

**ANALYSIS REPORT ON
FIRE FIGHTER FATALITIES**

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Any opinions, findings, conclusions or recommendations expressed in this publication do not necessarily reflect the views of the Federal Emergency Management Agency.

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Background

For over a decade and a half, the National Fire Protection Association (NFPA) has developed the most complete records on U.S. fire fighter fatalities both in breadth of coverage and depth of detail of any organization. This data base has been used to support the fire fighter fatality studies produced by NFPA each year since 1974.

For more than 10 years, NFPA also has worked with FEMA's U.S. Fire Administration (USFA) to provide, in a timely manner, lists of fire fighter fatalities and their next of kin to support the National Fire Academy's annual Fire Fighter Memorial Service, analyses of each year's fire fighter fatalities, and briefings on the latest experience. Under the present contract, NFPA has provided the USFA with lists, both hand lettered and typed, of 1993 fire fighter fatalities and with lists of names and addresses of next of kin and of fire department chiefs for use in the Memorial Service in October 1994.

In August, a briefing on the 1993 experience and three special analyses was presented by NFPA staff to USFA staff and guests in Emmitsburg, MD. Through the briefing and analysis, this contract continued the trend toward more extensive analysis of patterns and trends in specific parts of the fire fighter fatality problem. With 17 years of experience now classified in its computer data base, NFPA is able to provide increasingly detailed and focused examinations of the specific parts of the problem addressable by particular strategies.

The deliverables under this contract are (a) this analysis report, (b) the incident and casualty data on diskette in NFIRS Version 4.1 format, which is being delivered separately, (c) the various lists described above, and (d) the briefing provided in August.

I. Introduction

The purpose of this study is to analyze the circumstances surrounding fire fighter fatalities in the United States in 1993 in an attempt to identify potential means for reducing the number of deaths that occur each year. In addition to the 1993 findings, this study will also include special analyses of particular recurring scenarios, using NFPA's data base of fire fighter fatalities from 1984 through 1993.

A. Who Is a Fire Fighter?

For the purpose of this study, the term *fire fighter* covers all members of organized fire departments, whether career, volunteer or combination; full-time public service officers acting as fire fighters; state and federal government fire service personnel; temporary fire suppression personnel operating under official auspices of one of the above; and privately employed fire fighters including trained members of industrial or institutional fire brigades, whether full- or part-time.

Under this definition, the study includes not just local or municipal* fire fighters but also seasonal and full-time employees of the U.S. Forest Service and state wildland agencies; prison inmates serving on fire fighting crews; fire fighters for the Bureau of Land Management, the Bureau of Indian Affairs, the Bureau of Fish and Wildlife, the National Park Service, and the U.S. Department of Energy; military personnel performing assigned fire suppression activities; civilian fire fighters working at military installations; and members of industrial

* For this report, the term *local fire fighters* refers to members of city, town, county and township fire departments, members of independent volunteer fire departments providing primary protection to a municipality and contract fire departments providing primary fire protection. It excludes federal and state employees and contractors and members of prison and industrial fire brigades.

fire brigades.

B. What Constitutes an On-Duty Fatality?

The term *on-duty* refers to being at the scene of an alarm, whether a fire or non-fire incident; being en route while responding to or returning from an alarm; performing other assigned duties such as training, maintenance, public education, inspection, investigations, court testimony and fund raising; and being on call, under orders or on stand-by duty other than at home or at the individual's place of business.

On-duty fatalities include any injury sustained in the line of duty that *proves* fatal, any illness that was incurred as a result of actions while on duty that proves fatal, and fatal mishaps involving occupational hazards that occur while on duty. The types of injuries included in the first category are mainly those that occur on the fire ground, in training, or in accidents while responding to or returning from alarms.

The most common examples of fatal illness incurred on duty are fatal heart attacks. Another example is a fire fighter who contracted hepatitis when a victim being transported by ambulance pulled out his intravenous needle and stuck the fire fighter.

A few examples of fatal occupational mishaps that have occurred in the past include fire fighters who died of asphyxiation while working on fire apparatus in closed garages, a fire fighter who fell through a slide pole hole while working around the station, a fire fighter electrocuted while raising a banner for a town event, a volunteer fire fighter who was fatally injured when he fell down a flight of stairs in his home while responding to an alarm, a fire inspector who fell through a skylight, and a fire fighter killed when the aerial ladder he was strapped to

collapsed as he was hanging a banner.

Also included in the file are fire fighters who were murdered while on duty. These include fire fighters shot by snipers while on the fire ground, fire fighters shot in the station by off-duty or former fire fighters, one who was kidnapped and shot after responding to a verbal request for assistance, and one who was killed when a pipe bomb planted in his car exploded as he left the station.

Fatal injuries and illnesses are included even in cases where death is considerably delayed. When the onset of the condition and death occur in different years, the incident is counted on the basis of the former. For example, a Wisconsin fire fighter died in 1994 after being left a quadriplegic as a result of a motor vehicle accident while responding to a car/train accident in 1979. Because his death due to pneumonia was the direct result of his injury, and the injury occurred in 1979, he is counted as a 1979 fatality.

The NFPA recognizes that these definitions should include chronic illnesses (such as cancer) that prove fatal and that arise from occupational factors. In practice, there is as yet no mechanism for identifying fatalities that are due to illnesses that develop over long periods of time. This creates an ambiguous picture on the issue of occupational versus other factors as causes of fire fighter deaths. This is recognized as a gap that cannot now be filled because of the limitations in tracking the exposure of fire fighters to toxic environments and substances and the potential long-term effects of such exposure.

C. Sources of Initial Notification

As an integral part of its ongoing program to collect and analyze fire data, NFPA solicits information on fire fighter fatalities from the U.S. fire service and a wide range of other sources. These include the U.S. Fire Administration and the

Public Safety Officers' Benefits Program (PSOB). Both are organizations with whom NFPA has maintained long-standing cooperative efforts in collecting and analyzing fire fighter fatality data. Other contacts include federal agencies such as the U.S. Forest Service of the Department of Agriculture, the Bureau of Indian Affairs and the Bureau of Land Management of the Department of Interior, the U.S. military, the Department of Energy, and the Occupational Safety and Health Administration (OSHA). In recent years, significant assistance has been received from the National Wildfire Coordinating Group, an organization made up of representatives of state and federal wildland agencies.

The NFPA also receives notification from fire service organizations such as the International Association of Fire Fighters, state fire associations, state training organizations, state and local fire marshals, and fire service publications. A network developed over the years of individuals interested in the area of fire fighter fatalities also assists in identifying incidents, especially those that occur outside of large urban areas or that involve non-fire-incident-related fatalities. Among these individuals are fire fighters, photographers, fire buffs, and members of the insurance industry.

Notification of fatal incidents also comes from NFPA members and staff and through the use of a newspaper clipping service that reads all daily and weekly newspapers in the country.

D. Procedure for Including a Fatality in the Study

After initial notification of a fatal incident is received, contact with the local fire department is made by telephone to verify the incident, its location and the fire department involved. Data collection forms for the fatality and the fire, if it was a fire incident, are sent to the responsible local official identified during the

telephone follow-up. After the forms are returned to NFPA, a final decision is made to include or exclude the fatality, based on the inclusion criteria described previously. In order to make a final determination, additional information is sometimes sought, either by contacting the fire department directly to clarify some of the details or by obtaining data elsewhere, such as medical documentation frequently available from PSOB.

Some of the material that might be received to document an incident includes casualty forms, both NFPA fire fighter fatality study reporting forms and NFIRS-type forms; NFPA's Fire Incident Data Organization (FIDO) major-fire report form or the department's own incident reporting form, if a fire incident was involved in the fatality; medical data such as death certificates or autopsy reports; special investigation reports from other agencies; police and motor vehicle accident reports, if applicable; photographs and diagrams; and additional newspaper accounts. Incidents to be included in the study are then recorded in NFPA's FIDO system, which includes both incident and casualty information. By mutual agreement of the USFA and NFPA project staff, the same inclusion criteria were used for the USFA study as are used in the NFPA study.

Work described to this point was done as part of NFPA's ongoing program of data collection and analysis in the area of fire fighter fatalities and was completed at no cost to FEMA.

E Additional Data Collection Completed for the Contract

To meet FEMA's request for a list of the next-of-kin of the 1993 fatalities and the names and addresses of the fire chiefs, a follow-up mailing was sent to all departments asking them to verify the victims' names and dates of fatal injury, the names and addresses of the departments and chiefs, and the names and

relationships of the next of kin. Telephone calls were made to non-responding fire departments to obtain the information.

II. 1993 Findings

Seventy-seven fire fighters died while on duty in 1993, the second lowest total in the 17 years that NFPA has done this study and as shown in Figure 1, this is the second consecutive year that the death toll has been so far below 100.* Although the total of 77 deaths in 1993 is a 2.7 percent increase over 1992, it is still 28.0 percent lower than the total of 107 deaths reported in both 1990 and 1991. The number of deaths annually is now only slightly more than half what it was in 1988, the most recent peak year. This study will report some of the most frequently occurring scenarios and will present some conclusions and recommendations to address the problem.

A. Type of Duty

The distribution of deaths by type of duty being performed is shown in Figure 2. The largest proportion of deaths occurred during fire ground operations (44.2 percent).

Of the 34 fire ground deaths, 18 were due to heart attacks, five each to burns and internal trauma, four to asphyxiation, and one each to crushing injuries and electrocution. Twelve of the victims were career fire fighters and 22 were volunteers.

The second largest category involved responding to and returning from alarms, which accounted for slightly more than a quarter of the deaths -- a result consistent with the findings in previous years. Eleven of these 20 deaths were due to collisions, one to being struck while standing on the back step of a pumper by a

* The totals for some earlier years have been adjusted to reflect new information received since the earlier studies.

Figure 1
On-Duty Fire Fighter Deaths
1977 - 1993

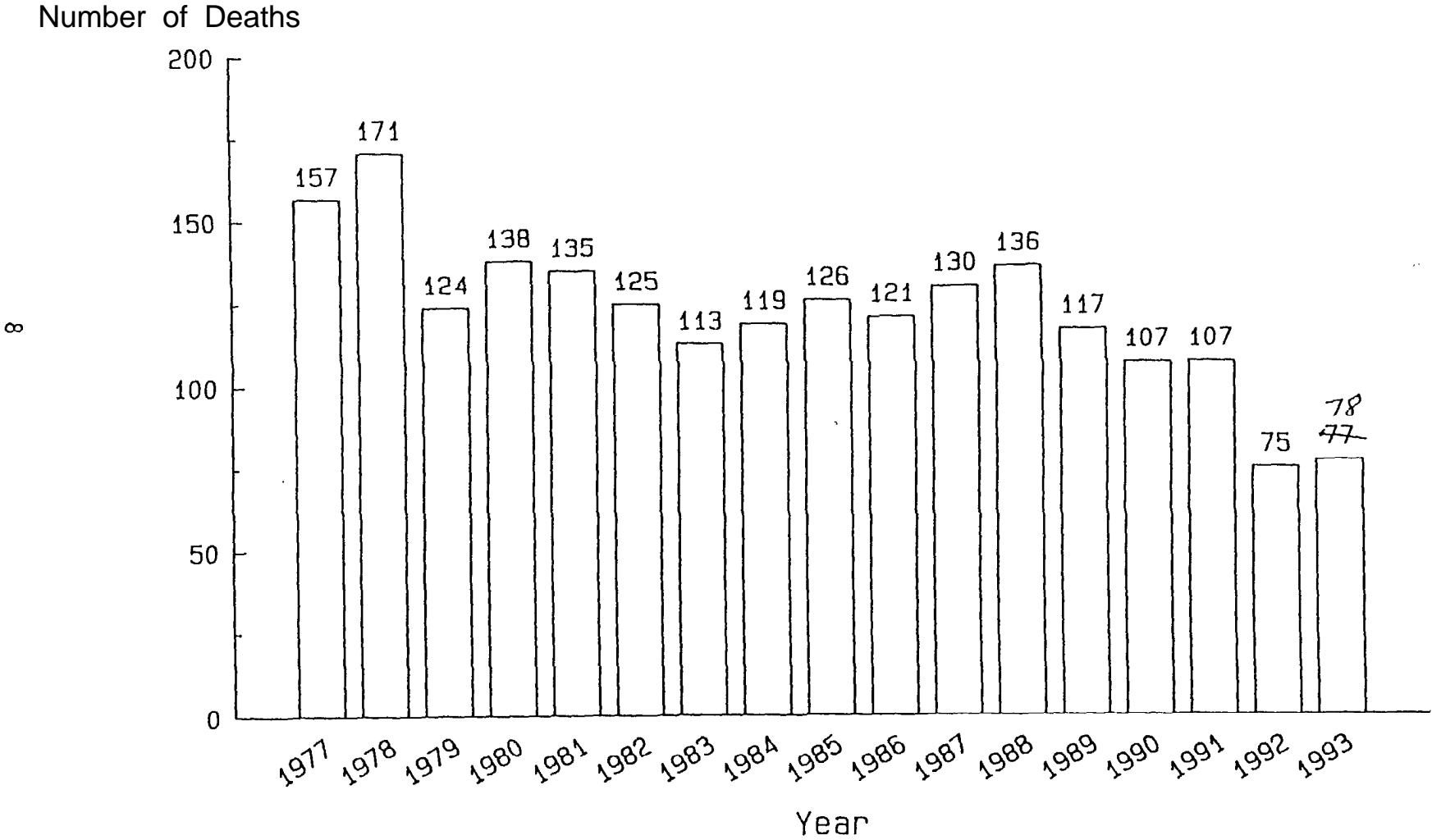
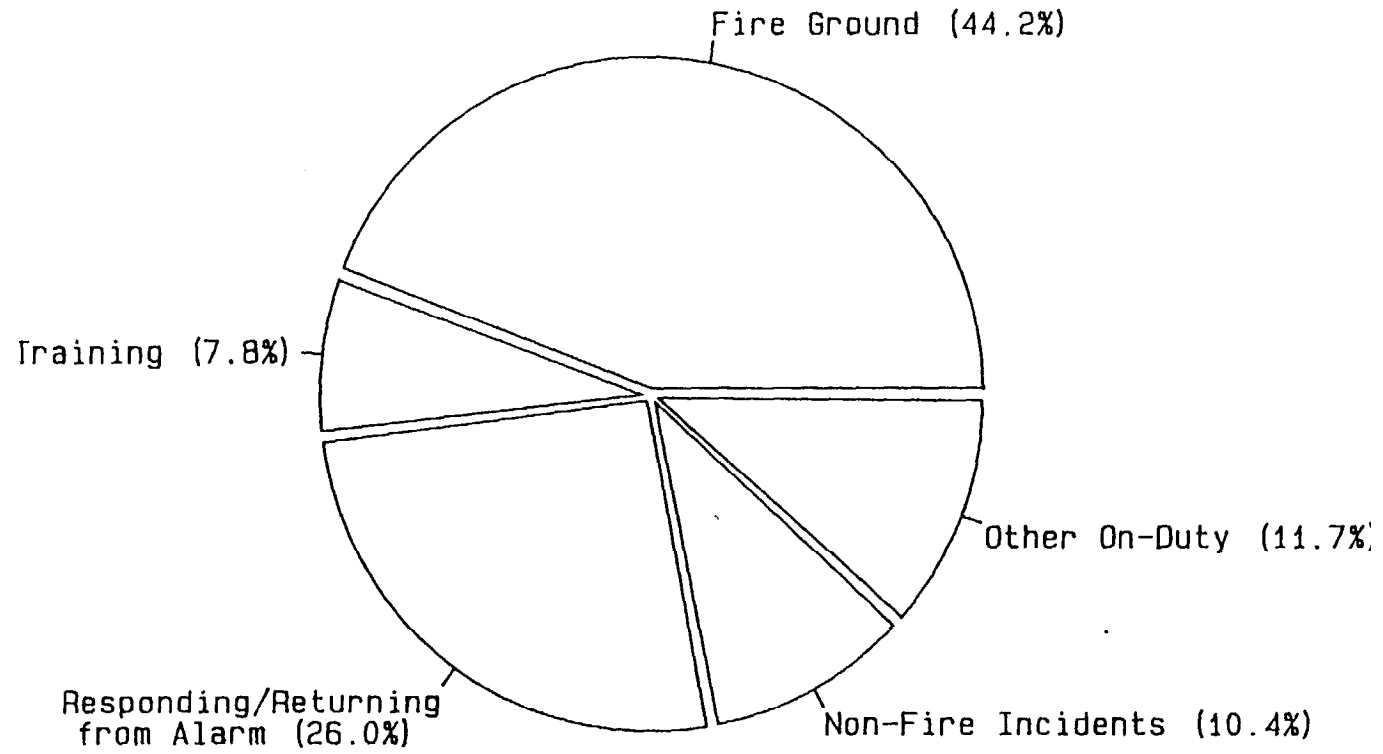


Figure 2
Fire Fighter Fatalities 1993
by Type of Duty



vehicle responding to the same incident, and the remaining eight were due to heart attacks. One was a career fire fighter and 19 were volunteers. One of the 20 fire fighters was killed while responding to a false call when his private vehicle collided with a truck and a tree.

Eight deaths occurred at non-fire incidents. These included four heart attacks -- one while directing traffic at a motor vehicle accident, one at an EMS call, another while awaiting orders during a smoke investigation at a single family home, and the fourth while operating at a natural gas leak in a warehouse. A fifth fire fighter was shot while helping police enter a building during a domestic dispute. Another fire fighter fell from a helicopter during equipment recovery following a helicopter rescue. One fire fighter was fatally burned at the scene of a motor vehicle accident when gasoline vapors from an apparatus-mounted generator ignited. And, finally, a fire fighter riding in the back of an ambulance with a patient was killed when the ambulance collided with another vehicle and then a tree.

There were six deaths related to training activities. Of these, four were due to heart attacks. One fire fighter was involved in a motor vehicle accident while en route to a training academy. The sixth victim died of head injuries he received while making a practice jump onto an inflatable bag. The number of training-related deaths that occurred in 1993 is far lower than the average 12 training deaths a year that have occurred over the past five years. Training-related deaths over the past 10 years are discussed in more detail in a separate section of this report.

The remaining nine deaths occurred during non-emergency-related, on-duty activities. These included five heart attacks -- three during normal station duties, one while testifying at a federal arson trial, and one while returning home from an apparatus inspection at a fire station. The sixth fire fighter died of

injuries he sustained when a self-contained breathing apparatus (SCBA) air cylinder that was being refilled exploded. One fire fighter was killed in a motor vehicle accident during a routine wildland fire patrol, and another was crushed by a front-end loader while clearing snow at a fire station. And the last fire fighter was struck by a passing vehicle as he directed traffic in front of a fire station while a fire apparatus was returning to the station after cleaning.

