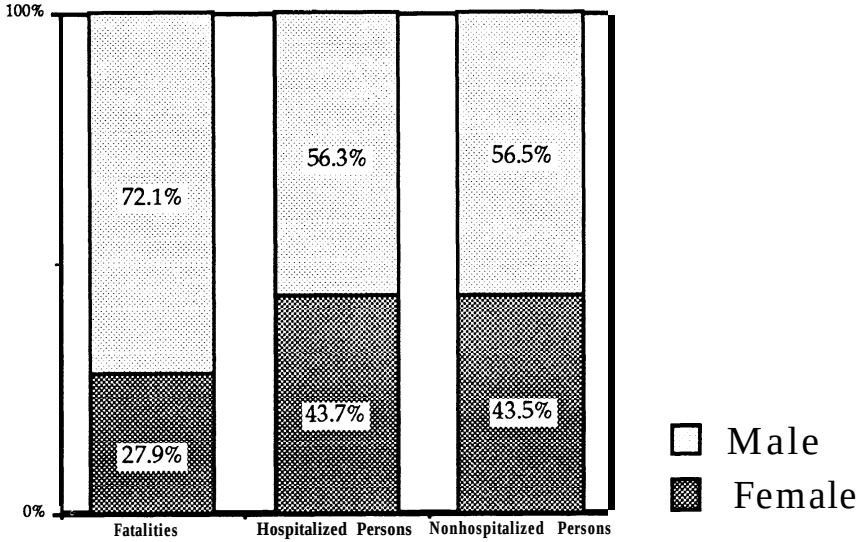
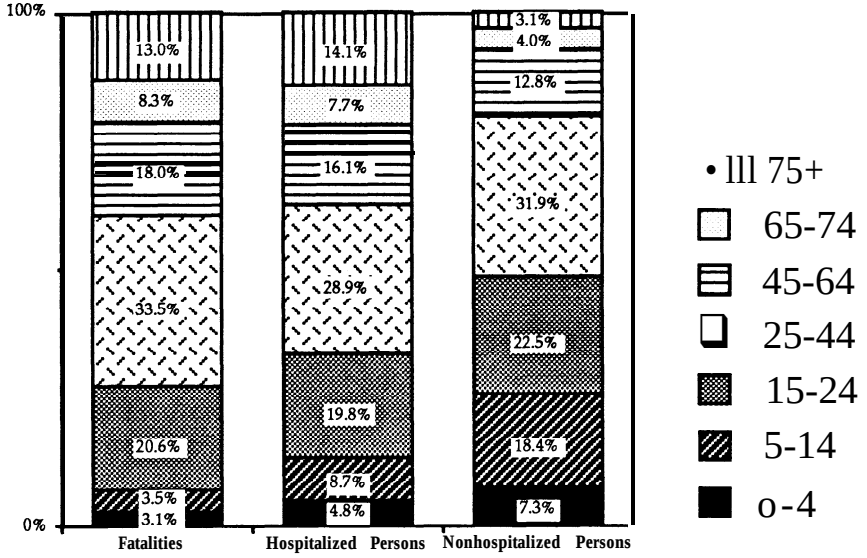


Figure 2

Distribution of Injured Persons by Age and Class of Injury, 1985



Patterns of injury by age are considerably different for less severe injuries not resulting in hospitalization. The elderly aged 75 and older are at a comparatively low risk of minor injury (14,593 per 100,000). Children aged 5-14 and adolescents and young adults aged 15-24 are at the highest risk of minor injury (29,420 and 31,619 per 100,000, respectively).

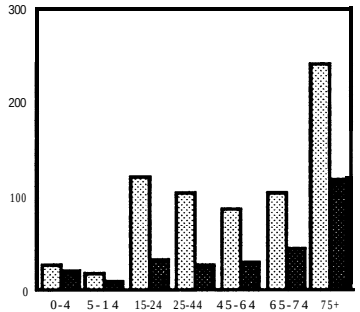
The risk of injury also varies by sex within each class of injury. In every age group except the very young, aged 0-4, the injury death rate for males is more than twice as high as the rate for females. In contrast, males are only 1.4 times as likely as females to sustain a nonfatal injury. Furthermore, among older adults, the risk to females of nonfatal injuries actually exceeds the risk to males. Among adults aged 65 and over, females are one and one-half to two times as likely as males to suffer a nonfatal injury.

Cause of Injury

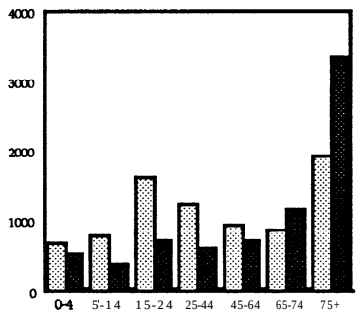
The distributions by cause vary for deaths, hospitalizations, and nonhospitalizations as shown in Table 2 and Figure 4. The number of injuries and rates for each cause of injury are shown in Appendix Tables C-2--C-8. The two leading causes of injury death are related to motor vehicles and firearms. They account for 45,923 and 31,556 deaths, respectively (19.4 and 13.3 per 100,000, respectively). Together, these two leading causes of injury death comprise more than half of the injury deaths. In contrast, the leading cause of nonfatal injury is falls, accounting for 783,357 hospitalizations (331 per 100,000) and 11.5 million nonhospitalized injured persons (4,848 per 100,000). Motor vehicle injuries comprise the second leading cause of nonfatal injury, resulting in 523,028 hospitalizations (221 per 100,000) and 4.8 million nonhospitalized injured persons (2,026 per 100,000). Firearms, on the other hand, account for less than 1 percent of nonfatal injuries. These differences in distribution by cause and class underscore the lethality of injuries involving firearms and motor vehicles.

Injuries categorized as ‘other’ include a variety of causes. For deaths, other causes primarily include stabbings, suffocations from foreign bodies, and hangings and represent 20 percent of all injury deaths. Nonfatal injuries resulting from other causes are primarily those related to being stabbed, hit by an object or person, or injured by a cutting or piercing instrument. Thirty percent of hospitalized injuries are in this category. For less severe nonhospitalized injuries, additional common causes categorized as ‘other’ include animal and insect bites, one-time lifting or exertion, and twisting or stumbling, and they comprise 64 percent of nonhospitalized injuries.

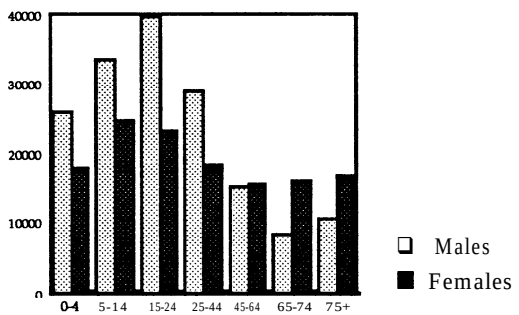
Figure 3
All Causes: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

Table 2

Number and Rate of Injured Persons by Cause and Class of Injury, *1985*

Cause	Total Number (000's)	Total Rate per 100,000 Persons	Fatalities* Number	Fatalities* Rate per 100,000 Persons	Hospitalized Number	Hospitalized Rate per 100,000 Persons	Nonhospitalized Number (000's)	Nonhospitalized Rate per 100,000 Persons
Total	**56,859**	23,985	**142,568**	60.1	**2,346,735**	**990.0**	**54,369**	22,935
Motor Vehicles	**5,372**	**2,266**	**45,923**	19.4	523,028	220.6	4,803	2,026
Falls	**12,289**	5,184	12,866	5.4	783,357	330.5	11,493	4,848
Firearms	**268** **	113	31,556	13.3	65,129	27.5	171 **	72
Poisonings	**1,702**	718	11,894	5.0	218,554	92.2	1,472	621
Fires/Burns	**1,463**	617	5,671	2.4	54,397	22.9	1,403	592
Drownings	**38** **	16	6,171	2.6	5,564	2.3	26**	11
Other	**35,726**	15,071	28,487	12.0	696,707	293.9	35,001	14,765
Male	32,116	28,018	**102,804**	89.7	1,321,573	1,152.g	**30,692**	26,776
Motor Vehicles	**2,459**	**2,145**	**32,454**	28.3	311,496	271.7	2115	1,845
Falls	**5,633**	4,914	7,002	6.1	317,980	277.4	5,308	4,631
Firearms	**216** **	189	26,366	23.0	56,718	49.5	133**	116
Poisonings	**688**	601	7,621	6.6	97,754	85.3	583	509
Fires/Burns	**797**	696	3,438	3.0	38,946	34.0	755	659
Drowningst	**35** **	30	4,951	4.3	3,928	3.4	26 **	23
Other	**22,288**	19,444	20,972	18.3	494,752	431.6	21,772	18,994
Female	24,742	20,209	39,764	32.5	1,025,162	837.3	23,677	19,339
Motor Vehicles	**2,913**	2379	13,469	11.0	211,532	172.8	2,688	2,196
Falls	**6,656**	5,437	5,864	4.8	465,377	380.1	6,185	5,052
Firearms	**52** **	42	5,190	4.2	8,411	6.9	38 **	31
Poisonings	**1,014**	828	4,273	3.5	120,800	98.7	889	726
Fires/Burns	**666**	544	2,233	1.8	15,451	12.6	648	529
Drowningst	**3** **	2	1,220	1.0	1,636**	1.3		
Other	**13,438**	10,976	7,515	6.1	201,955	165.0	13,229	10,805

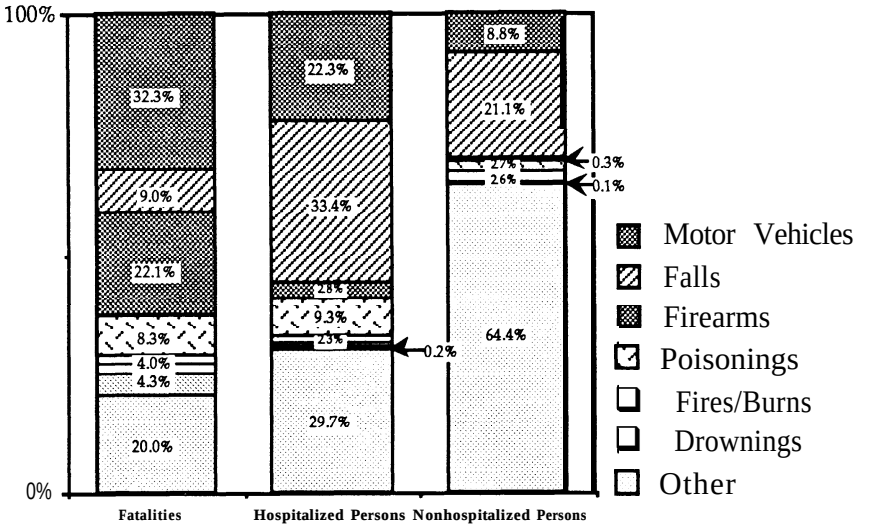
*** Excludes 13,097 deaths occuring in later years due to injuries incurred in 1985**
**** Figure has low statistical reliability or precision (relative standard error exceeds 30 percent)**
t Includes Near Drownings

Intent of Injury

Slightly more than one-third of all injury deaths involve intentional injuries (Table 3 and Figure 5). Of 49,276 intentional injury deaths, 40 percent are homicides (19,830) and 60 percent are suicides (29,446). The remaining two-thirds of the deaths are due to unintentional causes -- 51 percent to motor vehicles, 13 percent to falls, and 36 percent to other causes.

Figure 4

Distribution of Injured Persons by Cause and Class of Injury, 1985



Information regarding intent of injuries resulting in hospitalization is less complete than for injury deaths. Intent is not uniformly recorded in the medical record, and if it is, this information often represents conjecture on the part of the physician or nurse completing the narrative description of the injury. To arrive at a rough estimate of the numbers of intentional and unintentional hospitalized injuries, it is assumed that all injuries resulting from motor vehicles, falls, fires, and near drownings are unintentional. The remaining injuries are categorized by intent as reflected in the International Classification of Disease (ICD-9) E-code (Commission on Professional and Hospital Activities, 1980). Using this approach, 84 percent of all hospitalized injuries are classified as the result of unintentional injury, a-nd 11 percent the result of intentional injury, including poisonings (31%), firearms (11%), and other assaultive injuries (58%). The remaining 5 percent can not be classified. Approximately one-half of the hospitalized injuries recorded as intentional are self-inflicted. Sufficient data are unavailable to categorize nonhospitalized injuries by intent.