B. Cause and Nature of Fatal Injury or Illness

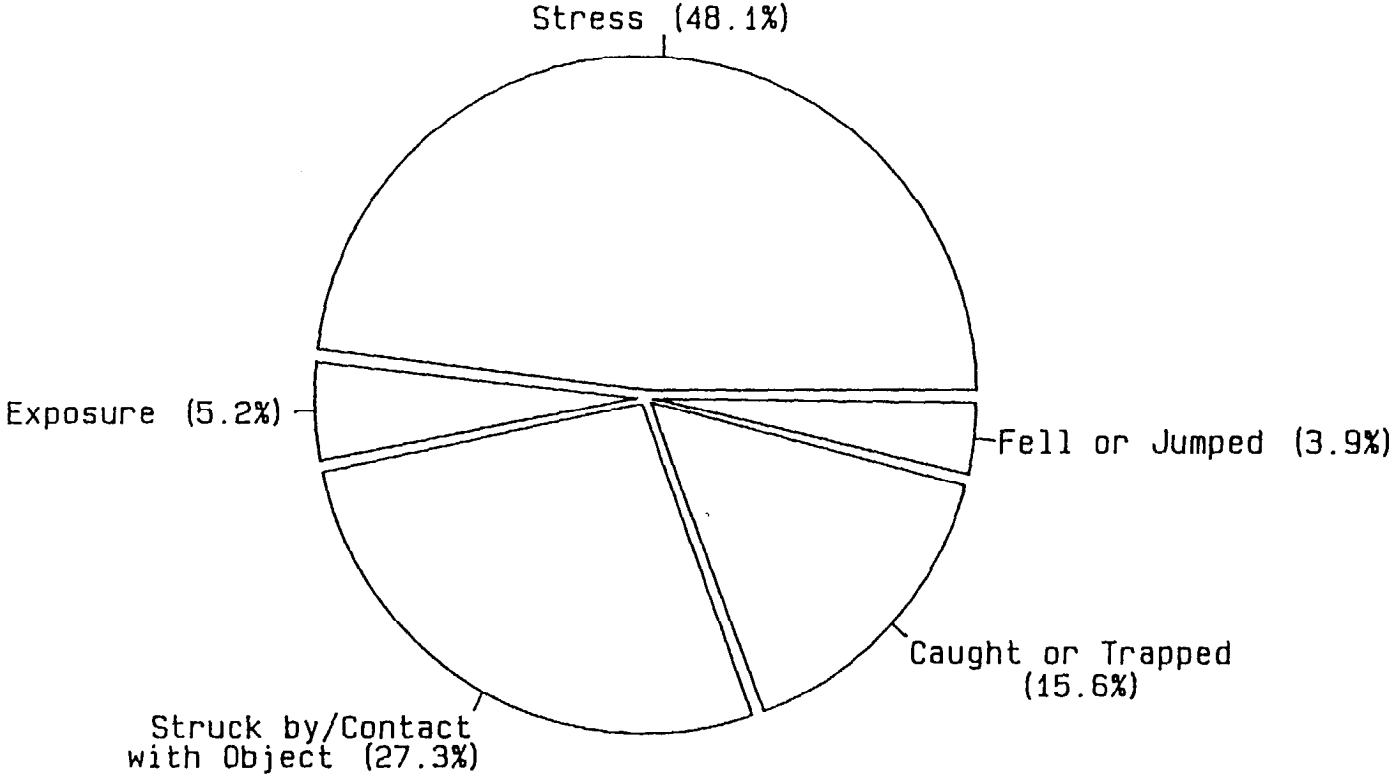
As used in this study, the term cause refers to the action, lack of action, or circumstances that directly resulted in the fatal injury, while the term *nature* refers to the medical nature of the fatal injury or illness, or what is often referred to as the cause of death. Often, the fatal injury is the result of a chain of events, the first of which is recorded as the cause. For example, if a fire fighter is struck by a collapsing wall, becomes trapped by the debris, runs out of air before being rescued, and dies of asphyxiation, the cause of fatal injury recorded is “struck by collapsing wall” and the nature of fatal injury is “asphyxiation.”

Figure 3 shows the distribution of deaths by cause of fatal injury or illness. As found in most previous years, the largest proportion of deaths (in this case, almost half) were due to stress or overexertion. Five of these 37 deaths were specifically attributed to strenuous physical activities. Stress deaths usually result in heart attacks or strokes.

The next major category was struck by or contact with objects. These 21 deaths included 18 from motor vehicle accidents, one by a collapsing wall, one by a collapsing chimney and one fire fighter who was shot by the occupant of a house as he was helping police enter the dwelling.

Fire fighter deaths that resulted from motor vehicle accidents over the past

Figure 3
Fire Fighter Deaths 1993
by Cause of Fatal Injury



10 years are discussed in more detail in a separate section of this report.

Twelve fire fighters were caught or trapped -- four by rapid fire progress; three in explosions; two in a floor collapse; two by being lost inside buildings; and one trapped in an elevator who died of smoke inhalation.

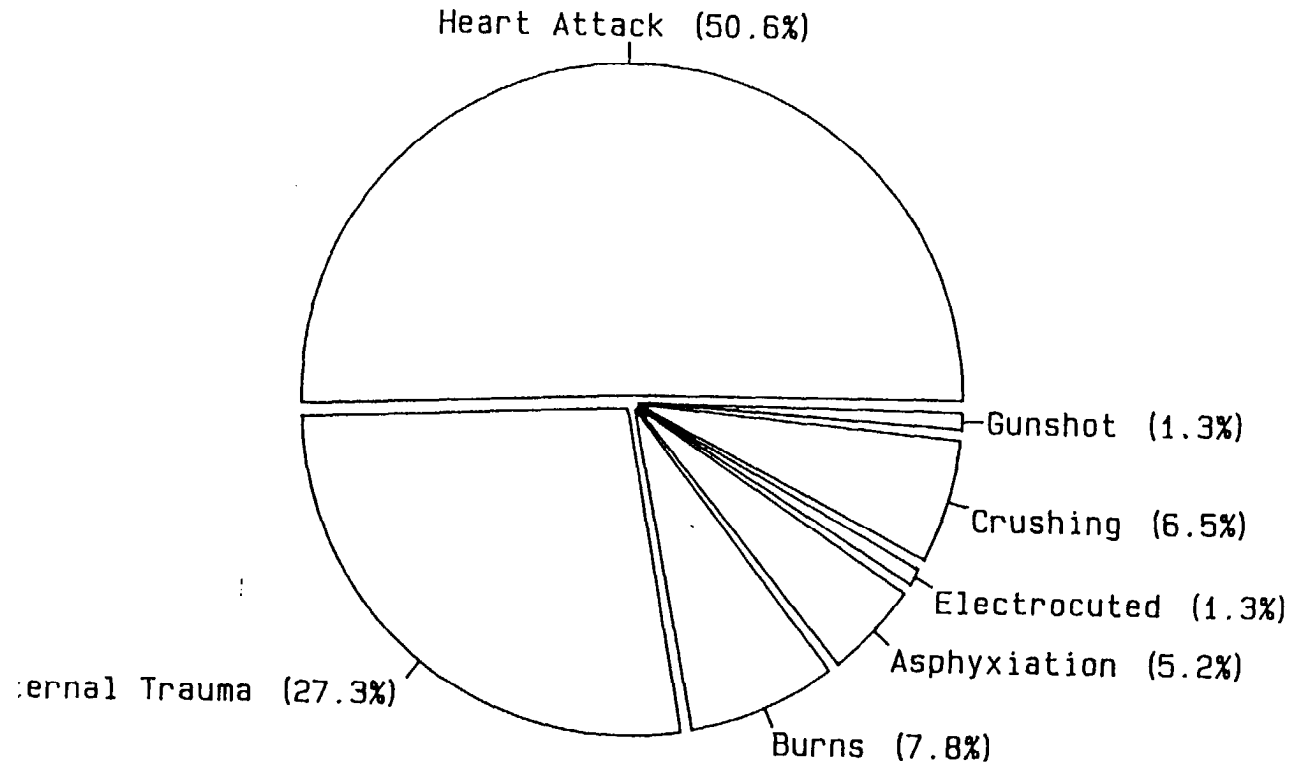
Four fire fighters died as a result of exposure. One was electrocuted when a ground ladder struck a power line. One was burned when gasoline vapors ignited while he was working on a stalled apparatus-mounted generator. And two were exposed to smoke and died of heart attacks -- one during overhaul and the other when he attempted to rescue the occupant of a single-family dwelling without using SCBA.

Three fire fighters were killed when they fell or jumped -- one from a helicopter, one down stairs while investigating a problem with an oil burner and one as a result of head injuries suffered when he jumped onto an inflatable bag during training.

Figure 4 shows the distribution of deaths by the medical nature of the fatal injury or illness. The largest proportion of deaths were due to heart attacks. Of these 39 deaths, medical documentation indicated that 16 of the victims had prior heart problems, either previous heart attacks or bypass surgery; and five others had severe arteriosclerotic heart disease (defined for this study as arterial occlusion of at least 50 percent but usually found to be in excess of 70 percent). One victim was diabetic and one was reported to have been fatigued. Medical documentation was not available for the other 16 heart attack victims.

The other categories of nature of fatal injury were internal trauma (21 deaths), burns (six deaths), crushing (five deaths), asphyxiation (four deaths), electrocution (one death), and gunshot wounds (one death). The four asphyxiation deaths included two trapped in a floor collapse, one rescuing an occupant of a single-family dwelling without SCBA and one trapped in an elevator.

Figure 4
Figure Fighter Deaths 1993
by Nature of Injury



C. Ages of Fire Fighters

The ages of fire fighters who died in 1993 ranged from 20 to 83 years with a median age of 47 years.

The distribution of fire fighter deaths by age and cause of death is displayed in Figure 5. Over two thirds of the fire fighters over age 40 who died were killed by heart attacks. The youngest fire fighter who died of a heart attack was 23 years old. He had undergone surgery two years earlier to repair a defective heart valve.

Figure 6 shows the death rates by age categories using estimates of the number of fire fighters in each age group from NFPA's 1991 profile of fire departments and the fatality data from 1989 through 1993¹. As the graph shows, the death rate is lowest for fire fighters under age 40, slightly below the average rate for those aged 40 to 49, and much higher than average for fire fighters aged 50 and over. This is a reflection of the fact that although only 14 percent of all fire fighters are over age 50, that age group accounted for 38 percent of the deaths from 1989 through 1993, including almost 60 percent of all heart attack deaths. When the rates are calculated for non-heart-attack deaths, fire fighters aged 60 and over have a rate more than twice the average.

Because heart attack consistently appears as the leading cause of fire fighter deaths, the experience of the past 10 years is discussed in more detail in a separate section of this report.

D. Fire Ground Deaths

The distribution of the 34 fire ground deaths by fixed property use is shown in Figure 7. The largest share of fire ground deaths (38.2 percent) occurred at residential structure fires. These 13 deaths included seven in apartment buildings

Figure 5 Fire Fighter Deaths 1993 by Age and Cause of Death

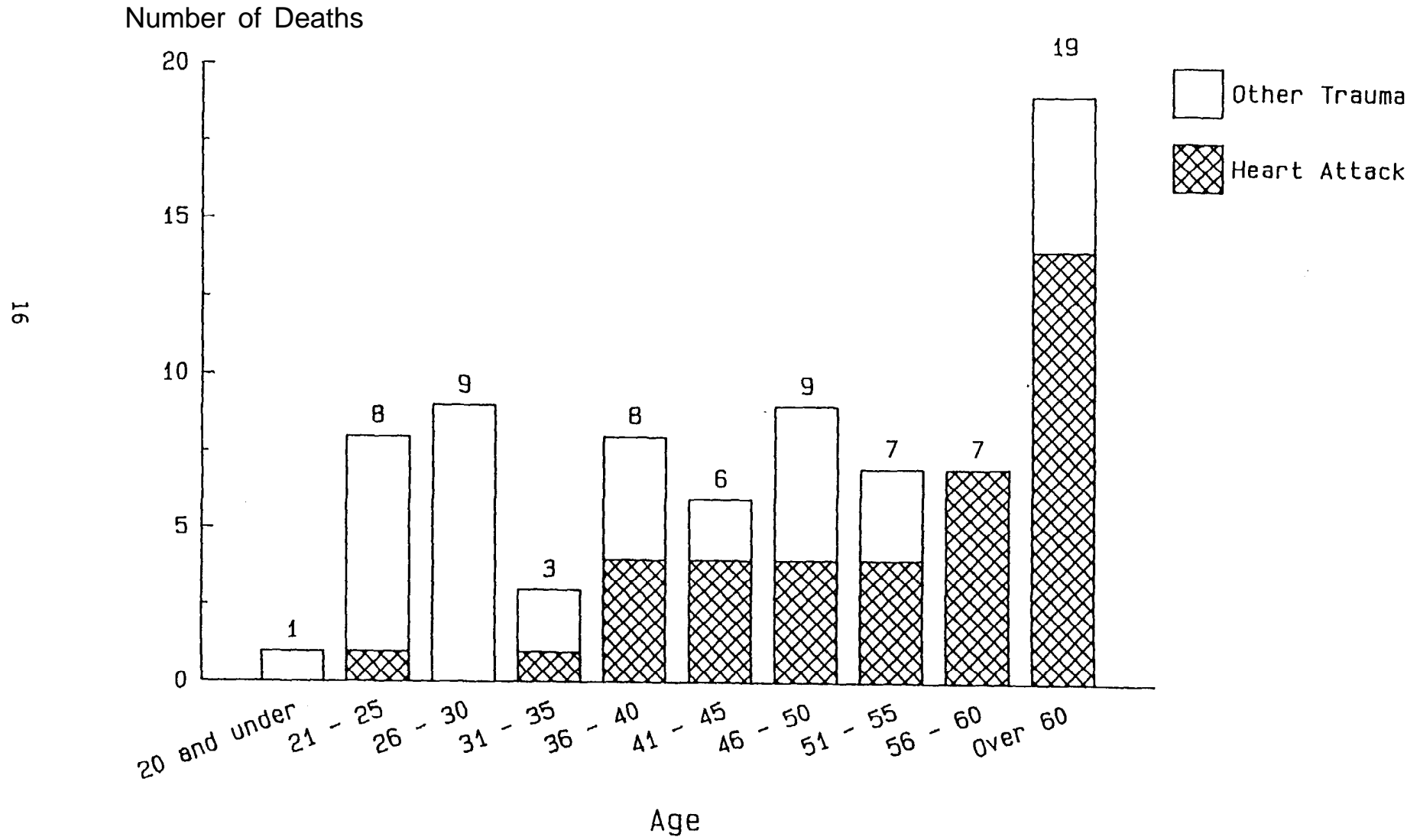


Figure 6
Average Death Rates per 10,000 Fire Fighters
1989 - 1993

Deaths per 10,000 Fire Fighters

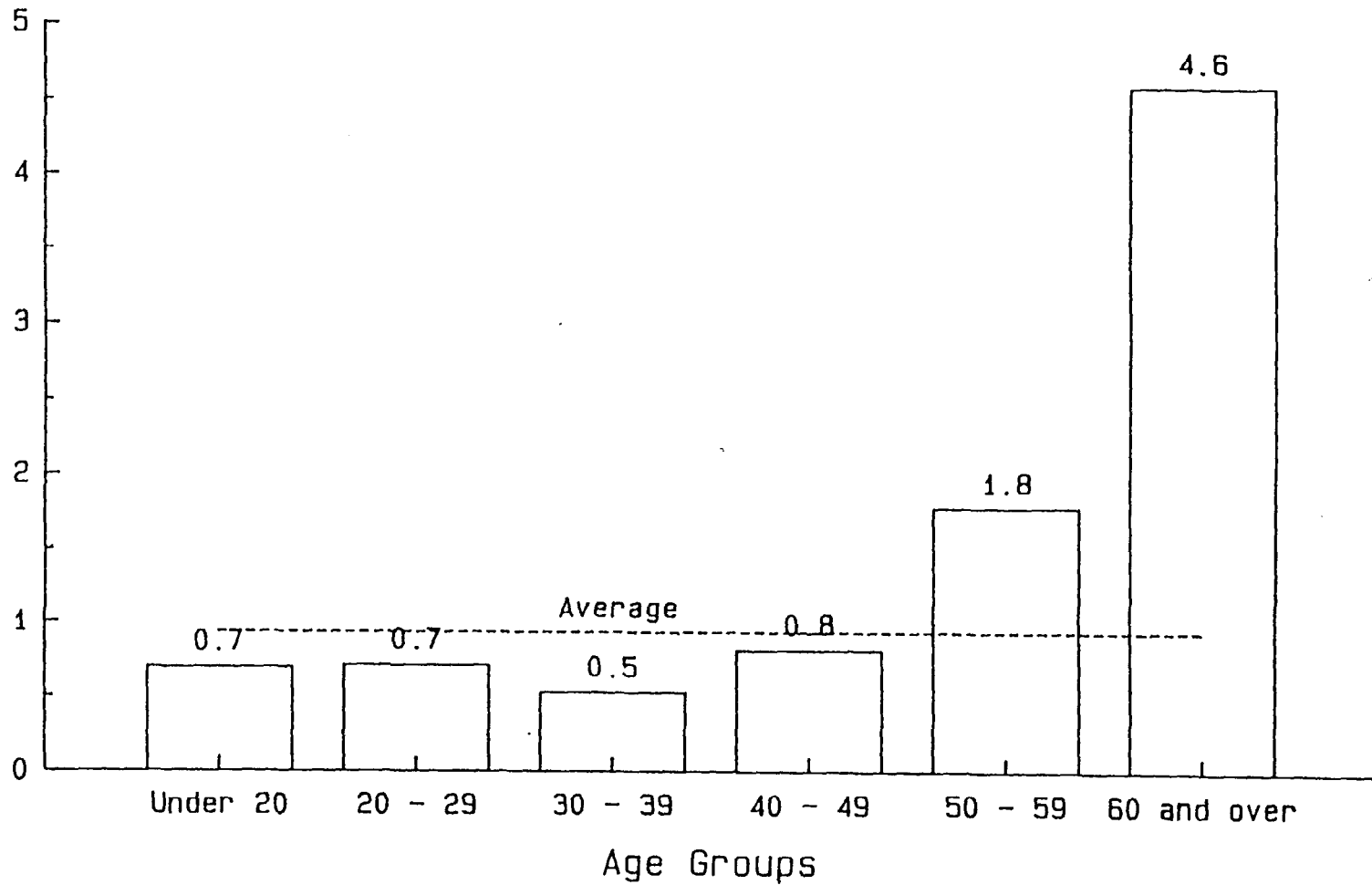
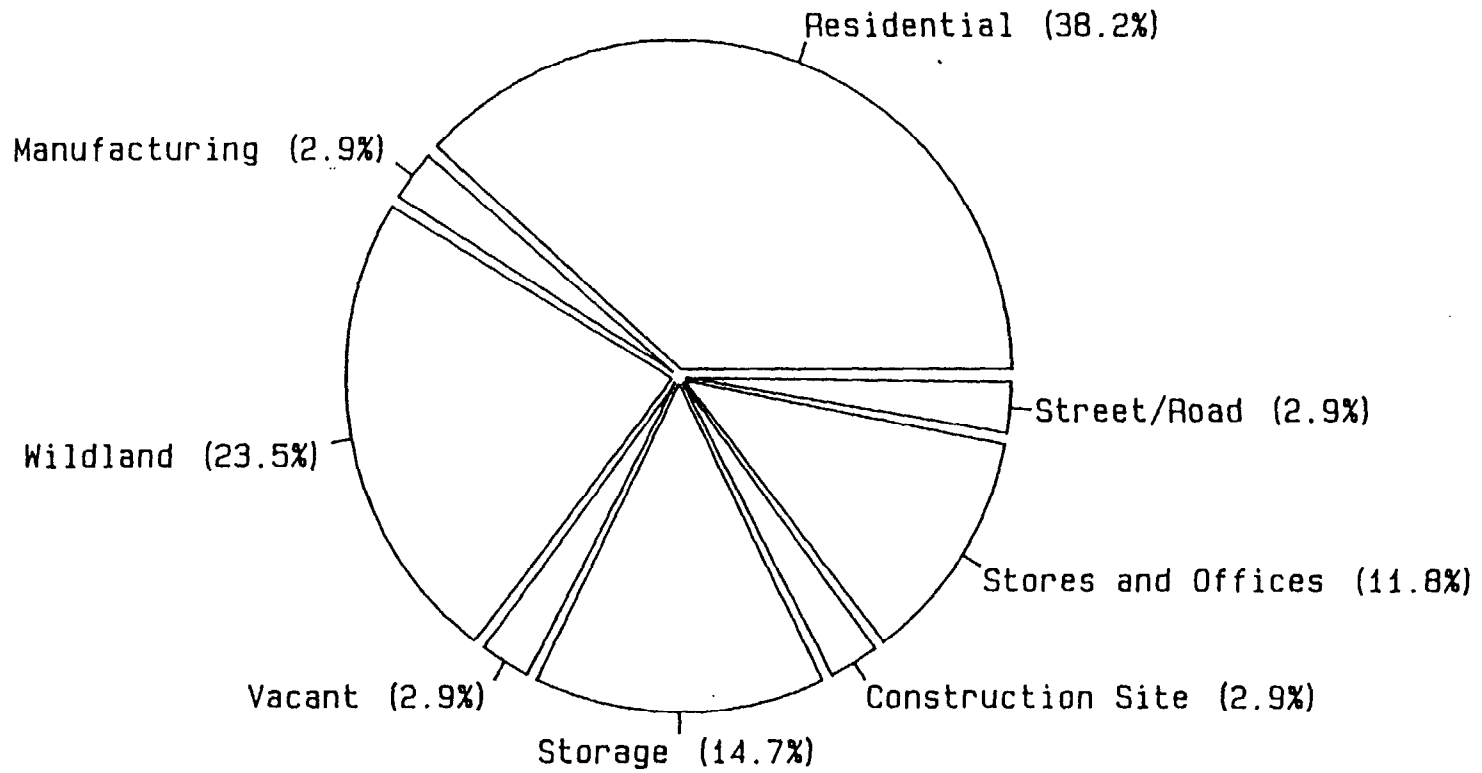


Figure 7
Fire Ground Deaths in 1993
by Fixed Property Use



and six in one- and two-family dwellings. This is slightly below the 15 deaths in residential structure fires in 1992, and the annual average of 16 deaths per year over the last 10 years.