Table 3

Number and Rate of Injured Persons by Intent and Class of Injury, 1985

	Fatalities*		Hospitalized	
Intent	Number	Rate per 100,000 Persons	Number	Rate per 100,000 Persons
Total	142,568	60.1	2,346,735	990.0
Unintentional	90,469	38.2	1,978,518	834.6
Intentional	49,276	20.8	261,738	110.4
Intent Unknown	2,823	1.2	106,480	44.9
Male	102,804	89.7	1321,573	1,152.g
Unintentional	62,628	54.6	1,096,692	956.8
Intentional	38,156	33.3	169,264	147.7
Intent Unknown	2,020	1..8	55,618	48.5
Female	39,764	32.5	1,025,162	837.3
Unintentional	27,841	22.7	881,826	720.3
Intentional	11,120	9.1	92,474	75.5
Intent Unknown	803	0.7	50,862	41.5

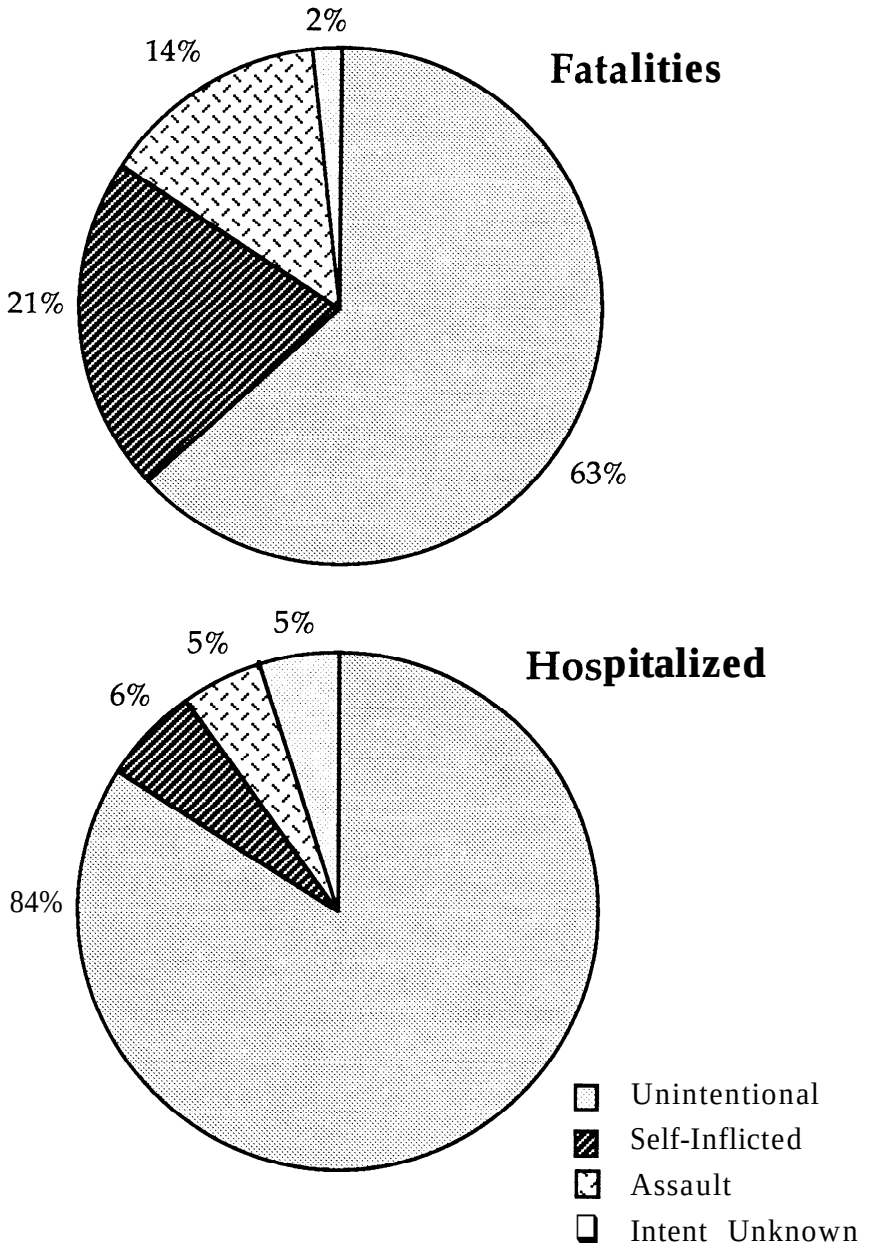
* Excludes 13,097 deaths occurring in later years due to injuries incurred in 1985

Hospitalized Injuries by Nature and Severity

Since hospitalized injuries include a broad spectrum of types and severities, these injuries are further distributed by nature and severity, using the International Classification of Disease/Abbreviated Injury Scale (ICD/AIS) (MacKenzie, Steinwachs, and Shankar, 1989) (Table 4). The AIS is a threat-to-life scale that categorizes injury severity by the nature of damage to different body regions. It ranges from 1 (minor injury) to 6 (maximum injury - virtually unsurvivable) (Committee on Injury Scaling, 1985). Injuries to the upper or lower extremities account

Figure 5

Distribution of Injured Persons by Intent and Class of Injury, 1985



for nearly one million hospitalized persons or 41 percent of the total. Slightly over one-third of these injuries are moderately severe or severe (ICD / AIS 3 or greater). For many of these more severe injuries, recovery can be long and expensive, and even optimal treatment can result in permanent impairment involving chronic pain, loss of motion or contracture of joints, deformity, or loss of limb. The primary cause of hospitalized extremity injury is falls; they account for an estimated 30 percent of upper extremity injuries and 50 to 60 percent of lower extremity injuries. Motor vehicle crashes also contribute significantly to the incidence of extremity injuries, accounting for an additional 15 to 20 percent of all new cases. Another important cause of upper extremity injury relates to injuries involving machinery and tools, which account for approximately 20 percent of all hospitalized upper extremity injuries.

About 300,000 individuals survive a head injury serious enough to result in hospitalization for one or more days. Head injury accounts for 12 percent of all injury hospitalizations. Although the majority (73%) of these injuries are minor, conservative estimates of the number of persons who survive moderate (ICD / AIS 3), severe (ICD / AIS 4), and very severe (ICD / AIS 5) head injury are 45,974, 25,239 and 6,710, respectively. The long-term consequences associated with severe head injury are substantial. Several studies have documented the persistence of significant physical, neuropsychological, and psychosocial deficits following severe head injury. Less is known about the residual effects of minor head injuries, although there is increasing evidence to suggest that they are associated with a multitude of physical symptoms such as persistent headaches, as well as with significant psychosocial and behavioral problems and difficulty in performing one's job. Motor vehicle crashes (including motorcycle, bicycle, and pedestrian) constitute the leading cause of head injury in the United States. They account for one-third to one-half of all head injuries. Falls are the second leading cause of head injury, accounting for an additional 20 to 30 percent of all injured persons. (Frankowski, Annegers, and Whitman, 1985).