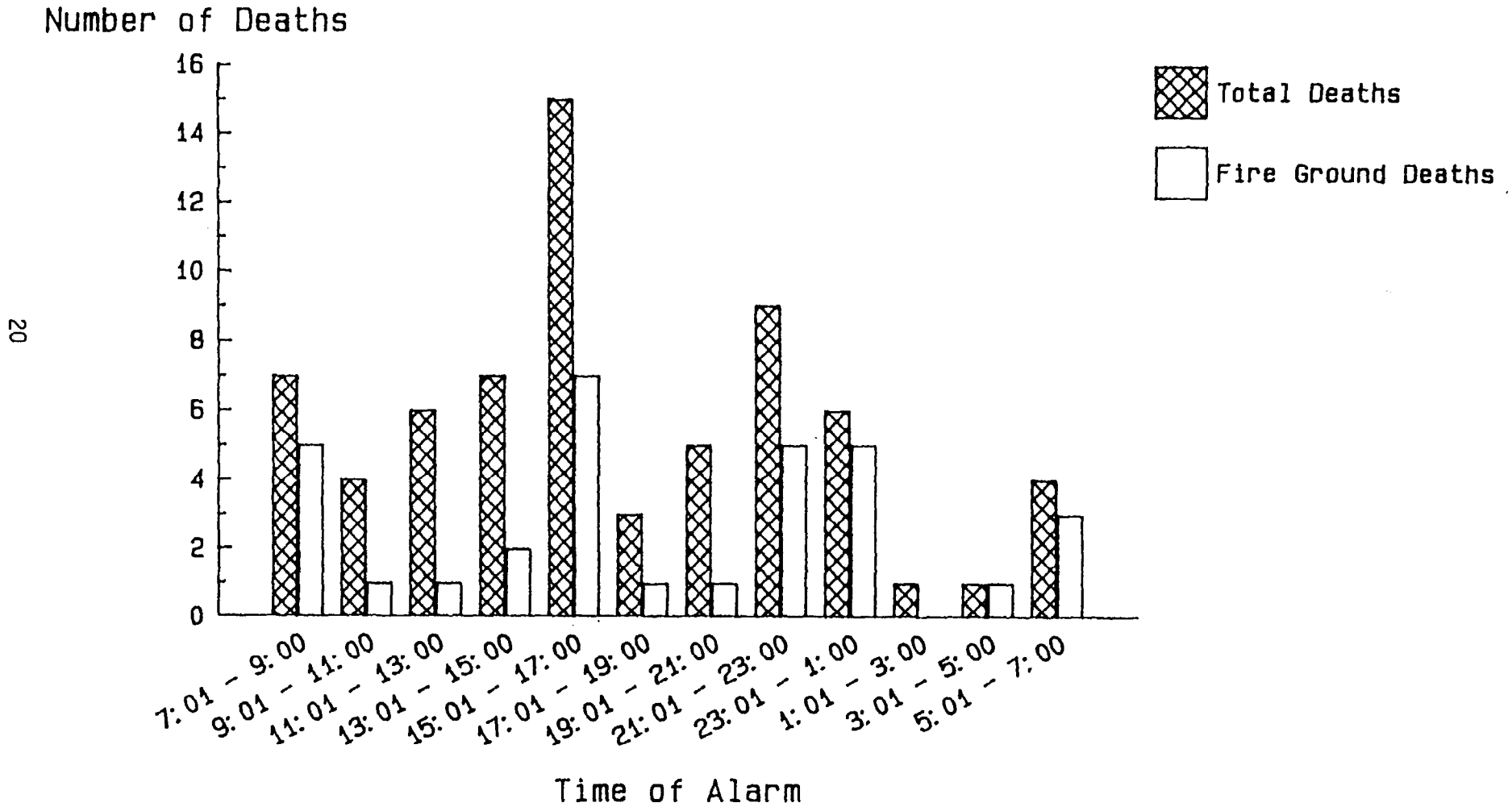
There were eight deaths in wildland fires in 1993 -- four of the victims suffered fatal heart attacks at grass fires, three were overrun by fires and one was struck by a passing vehicle while directing traffic at a brush fire. There were five deaths in storage properties and four in stores and office buildings. There was one death each at a construction site, in a vacant building, in a manufacturing plant and at a vehicle fire.

To put the hazards of fire fighting in various types of occupancies into perspective, the number of deaths per 100,000 structure fires was examined by fixed property use. The rates were calculated using the estimates of fire experience from NFPA's 1993 fire loss study². There were 2.8 fire fighter deaths per 100,000 residential structure fires, compared to 6.6 deaths per 100,000 nonresidential structure fires. Although three times as many fires occurred in residential structures, the size, complexity and special hazards often associated with nonresidential structures result in a much greater risk at such fires.

E. Time of Alarm

The distributions of 1993 fire ground deaths and total deaths by time of alarm are shown in Figure 8. The highest number of fire ground deaths occurred for alarms between 3 pm and 5 pm. The distributions of deaths by time of alarm over a 10-year period are shown in Figure 9. The number of deaths in both categories was at the highest level for alarms between 1 and 9 pm and dropped to the lowest level in the early morning hours.

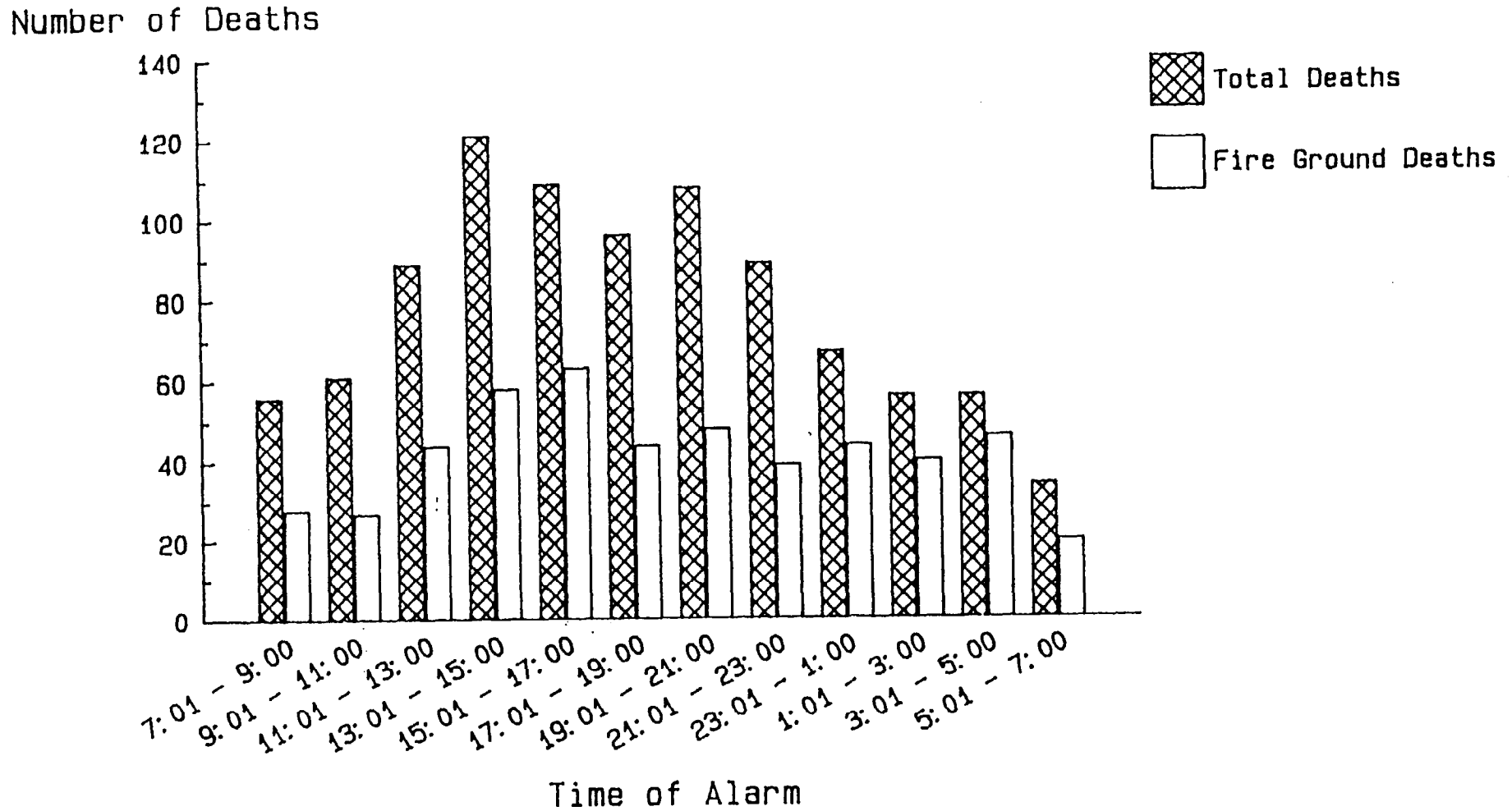
Figure 8 Fire Fighter Fatalities 1993 by Time of Alarm



Based on 32 fire ground fatalities and 68 total fatalities for which alarm time was reported.

Figure 9

Fire Fighter Fatalities 1984 - 1993 by Time of Alarm



Based on 501 fire ground fatalities and 942 total fatalities for which alarm time was reported.

F. Month of the Year

Figure 10 shows the distribution of 1993 fire fighter deaths by month. The same information for 1984 through 1993 is shown in Figure 11. The ten-year analysis shows that fire ground deaths are highest in the winter months and in July.

G. State and Region

The distribution of fire fighter deaths by state is shown in Table 1. Twenty-six states are represented on the list, led by New York with 13 deaths, California with nine and Pennsylvania with eight. The experience by region³ is displayed in Table 2 and Figure 12. The Northeast lost the largest number of fire fighters (34), followed by the South (21). The West lost 12 fire fighters and the Northcentral region, 10. The Northeast also had the highest average fire ground death rate, almost twice the national average.

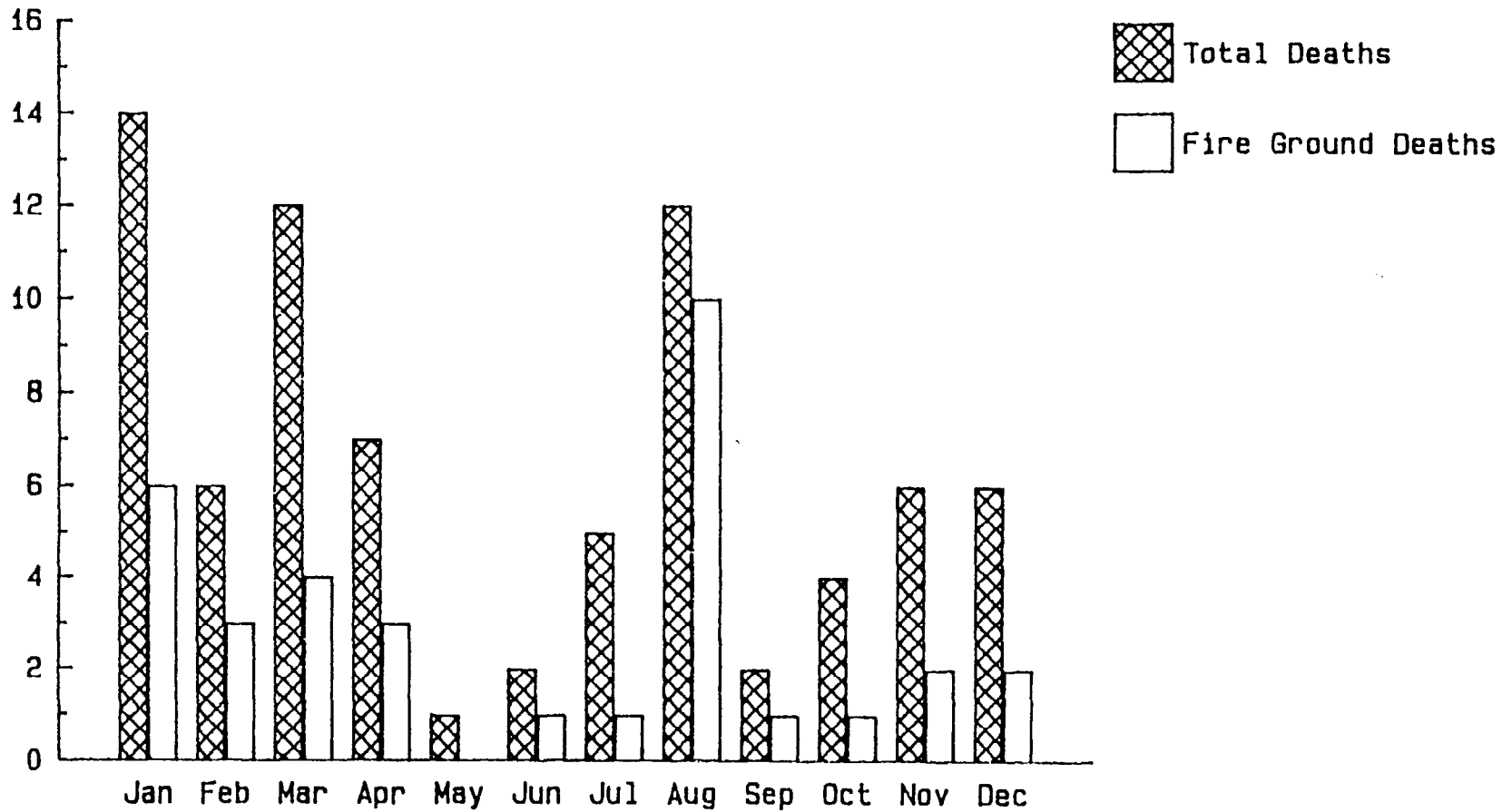
H. Analysis of Urban/Rural/Suburban Patterns in Fire Fighter Fatalities

The U.S. Bureau of the Census defines *urban* as a place having at least 2,500 population or lying within a designated urbanized area. *Rural* is defined as any community that is not urban. *Suburban* is not a Census term but may be taken to refer to any place, urban or rural, that lies within a metropolitan area defined by the Census but is not one of the designated central cities of that metropolitan area.

Fire department coverage areas do not always conform to the boundaries of Census places. For example, fire departments organized by counties or special fire protection districts may have both urban and rural sections, and there are

Figure 10
Fire Fighter Fatalities 1993
by Month of Year

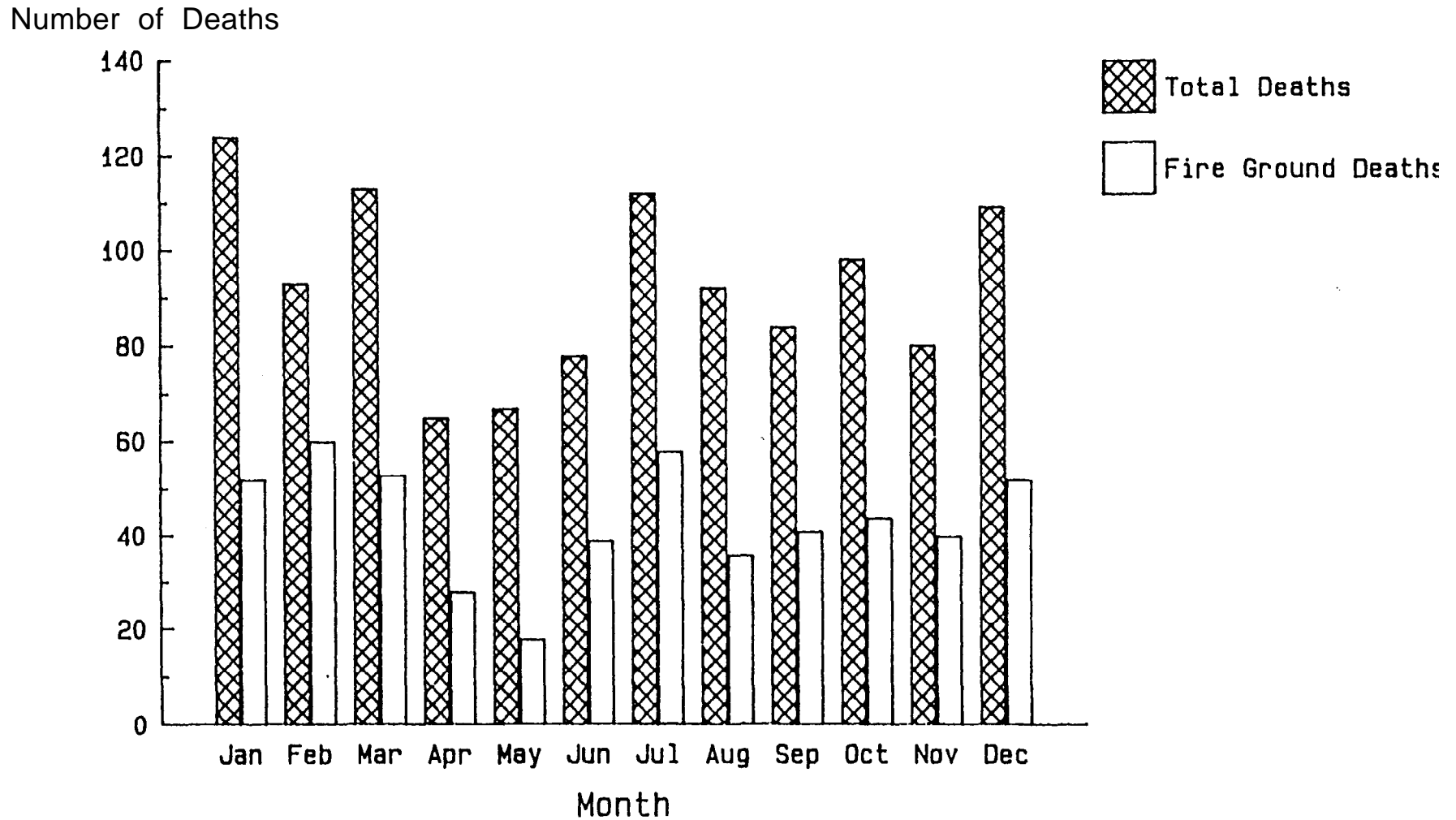
Number of Deaths



23

Based on 34 fire ground fatalities and
77 total fatalities.

Figure 11
Fire Fighter Fatalities 1984 - 1993
by Month of Year



Based on 521 fire ground fatalities and
1115 total fatalities.

Table 1
1993 On-Duty
Fire Fighter Fatalities

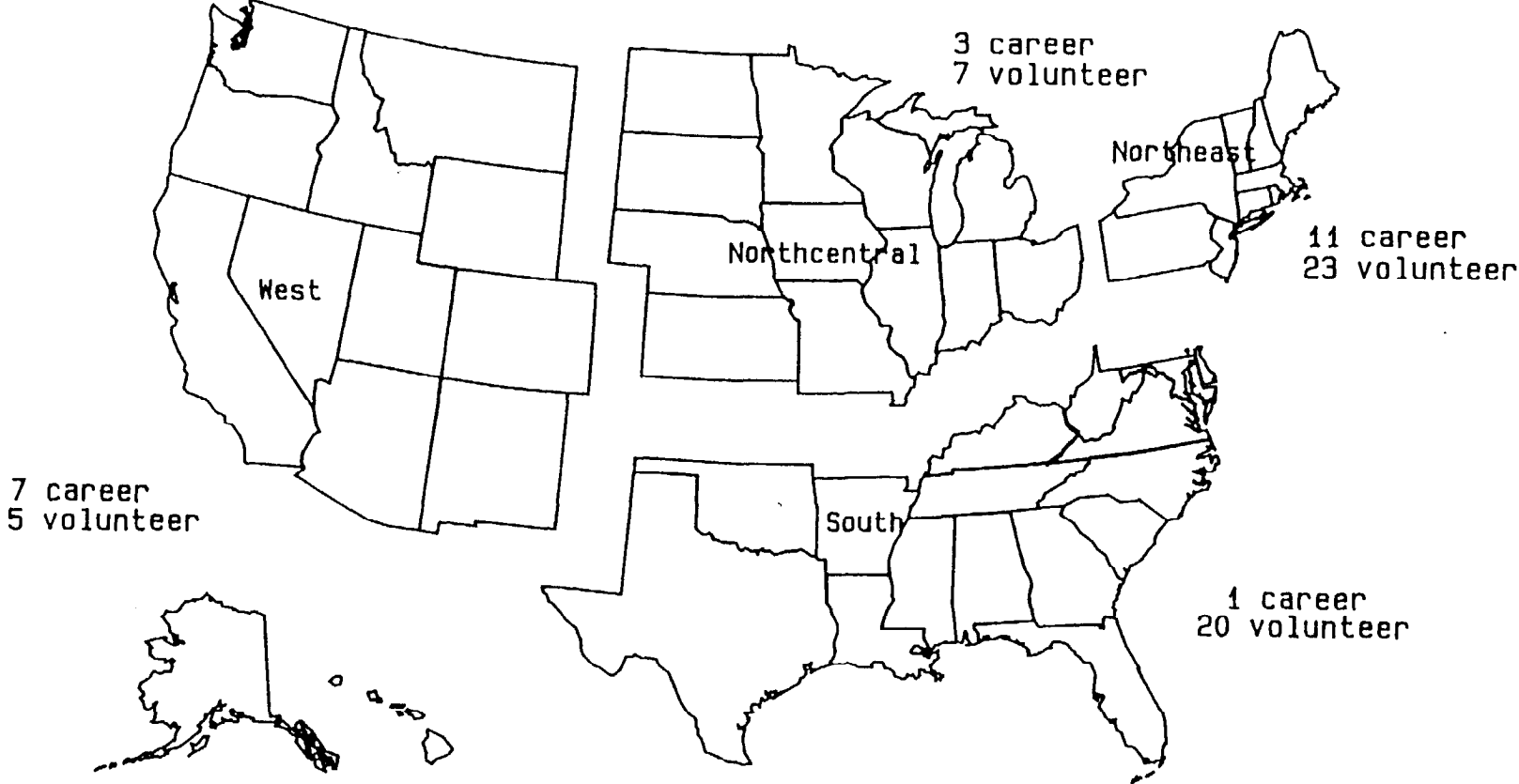
State	Number of Deaths	State	Number of Deaths
California	9	New Mexico	1
Colorado	1	New York	13
Connecticut	2	North Carolina	1
Florida	2	Ohio	3
Georgia	2	Oregon	1
Illinois	4	Pennsylvania	8
Kansas	1	Rhode Island	1
Kentucky	5	South Carolina	1
Maryland	2	Tennessee	1
Massachusetts	4	Texas	3
Nebraska	1	Virginia	3
New Hampshire	1	West Virginia	1
New Jersey	5	Wisconsin	1

TOTAL 77

Table 2
Fire Fighter Death Rates by Region
1993

Region	Number of Fatalities	Number of Fire Ground Deaths	Fire Ground Death Rate per 100,000 Fires
Northeast	34	14	3.26
Northcentral	10	4	1.01
South	21	11	1.38
West	12	5	1.52
Total	77	34	1.74

Figure 12
Fire Fighter Fatalities 1993
by Region



Federal, state, and private fire fighters. In such cases, it may not be possible to characterize the entire coverage area of a fire department as rural or urban, and one must assign a fire fighter death as urban or rural based on the particular community in which the fatal injury occurred.

Based on these rules, the following patterns were found and are shown with available patterns for the general population and for the population of fire fighters specifically in local fire departments:

	Urban*	Rural	Total
Total 1993 fire fighter fatalities	48 (62%)	29 (38%)	77 (100%)
Suburban location	23	9	32
Local fire department only**	48 (65%)	26 (35%)	74 (100%)
U.S. population (1990)	75%	25%	100%
U.S. fire fighters (1992), total***	62%	38%	100%
U.S. fire fighters (1992), career***	98%	2%	100%
U.S. fire fighters (1992), vol.	51%	49%	100%

* Note that the classification of fire fighters into urban and rural is based strictly on the population protected by the *fire* department and not on other community boundaries. However, if fire fighter fatalities were similarly classified, the distribution would shift by at most two percentage points, so the points here are not affected.

** Excludes one civilian employee of the military, one federal forestry employee and one state forestry employee killed in rural locations.

*** *U.S. Fire Department Profile Through 1992*, Quincy, Massachusetts: National Fire Protection Association, Fire Analysis and Research Division, October 1993. All percentages are for fire fighters in local fire departments.

As shown above, the distribution of local fire fighter fatalities is closer to the distribution of local fire fighters than to the distribution of the whole U.S. population suggesting a similar risk of dying for urban and rural fire fighters. This same result was reported for 1988 and 1990 fatalities.

In 1987, we reported that the distribution of fire fighter fatalities from local fire departments was closer to the distribution of the whole U.S. population than to the distribution of fire fighters from local fire departments, suggesting that urban

fire fighters faced a greater risk of dying than rural fire fighters. In 1989, 1991 and 1992, we reported that the distribution of local fire fighter fatalities fell between the distribution of the U.S. population and the distribution of local fire fighters.

Since the results fluctuate back and forth each year, it is not advisable to read too much into them. We can conclude though that urban fire fighters face at least as great a risk as rural fire fighters. But, more importantly, our analyses of fire fighter deaths over the years have indicated that fire fighter safety can be more reliably attributed to proper training, equipment and incident management than to geographical location.

III. Fatalities Resulting from Heart Attacks, 1984 - 1993

NFPA's first special study on fire fighter fatalities as a result of heart attacks, strokes and aneurysms was done in 1987 and covered the period from 1977 through 1986. A second was done, covering just heart attacks, for the period 1981 through 1990. Since heart attack continues to be the leading cause of U.S. fire fighter deaths, that analysis is updated again to cover the period from 1984 through 1993.

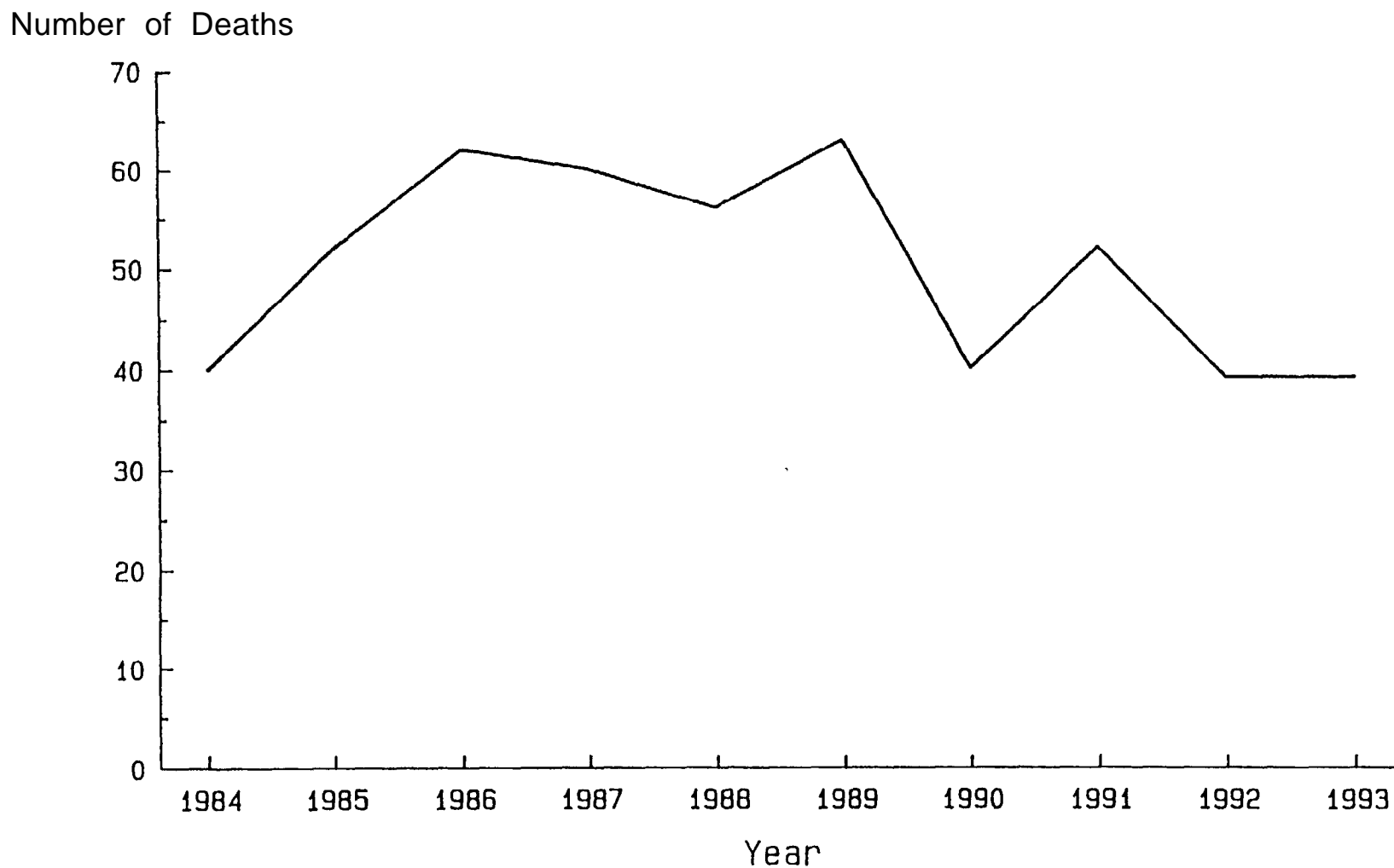
Like the second study, this analysis will concentrate on cardiac arrest, or heart attack, only, and does not include strokes (CVA) or aneurysms, though they also involve the cardiovascular system. Of the 1,115 on-duty fire fighter fatalities over the 10-year period, 503 (45.1 percent) fell into this category. (Over the same period, there were also 22 strokes and four aneurysms.) The aspects of the problem examined in this study include the physical condition of the victims prior to their deaths, the types of duty and activities they were engaged in and their ranks and ages.

Over the 10-year period, the annual number of deaths has ranged from a high of 63 in 1989 to its lowest level of 39 in 1992 and 1993. As shown in Figure 13, the numbers have fluctuated from year to year but seem to be trending downward since 1986. Looked at another way, the *proportion* of total deaths each year that these deaths account for has varied from a high of 53.8 percent in 1989 to a low of 33.6 percent in 1984.

Physical Condition

Information on physical condition prior to fatal injury was available for 264 of the 503 heart attack victims. This information was obtained from medical

Figure 13
Fire Fighter Deaths Due to Heart Attacks
1984 - 1993



documentation that accompanied fatality reports.* As shown in Figure 14, of these 264 fire fighters, 138 (52.3 percent) had had prior heart-related conditions, such as previous heart attacks or coronary bypass surgery. Another 80 of the victims (30.3 percent) had severe arteriosclerotic heart disease (defined for this study as medically documented arterial occlusion of at least 50 percent but usually found to be in excess of 70 percent). Taken together, then, over 80 percent of the heart attack victims for whom medical documents were available had known or detectable heart problems and were still active in the fire service.

Hypertension - another easily diagnosed, serious condition - was indicated in an additional 26 (9.8 percent) of the victims, and 12 others (4.5 percent) had diabetes. Four were reportedly fatigued (1.5 percent) but had no prior medical condition reported. One fire fighter had recently had an operation to remove the lower part of his left lung. One was taking medication for blood clotting. One had recently suffered a viral infection that had resulted in inflammation of his heart. And one had had a leg amputated and had a heart attack while responding to the station to act as dispatcher.

Available reports on the other 239 heart attack victims did not contain enough medical documentation to determine whether previous, related problems existed.

Type of Duty

Figure 15 shows the distribution of types of duty the 503 fire fighters were engaged in when they suffered their fatal heart attacks. The largest proportion,

* Medical documentation used to evaluate the physical conditions of heart attack victims was in the form of death certificates and autopsy reports. Fire fighters who experienced prior heart problems may or may not have been aware of their physical conditions prior to the fatal heart attack.

Figure 14
Fire Fighter Deaths Due to Heart Attacks
by Physical Condition
1984 - 1993

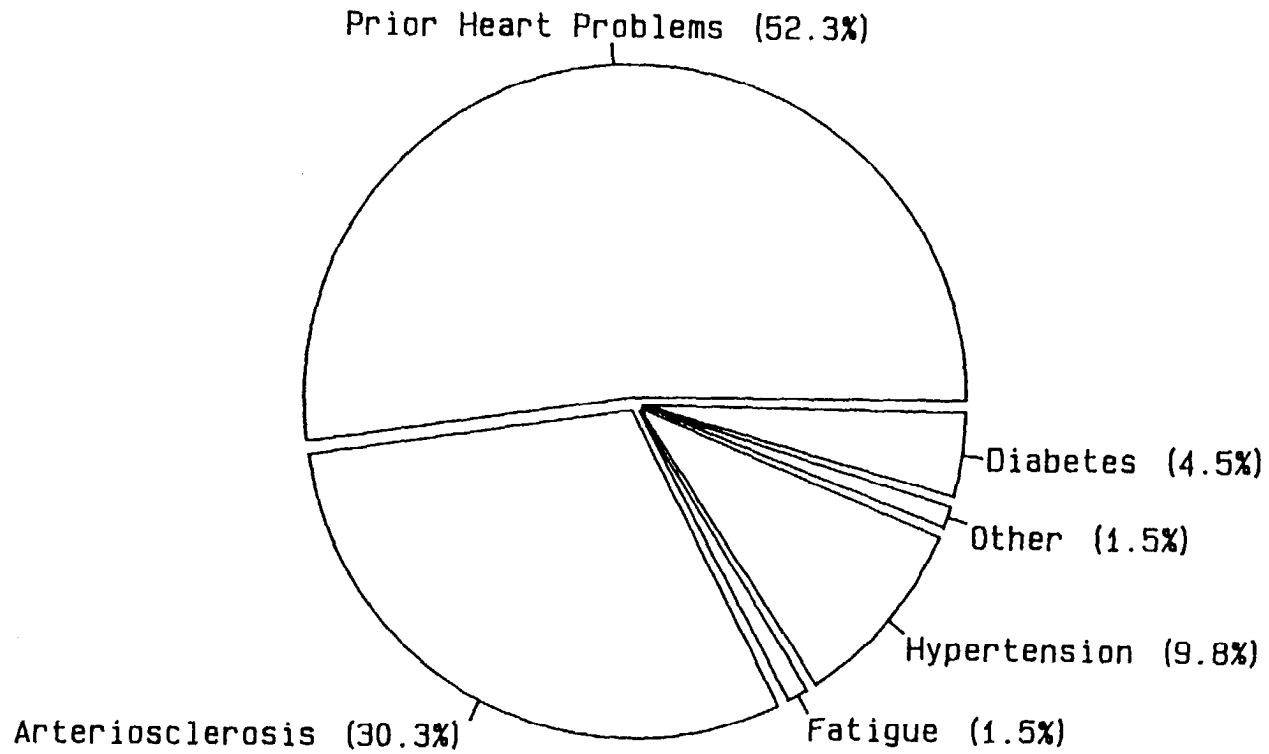
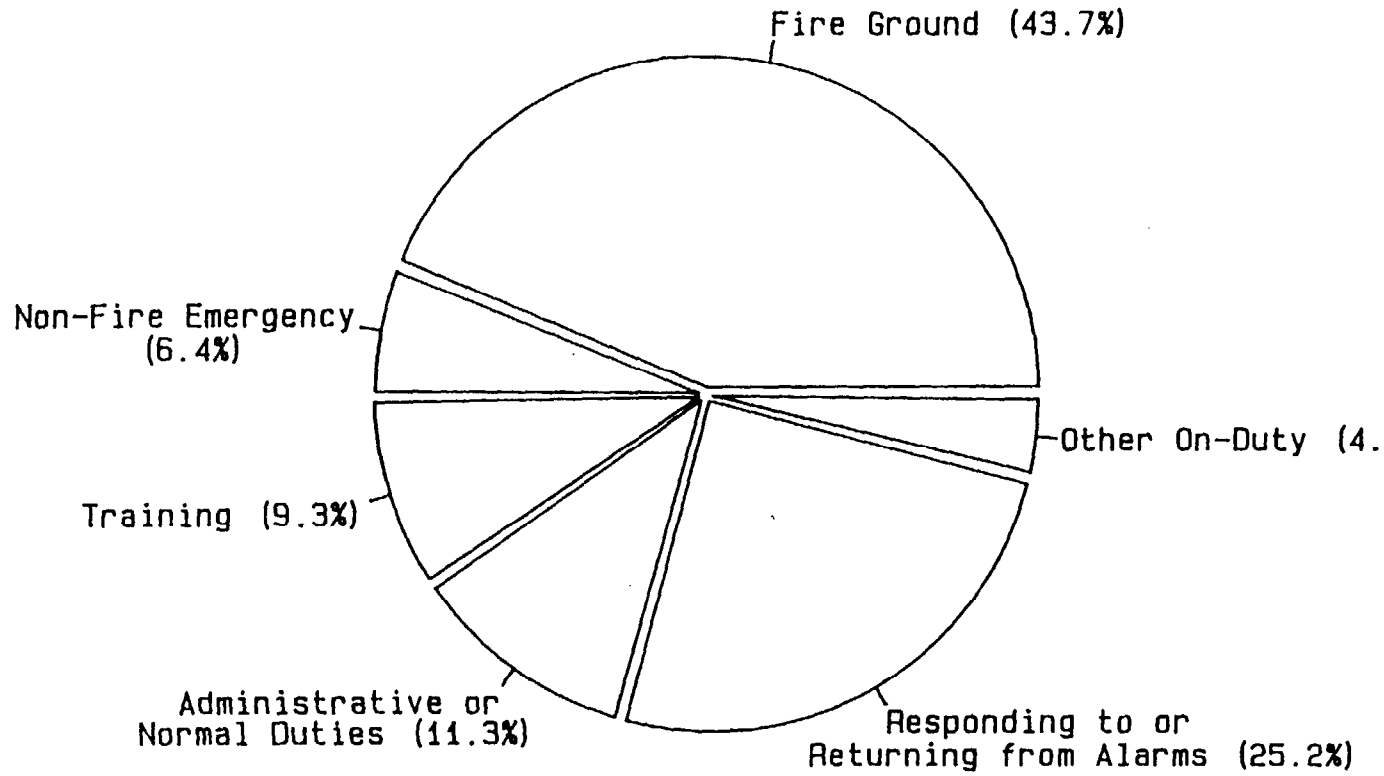


Figure 15
Fire Fighter Deaths Due to Heart Attacks
by Type of Duty
1984 - 1993



220 deaths (43.7 percent), occurred during fire ground activities. Of these, 205 were attributed to stress or overexertion (59 were reportedly during strenuous physical activity), 14 were due to exposure to smoke and one was due to hot weather. Three of the 14 smoke-exposure heart attack deaths occurred at wildland fires, where fire fighters do not use self-contained breathing apparatus (SCBA). A fourth victim was at an outside fire, and he also was not using SCBA. The remaining 10 deaths were at structure fires. In eight of those 10 cases and 21 of the 40 stress-related deaths that occurred inside structures, the fire fighters were not using SCBA. Of the remaining two smoke exposure deaths, one had his facepiece disconnected and the other, although he was reported to have been wearing breathing apparatus during overhaul in a smoke-filled basement, had a calculated carboxyhemoglobin (COHb) level of 24 percent at the time of his heart attack. Eleven of the 14 victims of smoke exposure heart attacks reportedly had pre-existing heart conditions.