Other injuries accounting for more than 5 percent of total hospitalizations include those to the vertebrae (6%); soft tissue injuries to the abdomen, thorax, and neck (6%); and poisonings (9%). Although spinal cord injuries account for a very small proportion of the total (less than l%J, they result in significant physical and psychological changes. Individuals who survive a severe spinal cord injury require extensive long-term medical treatment and rehabilitation. While relatively few in number, these injuries have a substantial impact on the individual and society. Motor vehicles are the major cause of spinal cord injury, accounting for an estimated 30 to 60 percent of all injured persons. Falls

Table 4

Number and Rate of Hospitalized Injured Persons by Principal Diagnosis and Severity of Injury, 1985

Principal Diagnosis	Severity (ICD/AIS)	Number of Live Discharges	Rate per 100,000	Percent Distribution
Total	na	2,346,735	990.0	100.0 %
Head	1-2 *	212,496	89.6	91
	3	45,974	19.4	2.0
	4	25,239	10.6	1.1
	5	6,710	2.8	0.3
Face	l-2 *	83,649	35.3	3.6
	3,4,5	1,629	0.7	0.1
Vertebrae	1-2 *	94,601	39.9	4.0
	3	44,659	18.8	1.9
Spinal Cord	3	6,872	2.9	0.3
	4,5	6,267	2.6	0.3
Abdomen/Thorax/Neck	l-2 *	99,371	41.9	4.2
	3	34,786	14.7	1.5
	4,5	11,805	5.0	0.5
Upper Extremities	l-2 *	271,195	114.4	11.6
	3,4,5	18,332	7.7	0.8
Lower Extremities	l-2 *	364,327	153.7	15.5
	3,4,5	319,217	134.7	13.6
Bums	l-2 *	36,623	15.4	1.6
	3,4,5	2,708	1.1	0.1
	Unknown	26,168	11.0	1.1
Foreign Bodies	na	33,437	14.1	1.4
Near Drownings	na	5,564	2.3	0.2
Poisonings	na	218,554	92.2	9.3
Other Nature	na	376,550	158.8	16.0

* Includes cases of unknown ICD/AIS severity
Note: na = not applicable

constitute the second leading cause; they account for an additional 20 to 30 percent of all spinal cord injuries. Approximately 5 to 10 percent of all spinal cord injuries are due to diving (Kraus, 1985a).

Patterns of Injury by Cause

The categorization of incidence and cost by cause of injury can be particularly useful in designing and targeting preventive strategies. For this reason, a more detailed discussion of the patterns of injury by age, sex, and severity class is presented below for each of the major cause categories.

Motor Vehicles

Motor vehicle crashes are the leading cause of injury death, resulting in 45,923 deaths in 1985. They also comprise the second leading cause of both injury hospitalizations (523,028) and less severe, nonhospitalized injuries (4.8 million). Adolescents and young adults aged 15-24 are at highest risk of both fatal and nonfatal injuries related to motor vehicles. Their rate for each class of injury is approximately twice the rate for all ages (Figure 6 and Appendix Table C-2). The elderly aged 75 and older are also at a relatively high risk of dying from motor vehicle injury. The rate of motor vehicle deaths in this age group is second only to that in the 15-24 age group.

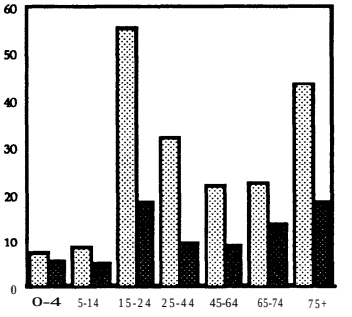
Over age 15, males are more than twice as likely as females to die from a motor vehicle crash, with the largest male to female ratio (over 3-fold) observed in the 15-24 and 25-44 age groups. Males under the age of 45 are also more likely to be hospitalized as a result of a motor vehicle injury, although the sex differential is not as great as for fatalities (male to female risk ratio is 1.7). Males and females 45 years and older, on the other hand, are equally likely to be hospitalized. A somewhat different pattern is observed for minor, nonhospitalized injuries. Over age 15, females are at a slightly higher risk for nonhospitalized injury than are males (female to male risk ratio is 1.2), although among the elderly aged 75 and older, males remain at higher risk.

Major factors contributing to the likelihood of a crash include speed, vehicle instability and braking deficiencies, inadequate road design (e.g., excessive curvature or gradient, inadequate guardrail and shoulders) and alcohol intoxication, which is involved in about half of all fatal crashes. When a crash occurs, important determinants of the likelihood of injury include speed of impact, vehicle crashworthiness, and the use of airbags, safety belts, and motorcycle helmets (Waller, 1985).

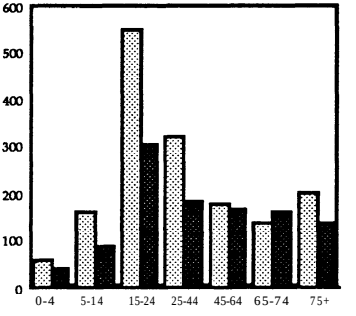
Falls

Falls are the leading cause of nonfatal injury in the United States, accounting for 783,357 hospitalizations and 11.5 million minor injuries that do not result in hospitalization. They also account for 12,866 deaths. The elderly are at highest risk of both dying and being hospitalized as

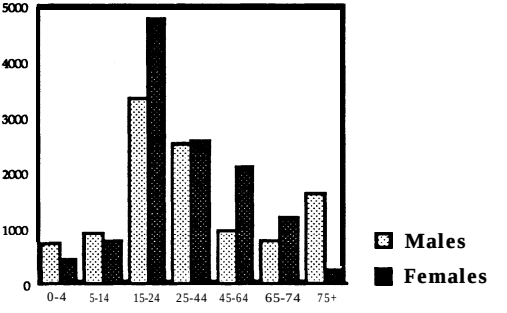
Figure 6
Motor Vehicles: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

the result of a fall (62 per 100,000 and 2,259 per 100,000, respectively) (Figure 7 and Appendix Table C-3). The death rate due to falls among the elderly aged 75 and older is nearly 12 times as great as the rate for all ages combined and the risk of hospitalization nearly 7 times as great. The risk of death or hospitalization-related to falls among children and young adults less than 45 years of age, on the other hand, is very small (less than 1 per 100,000 for deaths and less than 200 per 100,000 for hospitalizations).

A different age pattern is observed for falls resulting in minor, nonhospitalized injuries. The elderly aged 75 and over remain the age group at highest risk; they account for 993,000 injuries or 8,610 per 100,000. However, children less than 15 years of age are also at high risk; they comprise the second and third highest age groups at risk of minor injury due to falls. Falls represent over one-quarter of all minor injuries in this age group.

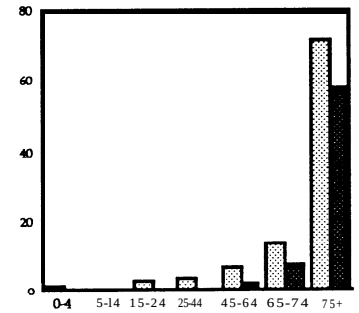
Males at all ages are at higher risk of fall-related deaths than females, although the male to female ratio is considerably less (1.3) than for other causes. Elderly females, however, are at considerably higher risk of nonfatal fall-related injuries than males. Females aged 65 and over are more than twice as likely as males in the same age group to sustain a nonfatal injury resulting from a fall.

Falls among the elderly tend to involve a trip or fall on a level plane. The high risk of death and serious injury resulting from falls among the elderly is due to several factors, including higher rates of osteoporosis and other medical conditions, as well as increased impairment of vision, gait, and balance. The use of medications is also correlated with falls among the elderly (Ray, Griffin, Schaffner, et al., 1987). Elders have a greater risk of complications, even with minor injuries. Falls resulting in hip fractures frequently signal the end of independent living for elderly persons. Falls are a significant risk among residents of nursing homes and chronic care facilities (Baker, O'Neill, and Karpf, 1984). Among younger people, most fatal falls are from a height (e.g., down stairs, out windows) (Gallagher, Guyer, Kotelchuck, et al., 1982). A classic program to install window bars in New York City reduced fall deaths among children (Speigel and Lindeman, 1977), although a more recent study questions whether the effect has been sustained (Bergner, 1982).

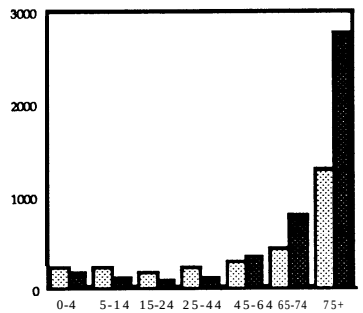
Firearms

Injuries resulting from either the unintentional or intentional use of firearms constitute the second leading cause of death due to injury in the United States. In 1985, 31,556 people died from firearm injuries (13 per 100,000). For all ages, 39 percent of firearm deaths are homicides and 56 percent are suicides. An additional 5 percent of firearm deaths are

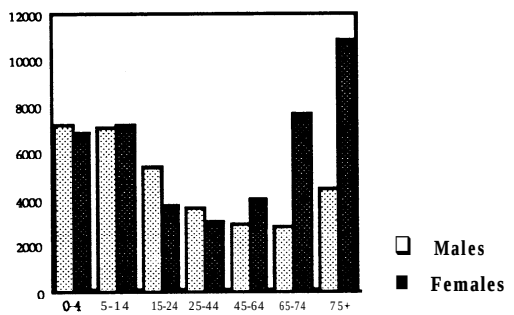
Figure 7
Falls: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

unintentional. The risk of a firearm death is highest for adolescents and young adults aged 15-44 (18 per 100,000) although among males, the elderly aged 75 and over are at higher risk than any other subgroup of the population (42 per 100,000) (Figure 8 and Appendix Table C-4). Their rate is 1.8 times as high as the rate for all males and 1.4 times as high as for males aged 15-44. Firearm injuries resulting in death among elderly males are largely due to suicides; 93 percent of all firearm deaths among males 75 and older are suicides. This is in contrast to firearm deaths among younger males, almost half of which are homicides (48%).

Patterns of incidence by age and sex are considerably different for nonfatal as opposed to fatal firearm injuries. For both hospitalized and nonhospitalized injuries, young adult males are at highest risk with relatively few injuries among females and the elderly.

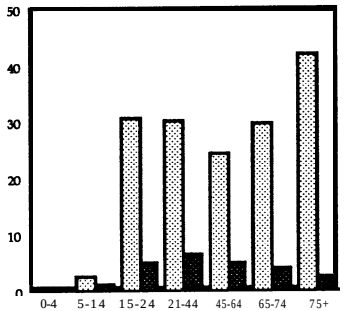
Handguns account for three-fourths of all gun-related homicides (U.S. DOJ, 1986), although recent increases in gang warfare and the adoption of assault weapons by drug traffickers may create different patterns of firearm deaths. Injury deaths caused by handguns are a uniquely American epidemic with a rate over 90 times greater than that of any other country. More than half of all suicides are committed with guns (American Medical Association, 1989). Alcohol has been found at autopsy in 45 percent of firearm-involved homicides (Goodman, Mercy, Loya, et al., 1986). Since the early 1970s, the year-to-year fluctuations in firearm availability has paralleled the numbers of homicides. While firearm retailers market handguns for self-protection, few firearm deaths in the home stem from acts of self-protection. Firearms are unintentionally or intentionally fired at family members, friends, or acquaintances (Kellerman and Reay, 1986).

Poisonings

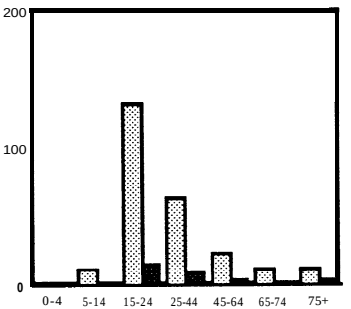
In 1985, poisonings accounted for 11,894 deaths, 218,554 hospitalizations and 1.5 million minor injuries (Figure 9 and Appendix Table C-5). Almost all poisoning deaths occur among persons over the age of 15. Young adults aged 25-44 are at highest risk of a poisoning death (8 per 100,000). Males are 1.9 times as likely as females to die of a poisoning. Nearly one-half (48 percent) of all poisoning deaths of adults are ruled suicidal. There is evidence to suggest that these statistics may nevertheless underestimate the number of suicidal poisoning deaths because deaths may be classified as unintentional when intent is not immediately obvious (Baker, Fisher, Masemore, et al., 1972).

Patterns of nonfatal poisonings by age and sex are quite different from those resulting in death. Persons at highest risk of a hospitalization associated with poisoning include the elderly aged 75 and older (165 per 100,000), very young children aged 0-4 (139 per 100,000), and adolescents

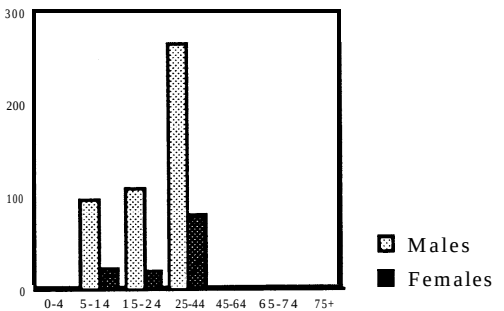
Figure 8
Firearms: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

and young adults aged 15-24 (130 per 100,000). Females aged 5 and older are at slightly higher risk of hospitalization than males, although the differences are small; for all ages, females are 1.2 times as likely as males to be hospitalized. Little is known about the intent of nonfatal poisonings resulting in hospitalization (42 percent are of unknown intent). Of the hospitalized injuries for which the intent is recorded, however, nearly two-thirds are ruled intentional (over 90 percent are recorded as self-inflicted). The risk of a less serious poisoning resulting in medical attention without hospitalization or in one or more days of restricted activity is highest among very young children aged 0-4 (1,745 per 100,000). They account for 21 percent of all nonhospitalized injuries. Rates among the elderly, on the other hand, are low.