The next largest proportion involved fire fighters responding to or returning from alarms (127 deaths or 25.2 percent). Of these 127 fire fighters, 66 were responding to incidents at the time they suffered the fatal heart attack. The other 61 were returning or had returned from the alarm when they were stricken. Most of the alarms that resulted in these deaths involved actual emergencies, but there were nine false calls involved -- five of them malicious false alarms.

The other major categories included 57 deaths during administrative and normal station duties (11.3 percent), 47 deaths during training (9.3 percent) and 32 deaths while working at non-fire incidents such as emergency medical and rescue calls (6.4 percent). The other 20 calls (4.0 percent) occurred during other on-duty activities such as fire prevention, inspection, maintenance, etc. Of the 47 fire fighters who died during training activities, 11 were engaged in physical fitness activities, such as jogging, playing basketball or undergoing stress tests.

Ages of Fire Fighters

The distribution of ages of the heart attack victims is displayed in Figure 16. The ages range from 16 to 83 years, with a median age of 52 years. Five of the 10 fire fighters aged 25 and under had congenital heart problems. Another had had a viral infection that damaged his heart and lungs, one had had surgery for an aortal blockage at age 11 and one had had a liver transplant 11 years earlier. Eight of the 22 fire fighters aged 26 to 35 had prior heart problems (heart attacks or bypass surgery) and three others had severe arteriosclerotic heart disease.

As can be seen from the breakdown by career and volunteer fire fighters (183 career fire fighters vs. 320 volunteer fire fighters) over a third of the victims were career fire fighters, although it is estimated that only 25 percent of the nation's fire fighters are career. Therefore, career fire fighters suffer proportionately more heart attack deaths than volunteer fire fighters. (Career fire fighters in fact suffer proportionally more deaths of all types than volunteers, possibly because of the higher number of hours and calls per year per person for career fire fighters.) Figure 16 also shows that the victims over age 60 were mostly volunteer, possibly due to the tendency of volunteer fire fighters to remain active well beyond the retirement ages of career fire fighters. Figure 17 compares the experience of career and volunteer fire fighters over the 10-year period. Heart attack deaths among career fire fighters have generally been decreasing since 1986; among volunteers, since 1988.

Ranks of Fire Fighters

Figure 18 shows the ranks held by the fire service personnel who suffered fatal heart attacks. The largest proportion (304 or 60.4 percent) were fire fighters.

Figure 16
 Fire Fighter Deaths Due to Heart Attacks
 by Age Group
 1984 - 1993

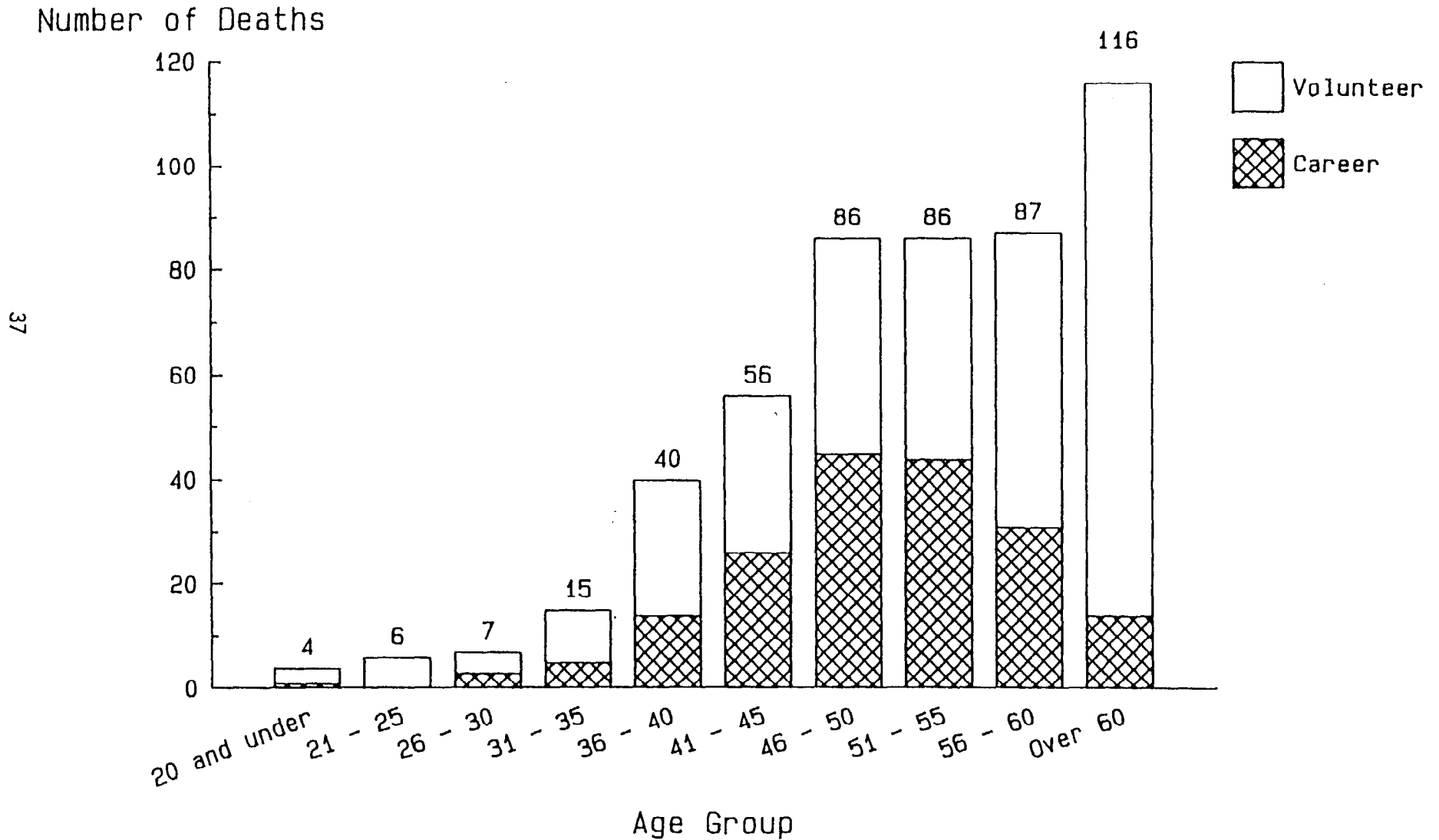


Figure 17
Fire Fighter Deaths Due to Heart Attacks
Career vs Volunteer
1984 - 1993

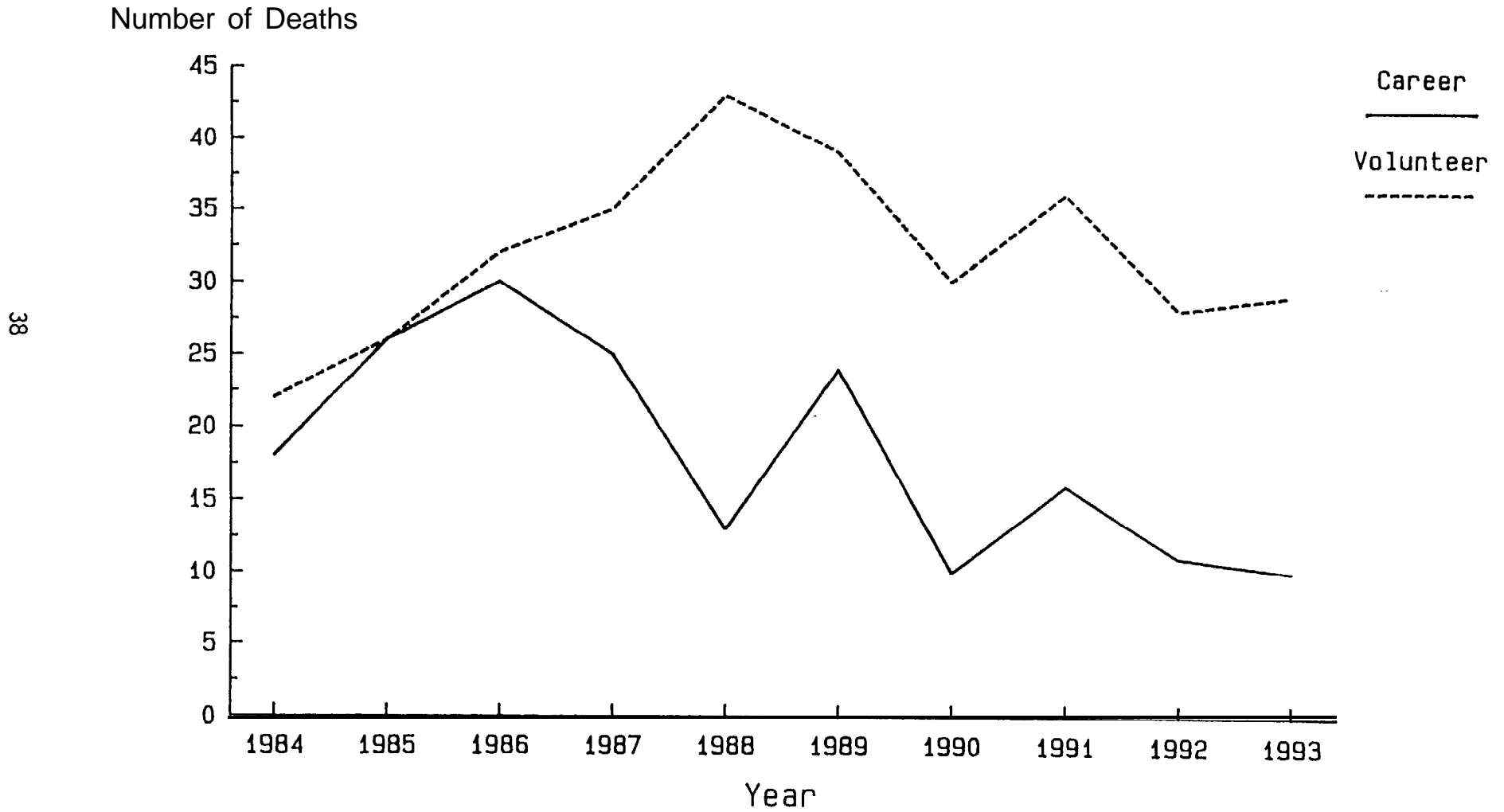
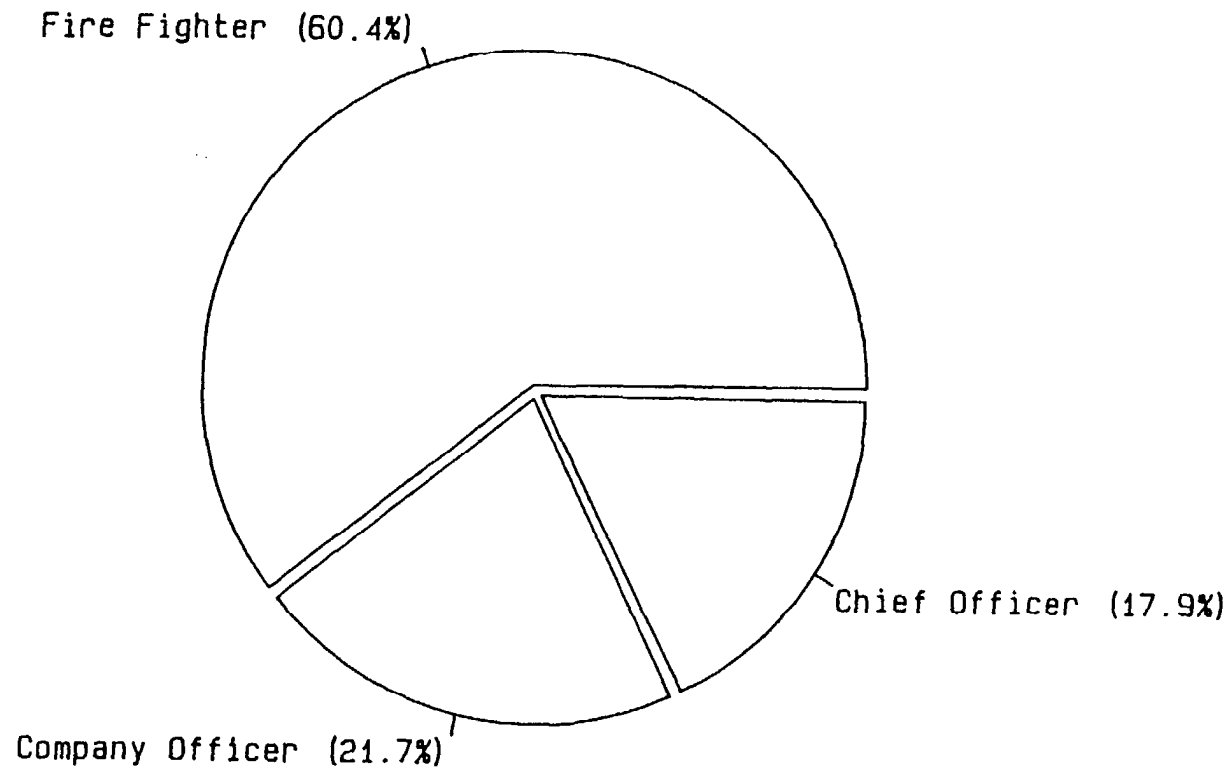


Figure 18
Fire Fighter Deaths Due to Heart Attacks
by Rank
1984 - 1993



Company officers made up 21.7 percent (109 deaths) of the total and the remaining 17.9 percent were chief officers (90 deaths). These statistics indicate that, for *every* 2.8 fire fighters stricken with a fatal heart attack, one company officer is stricken. Based on typical complements of three or four personnel to each fire company (one officer and two or three fire fighters) this suggests a roughly equal risk of heart attack for company officers and fire fighters. However, for every 3.4 fire fighters stricken, one chief officer died, showing a much higher risk for chiefs. Analysis of the age distribution of heart attack victims in the three categories shows no significant difference explained by rank. These patterns, taken together, show that *fire* service personnel of all ranks face the risk of heart attack, and so prevention programs should not focus on, or exclude, any one rank.

Summary

From 1984 through 1993, 503 fire fighters, or almost half of the total number of fire fighters who died in the line of duty, died as a result of heart attacks, and over 80 percent of those with medically documented prior conditions had known or detectable heart problems. (Nearly all had some serious prior health problems.)

Two out of five deaths on the fire ground and while responding to and returning from alarms were due to heart attacks. Most of the fire ground heart attacks were attributed to overexertion or strain, but in 14 cases where smoke exposure was given as the cause of injury, no fire fighter was using full protective equipment. This is to be expected in the three deaths that occurred at wildland fires, but while operating inside structures SCBA must be worn and properly used throughout fire fighting operations *and* overhaul.

Heart attacks continue to be the leading cause of on-duty fire fighter fatalities. Steps to reduce the risk of heart attacks among fire fighters, including

more detailed medical evaluations and further study in the areas of physical fitness and dietary requirements for fire fighters, must be taken.

Above all, attention must be focused on the significant problem of fire service personnel who have heart problems, yet are allowed to remain active in fire fighting.

IV. Fatalities Involving Motor Vehicle Accidents 1984 - 1993

For this analysis, the term *motor vehicle accident* refers to motor vehicle collisions, including those involving aircraft and boats, as well as to incidents such as falls from vehicles and pedestrians struck by vehicles where the involvement of a motor vehicle played an integral role in the incident. From 1984 through 1993, there were 254 deaths in motor vehicle accidents, accounting for 22.8 percent of the total 1,115 fire fighter deaths that occurred over the period. Of the 254 victims, 173 (68.1 percent) were killed in collisions, 50 of the victims (19.7 percent) were struck by vehicles, 28 (11.0 percent) fell from apparatus and three (1.2 percent) *were* caught or trapped by vehicles. Six of the victims were reportedly impaired by alcohol or other drugs. Of the six, four were driving the vehicles that were involved in accidents.

Figure 19 shows the distribution of deaths by year of occurrence. The number of motor vehicle fatalities ranged from 15 to 35 a year, with the highest total occurring in 1988 and the lowest in 1992. The number of deaths each year has been generally decreasing since 1988, but motor vehicle accidents still tend to account for 20 to 25 percent of the deaths each year.

Of the 254 victims, 201 were volunteer fire fighters (79.1 percent) and 53 were career fire fighters (20.9 percent). As shown in Figure 20, career and volunteer fire fighters experience quite different numbers of deaths each year. Among career fire fighters, the number of deaths per year have ranged from one to 10. For the 44 career fire fighter victims employed by local fire departments, the number of deaths per year ranged from a high of nine in 1984 to a low of zero in 1992. The proportion of local, career fire fighter deaths resulting from motor vehicle accidents is usually less than 15 percent of the total deaths in a year and is often less than 10 percent. In contrast, among the 169 volunteer members of local

Figure 19
Fire Fighter Deaths in Motor Vehicle Accidents
1984 - 1993

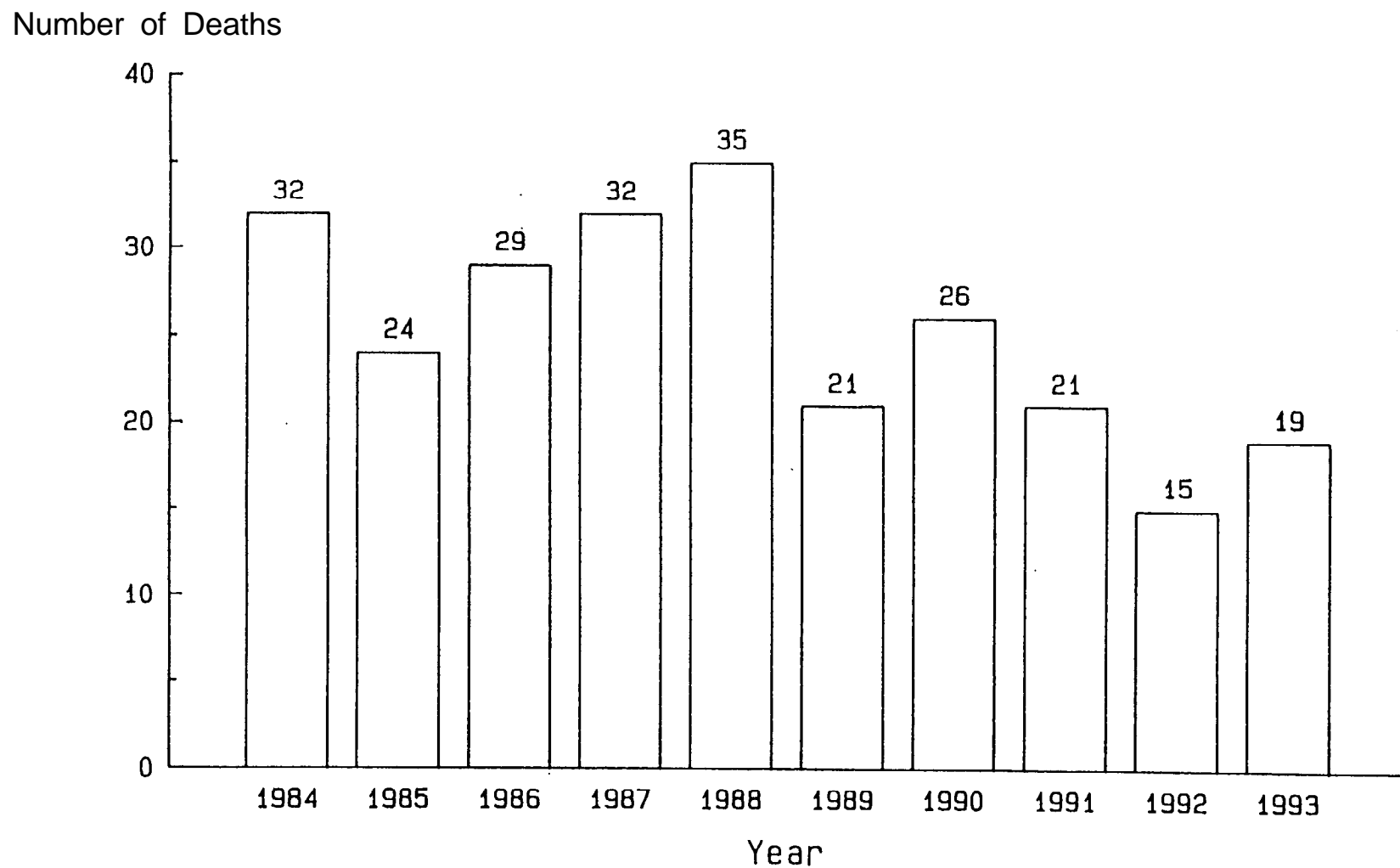
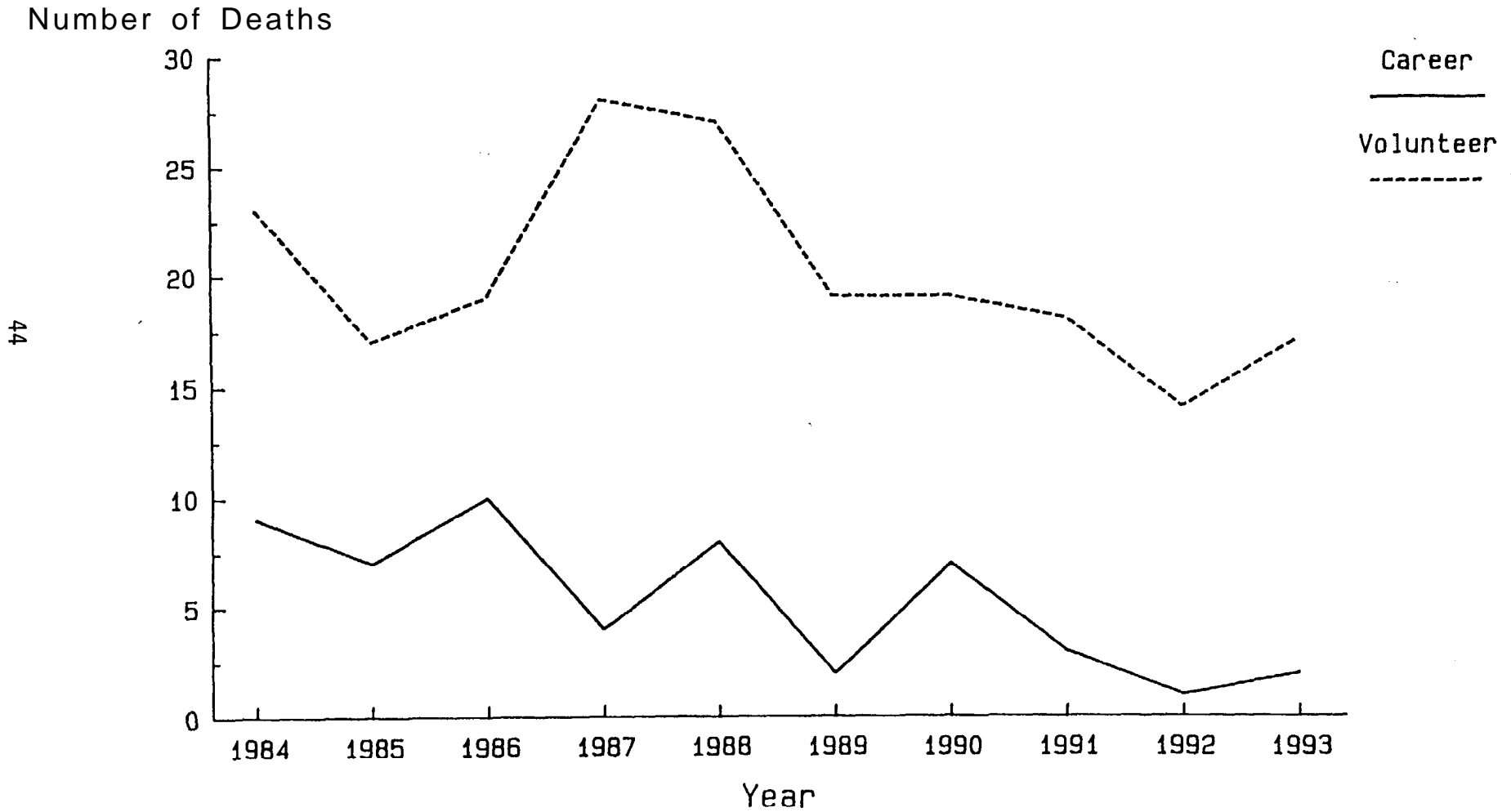


Figure 20
Fire Fighter Deaths in Motor Vehicle Accidents
Career vs. Volunteer
1984 - 1993



44

fire departments, the number of deaths in motor vehicle accidents ranged from 11 to 23 per year and generally accounted for a quarter to a third of the total number of deaths of volunteer fire fighters.

Nature of Fatal Injury

Figure 21 shows the distribution of motor vehicle accident deaths by nature of fatal injury, also often referred to as medical cause of death. Not surprisingly, we find that almost all of the collisions resulted in fatal crushing or internal traumatic injuries. In addition, three fire fighters died of burns, three drowned and one each died as a result of asphyxia and bleeding. And finally, a fire fighter whose vehicle collided with a hedge mower died of massive traumatic injuries.

Type of Fire Fighter

The majority of fire fighters killed in motor vehicle accidents were members of local fire departments (83.9 percent). These 213 fire fighters included 13 fire fighters acting as fire police and three members of a student fire brigade.

Another 20 fire fighters (7.9 percent) were private contractors for state or federal agencies. Fifteen fire fighters (5.9 percent) were employees of federal forestry agencies, three fire fighters (1.2 percent) were employees of state forestry agencies, two (0.8 percent) were members of a state prison inmate crew, and one (0.4 percent) was a member of the National Guard.

Type of Duty

As shown in Figure 22, not all deaths in motor vehicle accidents occur

Figure 21
Fire Fighter Deaths in Motor Vehicle Accidents
by Nature of Injury
1984 - 1993

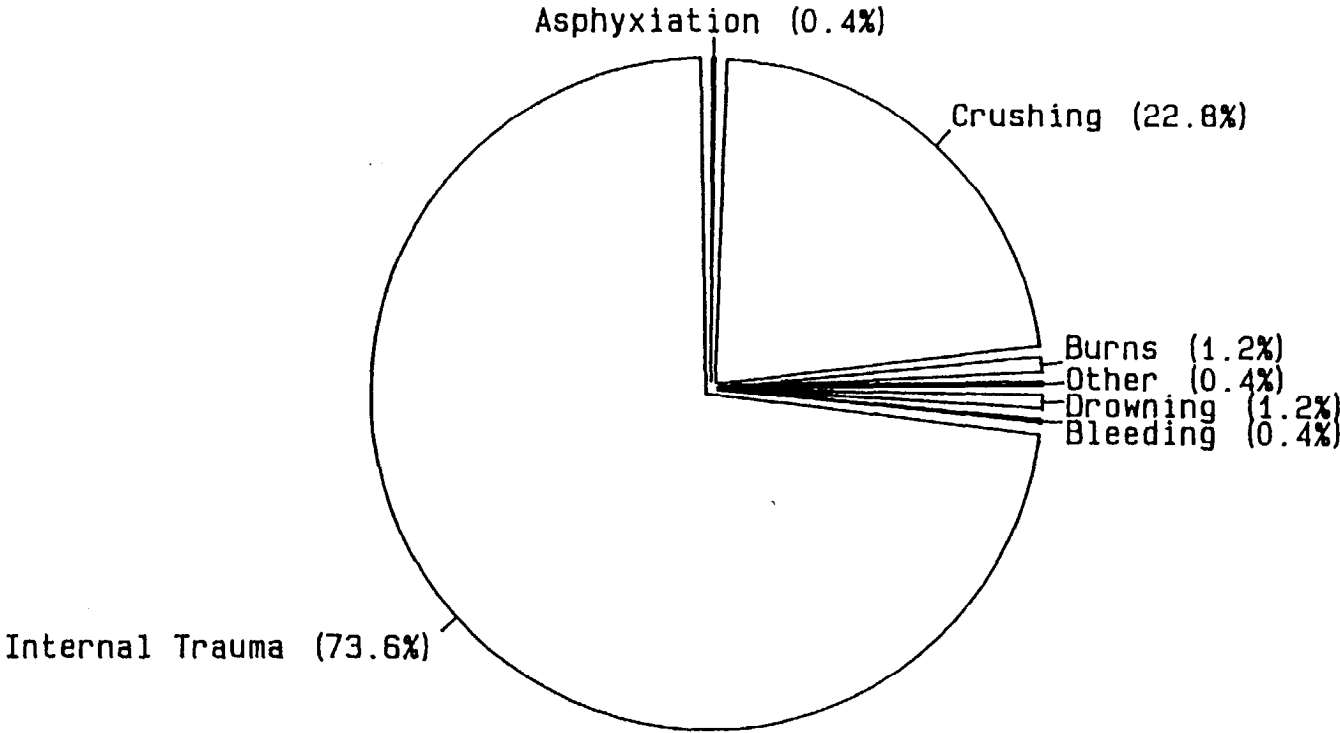
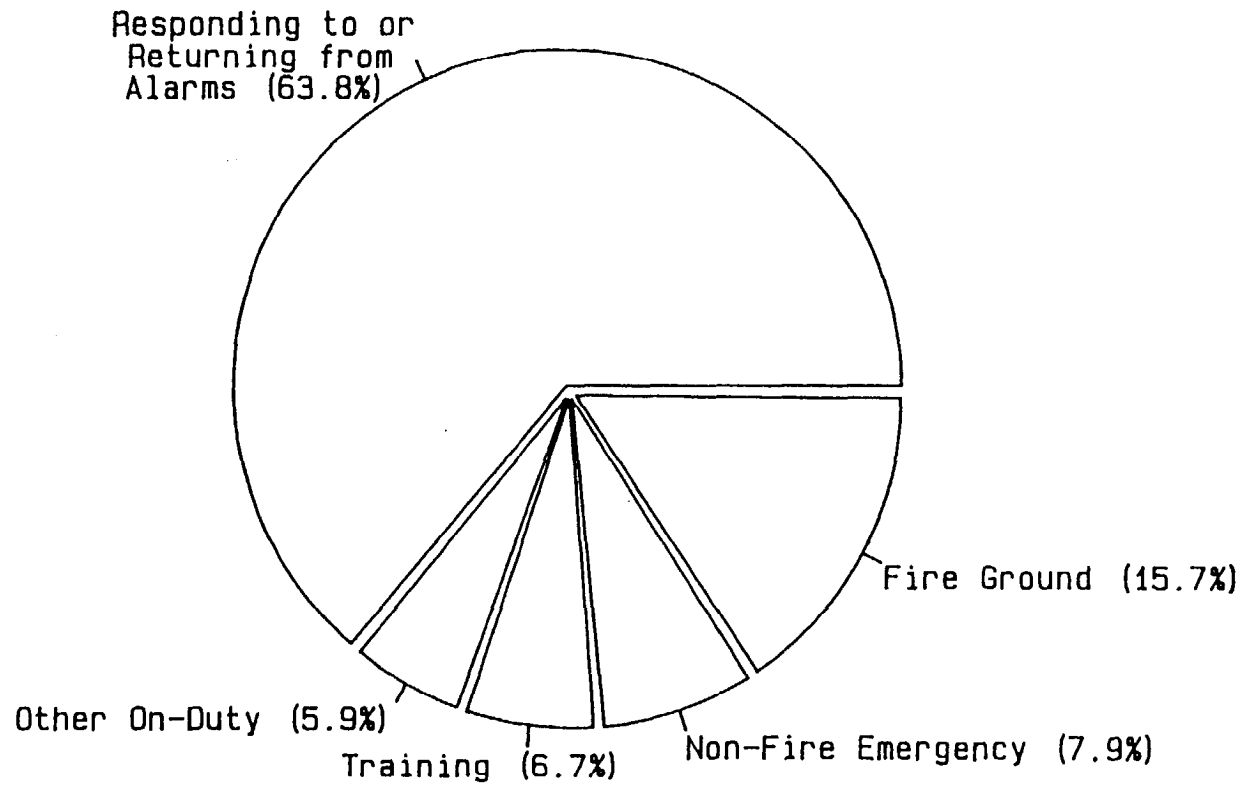


Figure 22
Fire Fighter Deaths in Motor Vehicle Accidents
by Type of Duty
1984 - 1993



while responding to or returning from alarms, although that is when the majority of accidents occurred (162 deaths or 63.8 percent). Another 40 deaths (15.7 percent) occurred on the fire ground, 19 deaths (7.5 percent) occurred at the scene of non-fire emergencies, 17 deaths (6.7 percent) occurred during training activities and 16 deaths (6.3 percent) occurred during other on-duty activities.

Of the 162 deaths that occurred while responding to or returning from alarms, 65 (40.1 percent) involved occupants of personal vehicles. All of the latter victims were volunteer fire fighters and almost all (92.2 percent) were killed while responding to alarms. Tankers were the next type of vehicle most frequently involved (26 deaths or 16.0 percent), followed by engines or pumpers (21 deaths or 13.0 percent). (Fatal accidents involving tankers were discussed in last year's contract report.) Other vehicles involved in accidents while responding to or returning from alarms were aircraft (10 deaths or 6.2 percent) and ambulance and rescue vehicles (5 deaths or 3.1 percent). Other public safety vehicles, e.g., brush vehicles, a fire department pickup truck and a fire department marine unit, were involved in five deaths (3.1 percent). Five deaths involved other types of vehicles -- four deaths when a dump truck transporting fire fighters at a wildland fire overturned and one death when a National Guard truck went off the road enroute to pick up fire fighters. For the remaining 25 responding and returning deaths, the victims were not occupants of motor vehicles involved in collisions -- 17 fell from apparatus, five were struck by apparatus and three were struck by non-fire department vehicles.

In 20 of the 40 deaths that occurred at the fire ground, the victims were occupants of motor vehicles -- 15 were in aircraft, two involved brush units and one each involved a bulldozer, an engine and a tanker. All these accidents occurred at wildland fires. Of the remaining 20 victims of motor vehicle accidents on the fire ground, 14 were struck by non-fire department vehicles, four were

struck by fire apparatus, one was caught or trapped by a fire department vehicle and one fell from apparatus.

Of the 19 deaths that occurred at the scene of non-fire emergencies, only two involved collisions -- one ambulance and one boat. Fifteen of the remaining victims were struck by non-fire department vehicles while operating at the scene and two fell -- one from the side of an engine while laying hose at an ammonia leak and the other from a helicopter while retrieving equipment after rescuing someone from a fall.

Of the 17 fire fighters killed during training-related activities, five were killed in collisions involving private vehicles traveling to or from training sessions and four others in collisions involving a GSA-licensed pickup truck, an engine, a ladder truck and a helicopter. The remaining eight fire fighters who were not killed in collisions died as a result of falling from competition (muster) vehicles (three deaths) and a pumper (one death), and being struck by fire department and non-fire department vehicles (two deaths each).

The remaining 16 fire fighters died in motor vehicle accidents while involved in other on-duty activities. Of these 16, three were killed in collisions during fire prevention or inspection activities and seven were killed while performing maintenance activities -- one fell from the bucket of a truck while repairing a fire alarm; one fell under the wheels of a vehicle being backed into the station for cleaning; one overturned in a pumper/tanker while returning from refueling the vehicle; one was crushed between two pieces of apparatus while doing vehicle maintenance; one was crushed by a front-end loader while clearing snow at the fire station; one was struck by a vehicle while directing traffic outside the fire station and one fire fighter was working on the grounds at the station when his tractor overturned. Another fire fighter was atop an aerial ladder replacing a flag at city hall when the ladder buckled and fell to the sidewalk. Of

the remaining five fire fighters, two died in aircraft crashes (one while transporting wildland fire personnel and the other en route to pick up a piece of apparatus), one was struck by a passing vehicle while assisting a disabled motorist, one was involved in a collision while driving to a fire fighter parade and competition and one was on routine fire patrol when his vehicle left the road and overturned.

Deaths by Time of Incident

The distribution of deaths by time of alarm (or time of accident if no emergency incident was involved) is shown in Figure 23. As shown, most fatal accidents occurred between 11 a.m. and 7 p.m. and the lowest number occurred in the early morning hours between 1 a.m. and 5 a.m.

Most of the collisions that resulted in fatalities could be attributed to operator error, frequently driving too fast for road conditions. Failure to use seatbelts was also frequently reported. As mentioned earlier, four of the drivers were reported to be intoxicated at the time of their accidents.