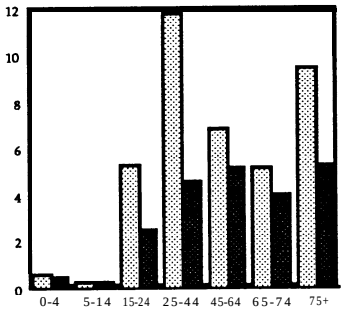
Deaths among adults from poisonings most commonly involve motor vehicle exhaust, other gases or vapors, antidepressants and tranquilizers, barbiturates, alcohol, and opiates. Poisonings among children under age 5 comprise 60 percent of all calls to poison control centers but only 1 percent of fatalities. Poisoning deaths among young children have declined dramatically since 1960 largely because of changes in the formulation and packaging of dangerous drugs (Walton, 1982). However, poisonings remain a major cause of hospitalization and emergency outpatient care. Poison control centers with hot lines provide consultation on appropriate emergency and therapeutic treatment for poisons, drugs, and other toxic substances involved in both unintentional and intentional poisonings (Chafee-Bahamon and Lovejoy, 1983.

Fires and Burns

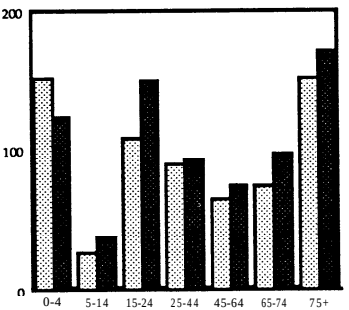
In 1985, fires and burns resulted in 5,671 deaths, 54,397 persons hospitalized and 1.4 million persons with minor injuries. The elderly aged 75 and older are at highest risk of death due to fires and bums (8.6 per 100,000), and young children aged 0-4 are at highest risk of nonfatal burns resulting in hospitalization (66 hospitalizations per 100,000) (Figure 10 and Appendix Table C-6). There is no consistent relationship with age for minor burns. Males are at slightly higher risk of both fatal and nonfatal injuries resulting from fires and burns, although the sex differential is not as great as for other injuries (1.7 for fatalities and 1.3 for nonfatalities).

House fires cause three-fourths of all fire and burn deaths, with smoke inhalation and resulting carbon monoxide poisoning causing two-thirds of these deaths (Birky, Halpin, Caplan, Fisher, McAllister, and Dixon, 1977). The same study reports alcohol involvement in 42 percent of fatal fires. The risk of dying in a housefire is halved in homes with operable smoke detectors. Smoke detectors are now present, but not always operable, in 82 percent of U.S. households (Hall, 1988).

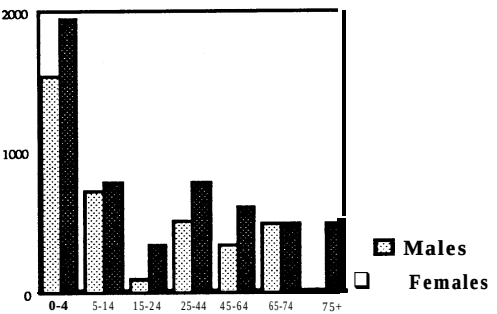
Figure 9
Poisonings: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

Cigarettes, the primary ignition source of fatal fires, can be manufactured to be less likely to ignite furniture (Technical Study Group, 1987). A severe nonfatal burn is among the most devastating injuries a person can survive and may result in permanent scarring. Scalds are the most common burn injury and flame burns tend to be the most severe. Clothing ignition burns are now rare in children but are still a significant problem among the elderly (Tinsworth, 1985).

Drownings **and** Near **Drownings**

Drownings accounted for 6,171 deaths in 1985. There were an additional 31,564 near drownings, of which 5,564 resulted in hospitalization (Appendix Table C-7). Drowning rates are highest among very young children aged 0-4 (4 per 100,000) and among young adolescents and young adults aged 15-24 (4 per 100,000). Males are over four times as likely to drown as are females.

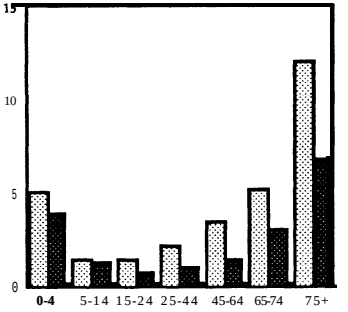
Approximately 11 per 100,000 young children are hospitalized as the result of a near drowning; 145 per 100,000 experience a near drowning that results in outpatient medical treatment or one or more days of restricted activity. Estimates of near drownings are based on a small number of sampled cases. Thus, caution must be exercised in interpreting patterns of incidence by age and sex. The numbers suggest, however, that nearly 90 percent of all near drownings occur among very young children aged 0-4, and that males are over twice as likely as females to be treated as the result of a near drowning.

Most drownings of young children occur in unprotected or unsupervised bodies of water such as swimming pools and can be prevented by adequate fences and self-latching gates around hazards close to home (Pearn and Nixon, 1977). Drownings among adolescents and young adults occur most often during swimming or boating activities, but effective strategies to prevent these drownings have yet to be developed. Alcohol has been detected in the majority of adults who drown while swimming or boating (Dietz and Baker, 1974), although the causal relationship needs further study (Howland and Hingson, 1988).

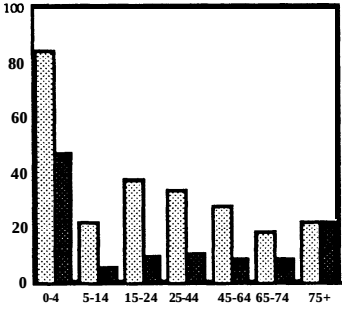
Data Sources and Methods

The major data sources used in estimating numbers of injuries are the National Mortality Detail File (for deaths), the National Hospital Discharge Survey (for live hospital discharges), and the National Health Interview Survey (for less severe, nonhospitalized injuries). Statewide hospital discharge abstract data from Maryland and California are used to supplement the information on cause for hospitalized injuries (Maryland HSCRC, 1988; California OSHPD, 1986). These data sources were chosen because they include population-based information on all

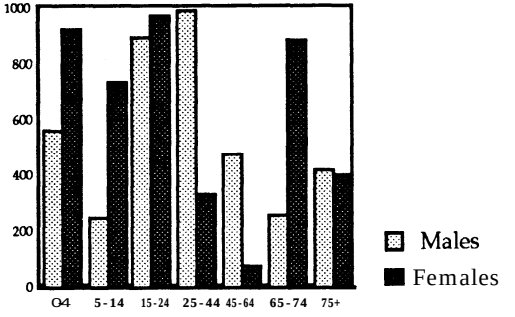
Figure 10
Fires/Burns: Injury Rate by Age and Sex, 1985
(rate per 100,000 population)



Fatalities



Hospitalized Persons



Nonhospitalized Persons

injuries regardless of the cause of injury and the age of the injured. Numerous other national population-based data sets exist from which estimates of incidence can be derived for particular types of injury (e.g., motor vehicle injuries (U.S. NHTSA, 1988b; 1988c), injuries related to consumer products (U.S. CPSC, 1983), or occupational injuries (Panel on Occupational Safety and Health Statistics, 1987). Differences in study design and definitions across these studies, however, make it difficult to integrate their results in arriving at uniform figures across all types of injury and subgroups of the population.

Age- and sex-specific intercensal estimates of the 1985 United States civilian population are used in calculating rates of injury per 100,000 (U.S. Bureau of the Census, 1988). The civilian population consists of U.S. residents excluding members of the armed forces. The 1985 population estimates are included in Appendix Table C-1. The definitions and assumptions used in developing estimates for each class of injury are discussed below.

Deaths

The data source for determining the number of injury deaths is the 1985 National Mortality Detail File, a complete record of deaths occurring in the United States, excluding foreign resident deaths. An injury death is defined as any death with an underlying cause of injury as defined by the Ninth Revision of the International Classification of Diseases (ICD-9CM), E-Codes 800-999 excluding E870-E879 (misadventures to patients during surgical and medical care) and E930-E949 (drugs, medical and biological substances causing adverse effects in therapeutic use). This definition includes all traumatic injuries, burns, poisonings, and drownings. Deaths with an injury noted only as a contributing cause and not as the underlying cause are excluded from the definition. Restricting the definition to deaths with an underlying cause of injury underestimates the total number of injury-related deaths, especially among the elderly (Fife and Rappaport, 1987). However, since it is difficult to ascribe the death in these cases to the injury per se, the more conservative definition is used.

The classification of ICD-9 E-codes by cause and intent of injury may be found in Appendix A. The classification by cause defined herein is somewhat different from that often used in national reports of injury mortality by cause because different categories of intent are combined under specific causes of injury. Caution should therefore be exercised in making direct comparisons.

Hospitalizations

The 1984, 1985, and 1986 National Hospital Discharge Survey (NHDS) micro data tapes are used to develop estimates of the number of injuries resulting in hospitalization. The NHDS consists of hospital discharge abstracts uniformly collected for a probability sample of approximately 200,000 patients discharged each year from nearly 600 short-stay, nonfederal hospitals located in the 50 states and the District of Columbia. Three years of NHDS data are used to provide more accurate estimates of incidence by age, sex, and nature of injury. National estimates of the number of hospitalizations are calculated by inflating the sample by the reciprocal of the probability of sample selection, adjusting for nonresponse. Annualized estimates for 1985 are obtained by averaging the estimates over the three years. Estimates of less than 3,000 have a relative standard error that may exceed 30 percent and are generally considered unreliable. These figures are noted in the tables with an asterisk.

Included in the definition of an injury-related hospitalization is any live discharge with a principal diagnosis of an injury as defined by the ICD-9CM N-codes N800-N999, excluding N958 (traumatic complications), N905-N909 (late effects of injuries), N995 (adverse effects), and N996-N999 (complications of surgical and medical care). N-codes are the International Classification of Disease (ICD) codes for the nature of injury and body part affected. For the three years (1984-86), a total of 41,601 live discharges included in the NHDS met these criteria.

Selecting all hospital admissions with a principal diagnosis of trauma overestimates the incidence of injury resulting in hospitalization. This overcount occurs for two reasons. First, transfers from one acute care hospital to another may be counted twice. However, less than 2 percent of injury hospitalizations are transfers (MacKenzie, Steinwachs, and Edelstein, 1988). A second and potentially more important source of overestimation is the inclusion of individuals who are rehospitalized for follow-up care of a previous injury. Hospitalizations classified by principal diagnosis as 'complications' or 'late effects' of injury, are excluded from the count by definition. Some of these rehospitalizations, however, have a principal diagnosis with a valid injury ICD N-code as defined above. These cases are not readily identifiable in the NHDS. However, several statewide hospital discharge abstract databases indicate whether admissions are elective or not. This classification is used as a surrogate for readmission.

Estimates of the number of hospitalizations obtained from the NHDS are adjusted downward using the percent of live discharges from all Maryland acute care hospitals that were elective. Adjustments are made within 24 injury categories defined by the body region and severity

of the principal or most severe injury sustained. Of all injury categories, 12 percent of admissions were elective in Maryland (Maryland HSCRC, 1988), a figure comparable to data from New Zealand in which first admissions and readmissions can be separately identified (New Zealand NHSC, 1989).

Classification by Nature and Severity

All injured persons discharged from the hospital are classified into one of 24 injury categories defined by the body region and severity of the principal or most severe injury sustained. Injury severity is determined using a computerized mapping of ICD-9CM coded discharge diagnoses into Abbreviated Injury Scale (AIS) scores, referred to as ICD/AIS scores (MacKenzie, Steinwachs, and Shanker, 1989). The AIS is the most widely recognized injury severity scoring system based on anatomic descriptors (Committee on Injury Scaling, 1985). The AIS is an ordinal scale ranging from 1 (minor injury) to 6 (maximum injury-virtually unsurvivable).

A drawback to the widespread application of the AIS in large population-based research and evaluation in the past was the need to review the entire medical record for adequate scoring. Development of the ICD-9CM to AIS conversion table has enabled AIS severity scoring when only ICD-9CM coded discharge diagnoses are available. Assumptions used in assigning ICD/AIS scores are generally conservative. Validation studies further show that errors in chart abstracting and ICD coding lead to lower than average AIS values (MacKenzie et al., 1989). Therefore, ICD/AIS scores are slightly lower than AIS scores obtained by reviewing the entire medical record. Thus, the distribution by severity of persons discharged from the hospital is conservative.

For the purpose of classification, all injured persons discharged from the hospital are grouped into 24 categories defined by the body region and AIS score of the principal diagnosis (Table 4).

Classification by Cause

A major limitation of the NHDS for estimating the incidence of hospitalized injuries is the lack of uniform coding of the cause of injury. The percent of cases in the NHDS for which the cause of injury can be identified either by an N-code (for drownings, poisonings, and burns) or by an E-code (for motor vehicles, falls, firearms, and other) is low -- approximately 25 percent. In most statewide discharge abstract databases, on the other hand, the percent of cases with information on cause is somewhat higher (50-60 percent). It has been shown, however, that even in these more complete databases, E-coding is not a random practice within or among hospitals, but is strongly correlated with the

age of the patient and the number and severity of injuries sustained (MacKenzie et al., 1988). Given a limited number of fields for recording diagnoses, hospitals are encouraged to record the conditions that influence the reimbursement rate. Thus, patients with multiple injuries and elderly patients who are likely to present with an underlying chronic disease or who develop complications during hospitalization are less likely to be assigned E-codes.