Deaths by Age

The fire fighters who died in motor vehicle accidents ranged in age from 17 through 77 years with a median age of 32 years. The breakdown by age group is shown in Figure 24. Figure 25 shows how death rates per 10,000 fire fighters vary by age group. Death rates are highest for fire fighters under age 20 and those age 60 and over. The rate for fire fighters under age 20 is more than twice the average for all fire fighters. The rate for fire fighters age 60 and over is more than three times the average. This is a very different distribution than is observed in total

Figure 23
Fire Fighter Deaths in Motor Vehicle Accidents
by Time of Alarm
1984 - 1993

Number of Deaths

51

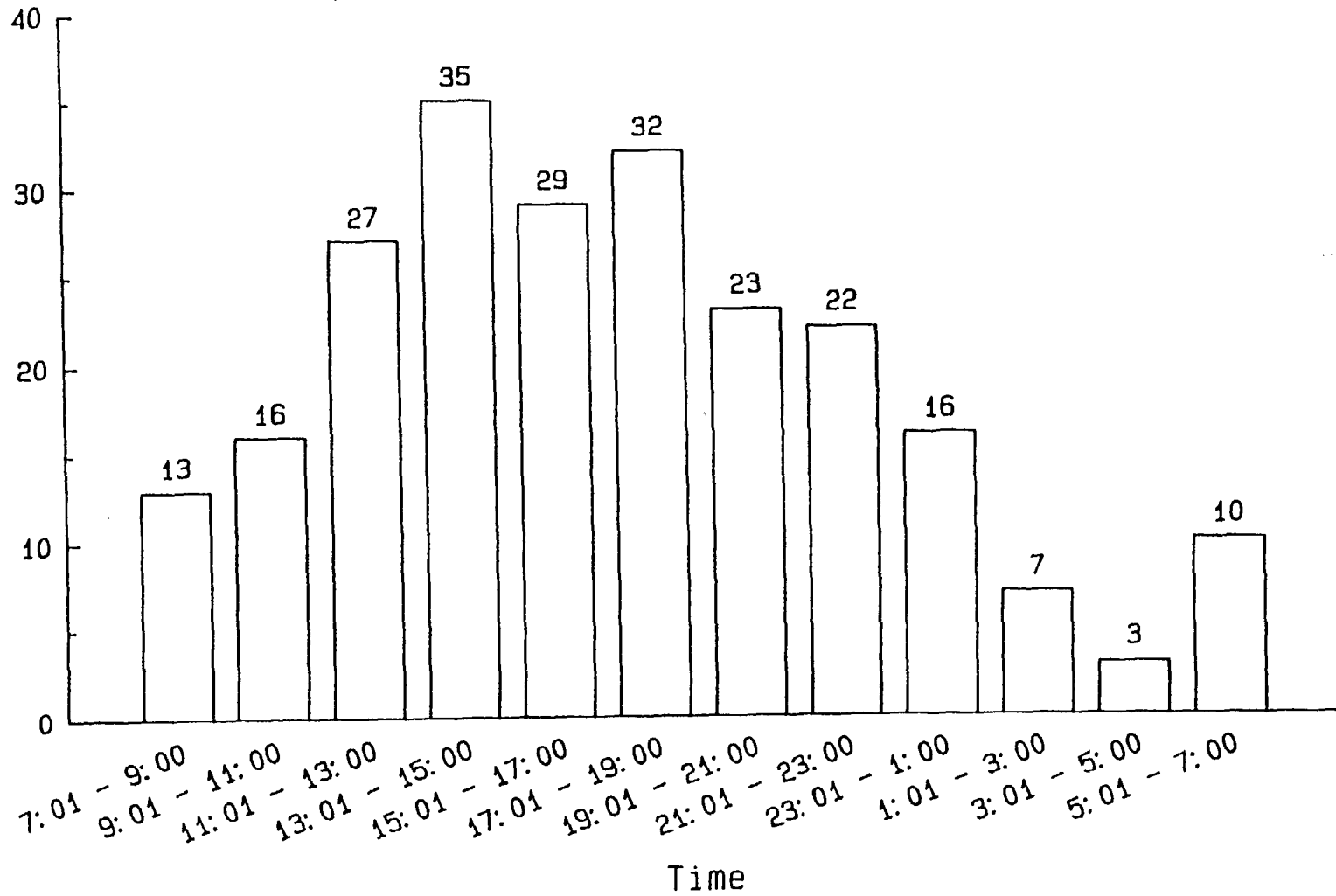


Figure 24
Fire Fighter Deaths in Motor Vehicle Accidents
by Age of Victim
1984 - 1993

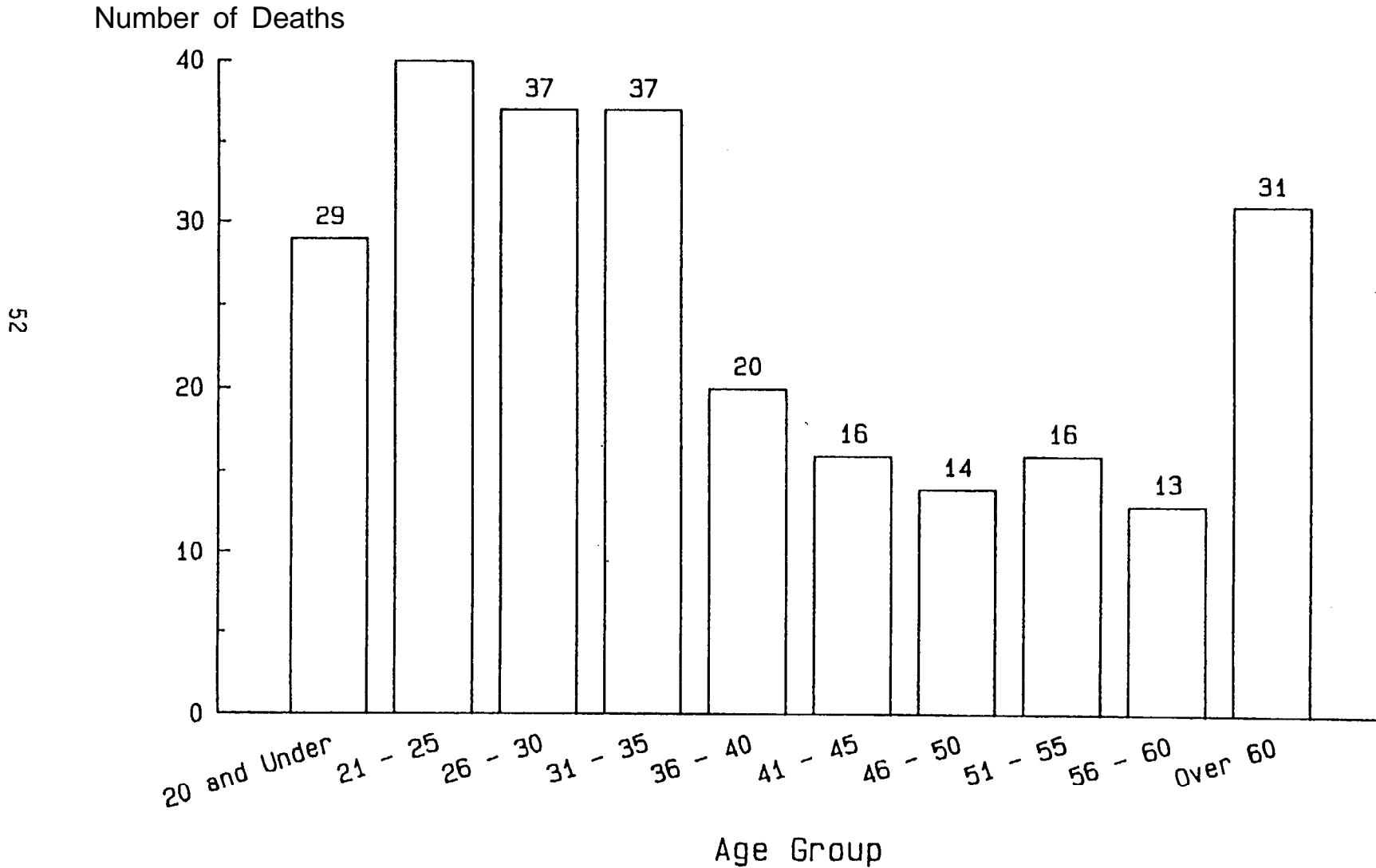
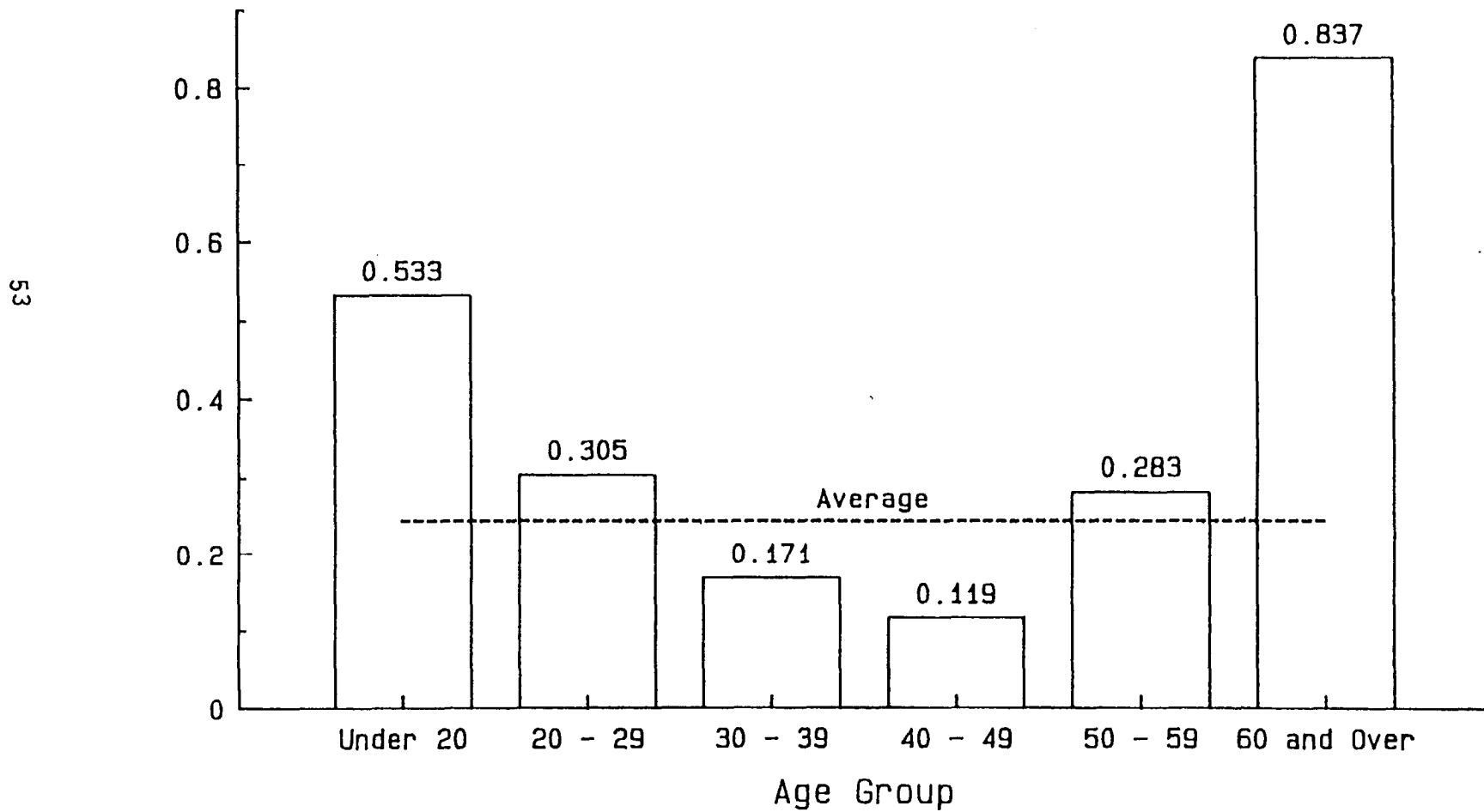


Figure 25
Death Rates by Age Group for Fire Fighter Deaths
in Motor Vehicle Accidents
1984 - 1993

Rate per 10,000 Fire Fighters



fire fighter fatalities, as was shown in Figure 6.

Of the 34 fire fighters aged 60 and over who died, 15 were struck by vehicles, 11 of the 15 as they were directing traffic. Among the 20 victims under age 20, 15 were killed in collisions.

Conclusion

Motor vehicle accidents continue to claim a substantial share of all fire fighter deaths each year. In many cases, it was failure to heed the rules of the road, not adverse conditions, that led to the fatalities. The importance of training in the handling of tankers was discussed in last year's contract report. Wildland fires present special potential for fatal accidents, both aircraft crashes and road accidents that are almost inevitable on rough terrain.

Deaths resulting from falls from back steps have decreased over the last several years with the increased use of enclosed cabs and directives prohibiting the use of back steps. Fire fighters operating at the fire ground and other emergency scenes must make sure that they are visible to passing motorists and be alert to emergency vehicles that may be maneuvering around the scene.

Many accidents are preventable, either through driver training or through procedural changes in how responses to incidents are handled. Often, in communities where volunteer fire fighters respond to incidents in their own cars or trucks, dozens of vehicles will travel to an incident scene from every direction. Under those conditions, the potential for accidents is obvious. Fire departments must stress driver safety and establish an enforced, written policy that will ensure a rapid, adequately-staffed response to incidents without jeopardizing the safety of responders or others traveling the roads. Resources include insurance carriers and state training organizations who may be able to provide assistance in

hazard identification, training materials and potential training programs.

V. Fire Fighter Deaths Related to Training, 1984 - 1993

Training is, of course, a vital part of fire department operations, but it too often results in unnecessary deaths and injuries. In the 10-year period from 1984 through 1993, 88 fire fighters (7.9 percent) died while engaged in training-related activities. In 1993, there were six training deaths, but there have been as many as 17 deaths in a single year during the 10-year period. This distribution of training-related deaths since 1984 is shown in Figure 26. Of the 88 fire fighters, 49 were career fire fighters and 39 were volunteers.

Type of activity

Training-related deaths cover a broad range of activities as shown in Figure 27. The category where the most deaths were reported (23 deaths or 26.1 percent) involved apparatus and equipment drills. This category includes ladder climbing, pump and drafting operations, hose evolutions, high-rise drills, rappelling, smoke jumper training and emergency medical training. The second largest category was physical fitness training with 14 deaths (15.9 percent). The next category, live fire training, claimed 11 lives (12.5 percent). Three of these deaths occurred in one incident when the victims were caught by rapid fire progress and died of smoke inhalation.

Nine fire fighters (10.2 percent) died while attending classes, seminars or meetings. Eight were the result of heart attacks and the ninth was the result of a stroke. There were five deaths each during underwater training and driver training and four deaths each during recruit training and involving fire fighter competitions and musters. Three fire fighters died during SCBA training and one suffered a fatal heart attack at a disaster drill.

Figure 26
Training-Related Fire Fighter Fatalities
1984 - 1993

Number of Deaths

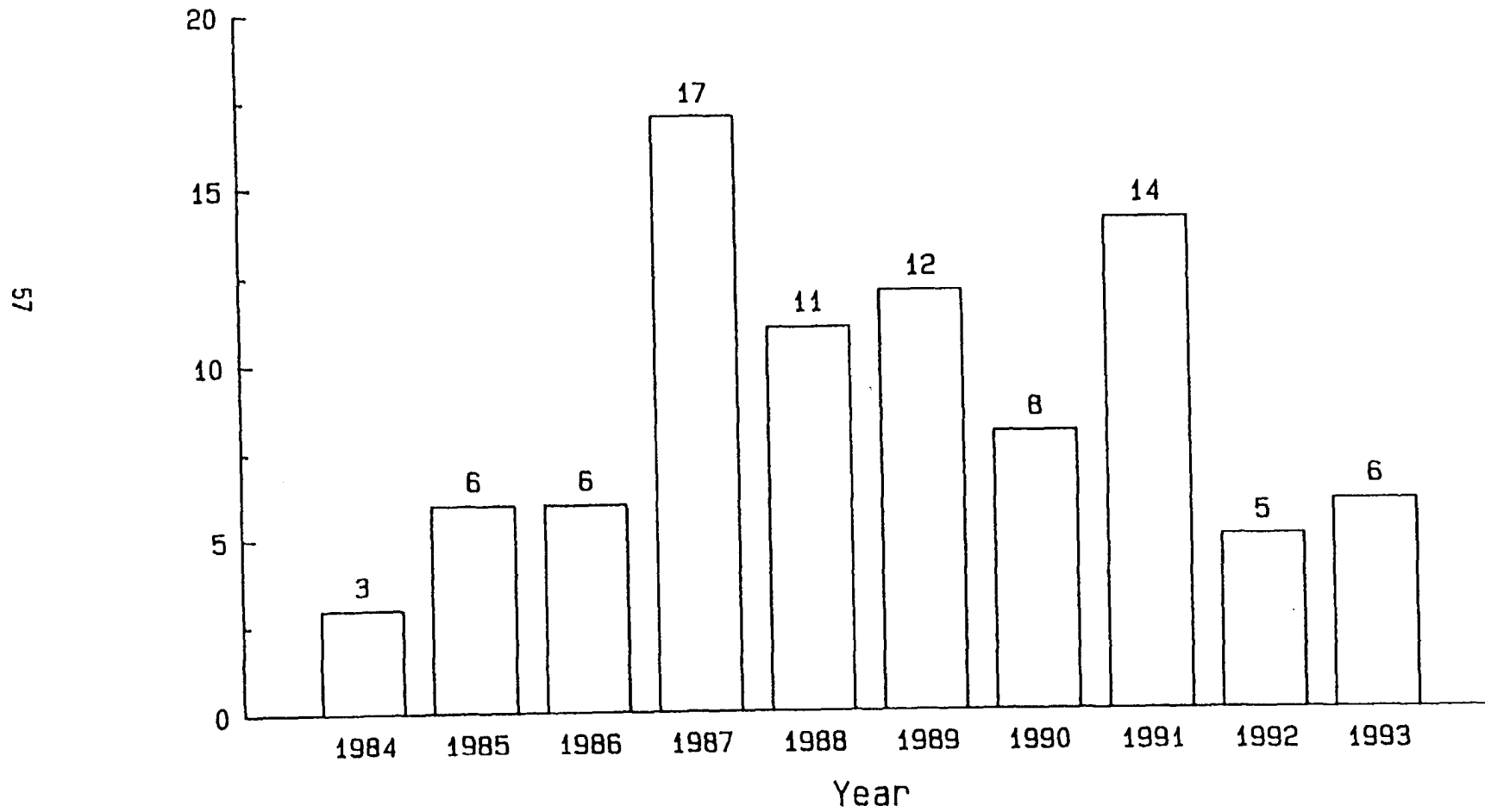
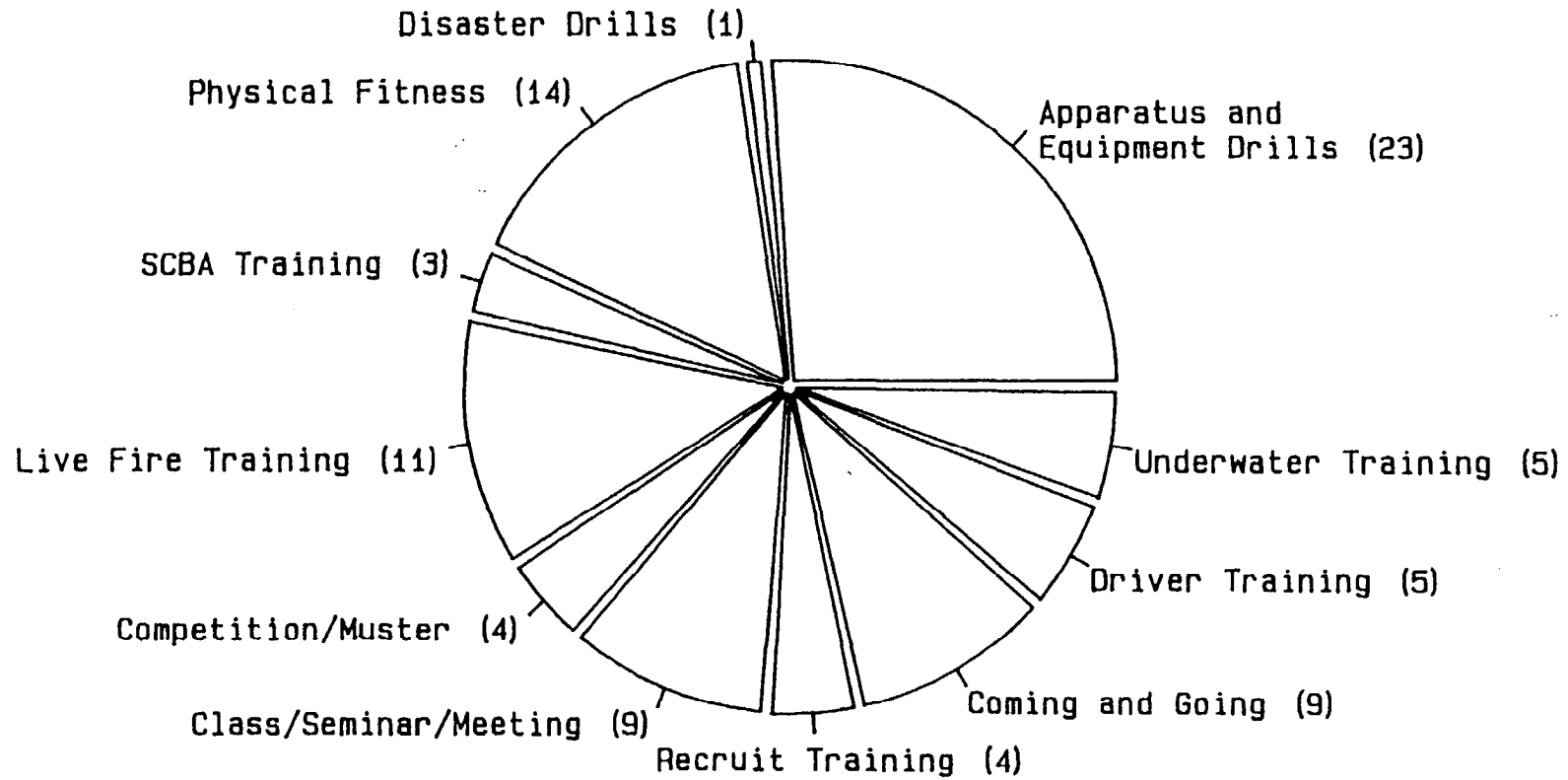