Because of the limitations of both the NHDS and the statewide discharge abstract databases, the following procedures are used to distribute U.S. hospitalized injuries by cause. First, all injuries in the NHDS for which the cause is synonymous with the nature of injury are identified by an ICD-9CM N-code. These injuries include burns, (N940-N949), near drownings (N994.1), poisonings (N960-N969; N970-N989), foreign bodies (N930-N939), and adverse effects (N990-994.0; N994.2-N994.9).

The remaining injuries are distributed by cause using hospital discharge abstract data from Maryland in which cause of injury is known for 59 percent of the cases. Maryland data are used for three reasons: first, a relatively high percent of hospitalized injuries are E-coded in the Maryland database. Second, the demographic distribution of the Maryland population is similar to that of the United States. Third, the distribution of injury deaths by cause occurring in Maryland is very similar to the distribution for the United States (Baker, O'Neill, and Karpf, 1984). As a further check on the suitability of using Maryland data, the distribution by cause for Maryland discharges was compared with distribution by cause for California discharges. Within age and nature of injury categories, the distributions are similar.

Three years (1984-86) of live discharges from the 56 acute care hospitals in Maryland for which E-codes are recorded (N=68,211) are distributed by cause within the seven age groups, the male and female groups, and the 24 categories defining the body region and ICD/AIS severity of the principal injury. Based on the Maryland discharge data, the percent distributions of cause within each age, sex, and nature of injury category are multiplied by the NHDS estimates of the total number of hospitalizations within each group.

Nonhospitalized Injuries

Estimates of the number of minor injuries resulting in medical attention without hospitalization or in one or more days of restricted activity with no medical attention are derived using the National Health Interview Survey (NHIS) for 1984, 1985, and 1986. The NHIS is a continuous survey of a probability sample of households in the United States. Each year, approximately 50,000 households are sampled and

information obtained on 122,000 individuals. In 1985, however, only three-quarters of the households were sampled and in 1986, only one-half. Interviews are designed to obtain information about the health characteristics of each civilian noninstitutionalized member of the sampled households. Three years of data are used to provide more accurate estimates of incidence by age, sex, and cause of injury. National estimates are derived by weighting sample estimates by the reciprocal of the probability of selection, adjusted for nonresponse. Annualized estimates for 1985 are obtained by averaging the estimates over the three years. Estimates of less than 312,000 may have a relative standard error that exceeds 30 percent and are considered to have low statistical reliability. These data are marked in the tables.

Included in the definition of nonhospitalized injuries are all acute injuries occurring within two weeks prior to interview, not resulting in hospitalization, but requiring medical attention (including consultation over the phone) or at least one full day of restricted activity. When a person is injured more than once in a two-week period, the injuries are counted separately. An acute injury is defined as any condition with an ICD-9CM N-code of N800-994, excluding N958 (traumatic complications), N905-N909 (late effects of injuries), N995 (adverse effects), and N996-N999 (complications of medical and surgical care).

Nonhospitalized injuries are distributed by cause in the following manner. The NHIS distinguishes between motor vehicle versus non-motor vehicle related injuries. Among the non-motor vehicle injuries, injuries related to fires and burns, poisonings, and near drownings can be further identified by the N-code used in the NHIS to classify the nature of the condition. The remaining injuries are distributed according to the distribution of cause for non-motor vehicle related injuries as reported in the NHIS conducted in 1972, the most recent year for which detailed information on the cause of injury was obtained (U.S. NCHS, 1976).

Data Limitations

The incidence estimates presented in this report are derived from national databases that include a minimum of information on injuries within a certain class regardless of cause or age of the injured persons. At this time, there is no comprehensive source of information on all injuries from which more accurate estimates of incidence by cause, nature, and severity of injury can be derived.

The databases used have limitations, however, and many assumptions and adjustments to the national data are necessary. In general, the estimates are believed to be conservative, both in overall magnitude and in distribution by severity. As noted above, the number

of injury deaths is underestimated, especially among the elderly for whom an injury may only be coded as a contributing rather than the underlying cause of death. The number of hospitalized injuries is also likely to represent an undercount since admissions to Veterans Administration and other state or federal hospitals are not included in the NHDS sample. Finally, injuries occurring in institutions such as mental institutions and prisons and not resulting in hospitalization are omitted from the totals since the NHIS collects information only on household members who are not institutionalized at the time of the interview. The NHIS is based on self-reporting, unlike the National Mortality Detail File and the NHDS, which are based on medical records. Therefore, there may be overcounting of injuries to survey respondents and undercounting of injuries to other household members.

Due to limitations of the mapping from ICD-9CM codes to AIS severity scores, the distribution of traumatic injuries by severity is also likely to be conservative -- that is, the number of severe injuries (ICD / AIS 5) is underestimated. Comparison with more comprehensive sources on specific types of injury such as head injuries and spinal cord injuries, however, indicates that the bias is not great (Kraus, 1985a; Frankowski et al., 1985).

In comparing these estimates to those derived from other studies or surveillance systems, the following potential sources of difference may be observed. First, classification by cause is without regard to intent. Also, definitions of specific cause categories may differ from one study to another. Second, estimates of hospitalized injuries exclude inpatient deaths. Thus, for example, the number of severe (ICD / AIS 5) head injuries in Table 4 includes only persons who survive to discharge although studies have shown that an equal number of people are admitted to a hospital with a severe head injury and subsequently die prior to discharge (MacKenzie et al., 1989; Kraus, Black, Hessol, et al., 1984). These hospital deaths are included in the mortality figures. Finally, in comparisons of these estimates to those developed using more accurate information about the incidence of specific types or causes of injury, rates of injury may vary over time and across geographic regions. (Baker et al., 1987; U.S. CDC, 1988)

Conclusion

Incidence data are essential for estimating the cost of injury in the United States. About 56.9 million persons, one in four persons in the nation, are estimated to have been injured in 1985. Of this total number of injured persons, 142,568 died, 2.3 million were hospitalized, and 54.4 million were less severely injured, not requiring, hospitalization. Injury occurs across the age range and to both genders, but younger persons

and males are most affected. Four of five injuries occur annually among persons under age 45 and three in ten males sustain injuries in a year. Motor vehicles and firearms are the leading causes of injury death, accounting for more than half of all injury deaths. Falls, however, are the leading cause of nonfatal injury.

The injury incidence data in this chapter represent a major contribution to understanding the full burden of injury in the United States. This is the first attempt to present a comprehensive picture of all injuries by sex, age, severity class, cause, and intent. The estimates are believed to be conservative, undoubtedly understating the overall magnitude of a serious public health problem facing the nation today.