Figure 27
Training-Related Fire Fighter Fatalities
by Activity



In addition to these deaths, nine fire fighters died while traveling to or from training activities.

Apparatus and Equipment Drills The 23 deaths that occurred during apparatus and equipment drills included 14 heart attacks, one stroke and an aneurysm. Three fire fighters died in falls - one from apparatus as it was leaving the drill, one from a ladder during the drill and a smoke jumper whose parachute failed to open. Two fire fighters were electrocuted -- one when he hit a power line while practicing or demonstrating rappelling and another when his ground ladder contacted a high voltage power line while he attempted to demonstrate a ladder set to a new fire fighter. One fire fighter was struck by a hose coupling during pump operation training and hose testing. Another was killed when the helicopter ambulance he was riding in as an observer for training crashed.

Physical Fitness Training Physical fitness training accounted for 14 fire fighter deaths -- 12 were the result of heart attacks. Another fire fighter died as a result of an embolism that had formed after he tore a muscle while jogging. And one fire fighter collapsed and went into respiratory arrest while playing basketball.

Live Fire Training Live fire training resulted in 11 of the 88 deaths. Three of the deaths occurred in one incident when the victims were caught by rapid fire progress and died of smoke inhalation. In other incidents, two fire fighters were asphyxiated during live fire training -- one became disoriented when attempting to exit the building after a flashover occurred and the other depleted his SCBA air supply while attempting to exit. Four fire fighters suffered fatal heart attacks during or just after live fire training. One fire fighter was struck and killed by a collapsing chimney and one fire fighter was struck by a motor vehicle while directing traffic during training.

Classes, Seminars and Meetings Nine fire fighters died during classroom

training, at seminars or while attending department meetings. Eight suffered fatal heart attacks and one suffered a stroke.

underwater Training Water rescue training resulted in the deaths of five fire fighters -- two drowned, one suffered a fatal heart attack after the exercise, one suffered a stroke and the fifth died of heart failure when he was drawn into a drain pipe.

Driver Training Five fire fighters were killed at driver training exercises. Three were struck by vehicles during driver training -- one was struck while he was taking photos during the training exercise, another was run over by the apparatus he was directing and the third was killed when the trailer section of a ladder truck struck a pole while he was standing on the outside directing the tiller operator. The fourth fire fighter killed during driver training was crushed when the apparatus rolled over. The fifth fire fighter fell and struck his head while playing football with other fire fighters awaiting their turn for driver training.

Fire Fighter Competitions and Musters Four fire fighters were killed in connection with fire fighter competitions and musters. Three were killed when they fell from competition vehicles during training. The fourth fire fighter died of a heart attack at a muster.

Recruit Training Three recruits died during training -- one fell from a ladder, one collapsed while running stairs in full gear and one was killed when he jumped onto an inflatable bag at a fire academy. Also, a fire fighter died of a heart attack while setting up for an evaluation drill for fire department candidates.

SCBA Training Three fire fighters suffered fatal heart attacks during SCBA training.

Disaster Drills One fire fighter suffered a fatal heart attack at a disaster drill.

Traveling to and from Training Nine fire fighters died while traveling to or from training sessions. Six were involved in motor vehicle accidents and two suffered fatal heart attacks. One fire fighter was struck by a passing vehicle as he walked home from a disaster drill.

Cause of Fatal Injury

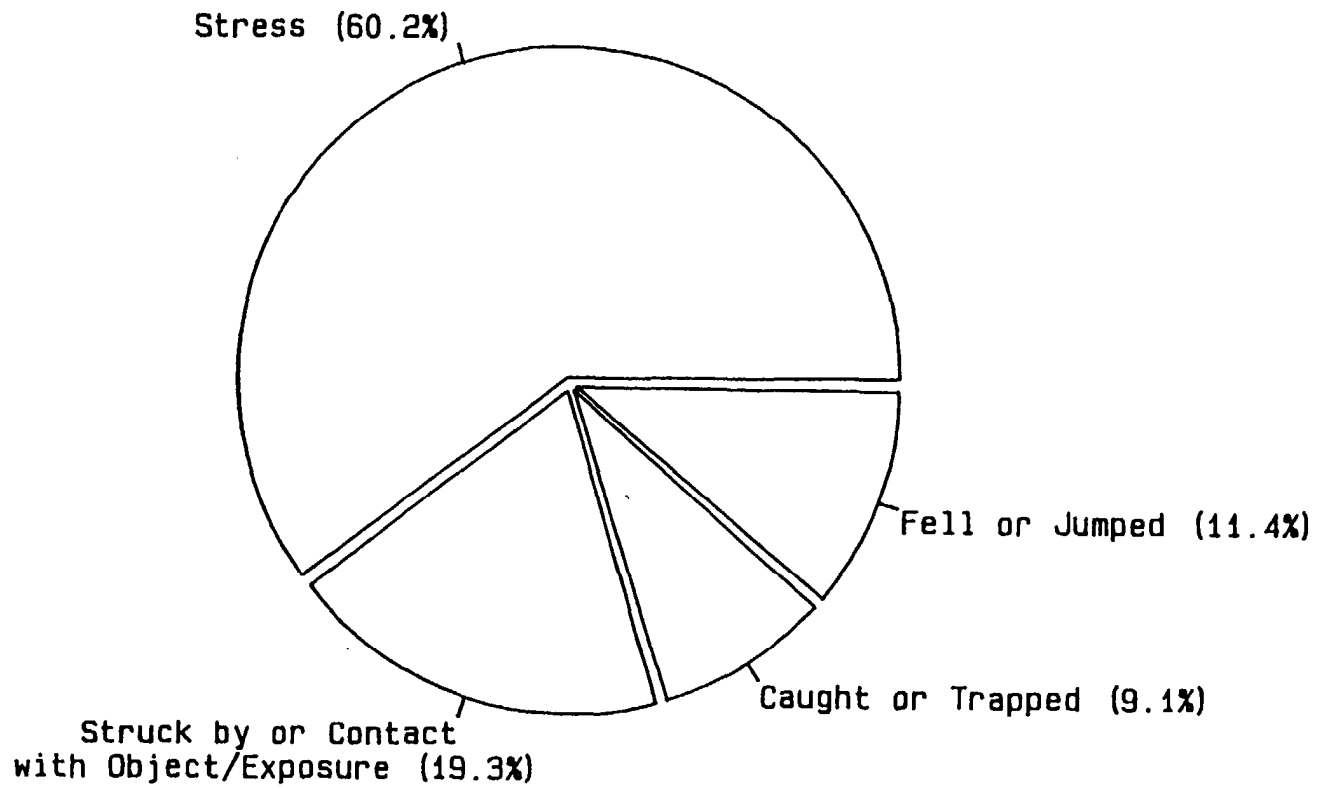
Figure 28 shows the distribution of training-related deaths by cause of fatal injury or illness. As was found for total fire fighter deaths in most years, the largest proportion of deaths (in this case, 60.2 percent) were due to stress or overexertion. Seven of these 53 deaths were specifically attributed to strenuous physical activities. Stress deaths usually involve heart attacks or strokes.

The next largest category is struck by or contact with object and exposure with 17 deaths (19.3 percent). These included nine in collisions, four fire fighters struck by vehicles, two who came into contact with power lines, one struck by a hose coupling and one by a collapsing chimney.

Ten fire fighters (11.4 percent) died when they fell or jumped including three from competition vehicles, two from ladders (including *one* during recruit training) and one from apparatus. One fire fighter's parachute failed to open during smoke jumper training. One fire fighter tore a muscle while jogging and died as a result of an embolism that formed. Another fire fighter fell while playing football while waiting at driver training and died as a result of his injuries. And a recruit died when he jumped onto an inflatable bag then fell to the ground.

Eight fire fighters (9.1 percent) were caught or trapped -- five by rapid fire progress in live fire training exercises and three underwater, where two drowned and one died of heart failure after being caught in a pipe.

Figure 28
Training-Related Fire Fighter Fatalities
by Cause of Injury
1984 - 1993



Nature of Fatal Injury

The distribution of training-related deaths by nature of fatal injury is shown in Figure 29. Overall, more than half of the training deaths (47 deaths or 53.4 percent) were due to heart attacks. In findings similar to those reported for fire fighter deaths in 1993, almost all of the fire fighters who died of heart attacks during training-related activities, for whom medical documentation was available, had had prior heart attacks, bypass surgery, severe arteriosclerotic heart disease, diabetes or hypertension. This includes 14 fire fighters who had had prior heart attacks or bypass surgery, four with severe arteriosclerotic heart disease, two with hypertension and two with diabetes. In addition, one fire fighter was reported to be fatigued. No medical documentation was available for the other 24 heart attack victims.

Another 28.4 percent (25 deaths) were due to internal trauma and crushing injuries. This includes mainly the motor vehicle accidents and falls, The remaining deaths resulted from asphyxiation (five deaths), strokes and aneurysms (four deaths), drowning (two deaths), electrocution (two deaths), respiratory arrest (two deaths) and strain (one death).

Ages of Fire Fighters

The distribution of the training-related fatalities by age and cause of death is shown in Figure 30. The victims ranged in age from 18 to 73 years with a median age of 39.5 years. As can be seen in this graph, deaths are more frequently the result of heart attack as age increases. Figure 31 shows the death rate in training-related incidents by age group. The rates for fire fighters under age 40 are below the average for all fire fighters. The rates then climb as fire

Figure 29
Training-Related Fire Fighter Fatalities
by Nature of Injury
1984 - 1993

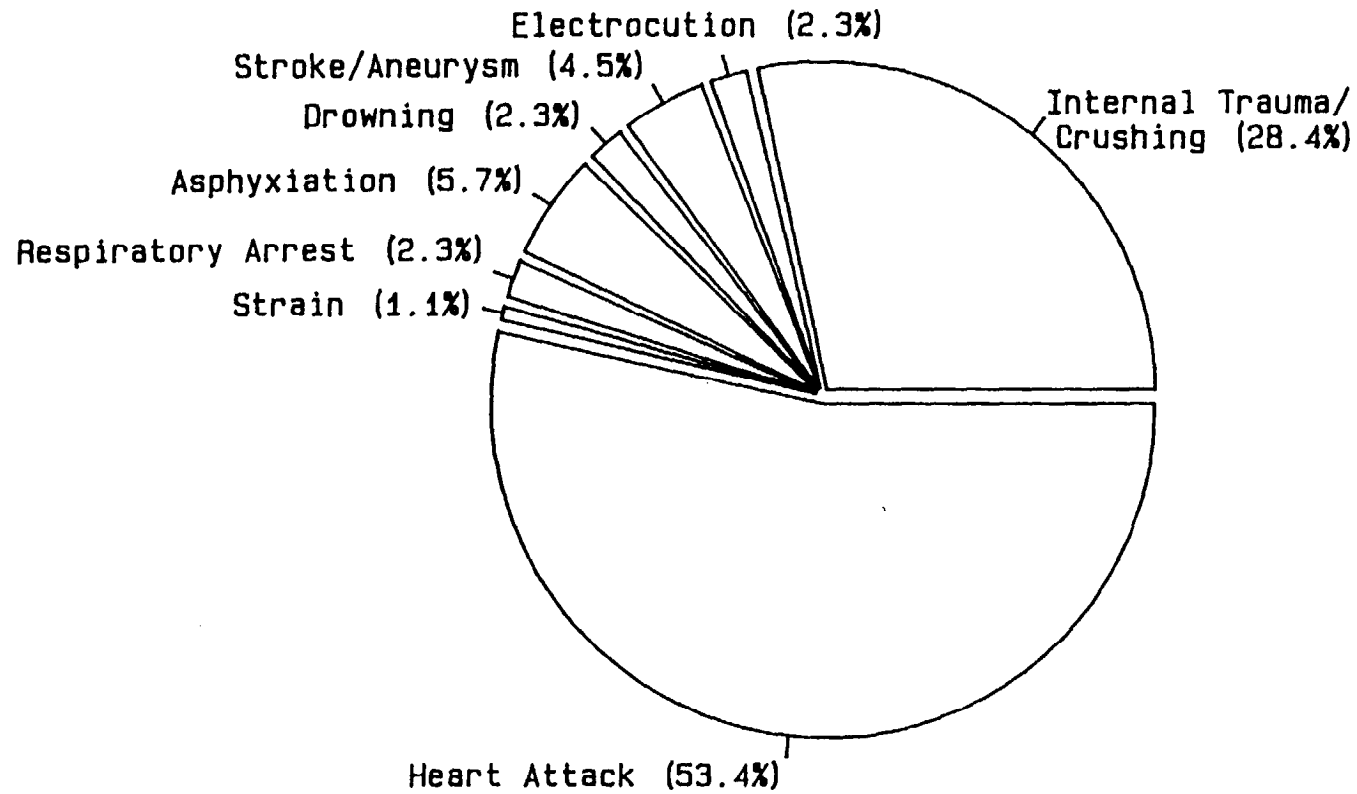


Figure 30
 Training-Related Fire Fighter Fatalities
 by Age and Cause of Death 1984 - 1993

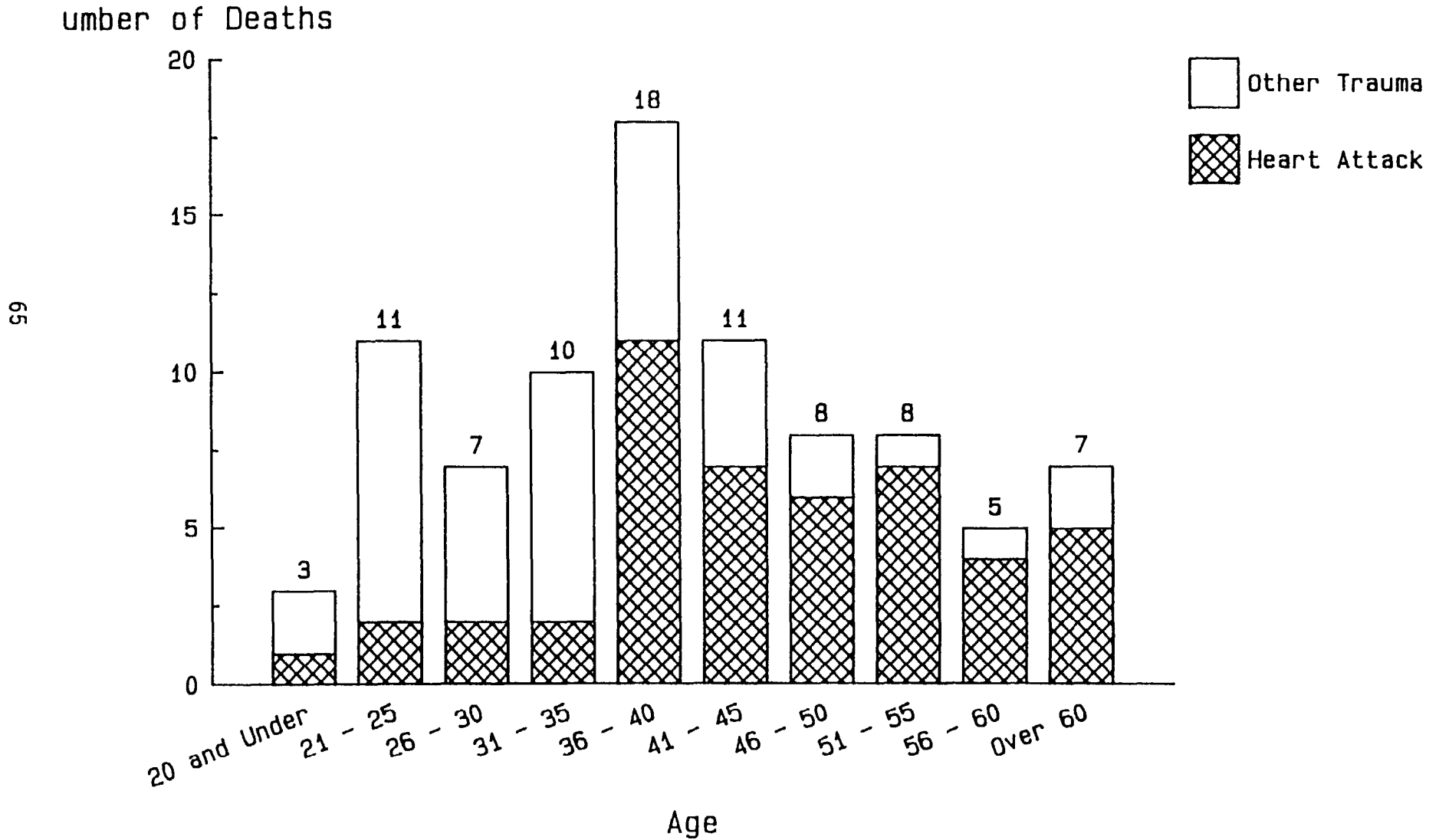
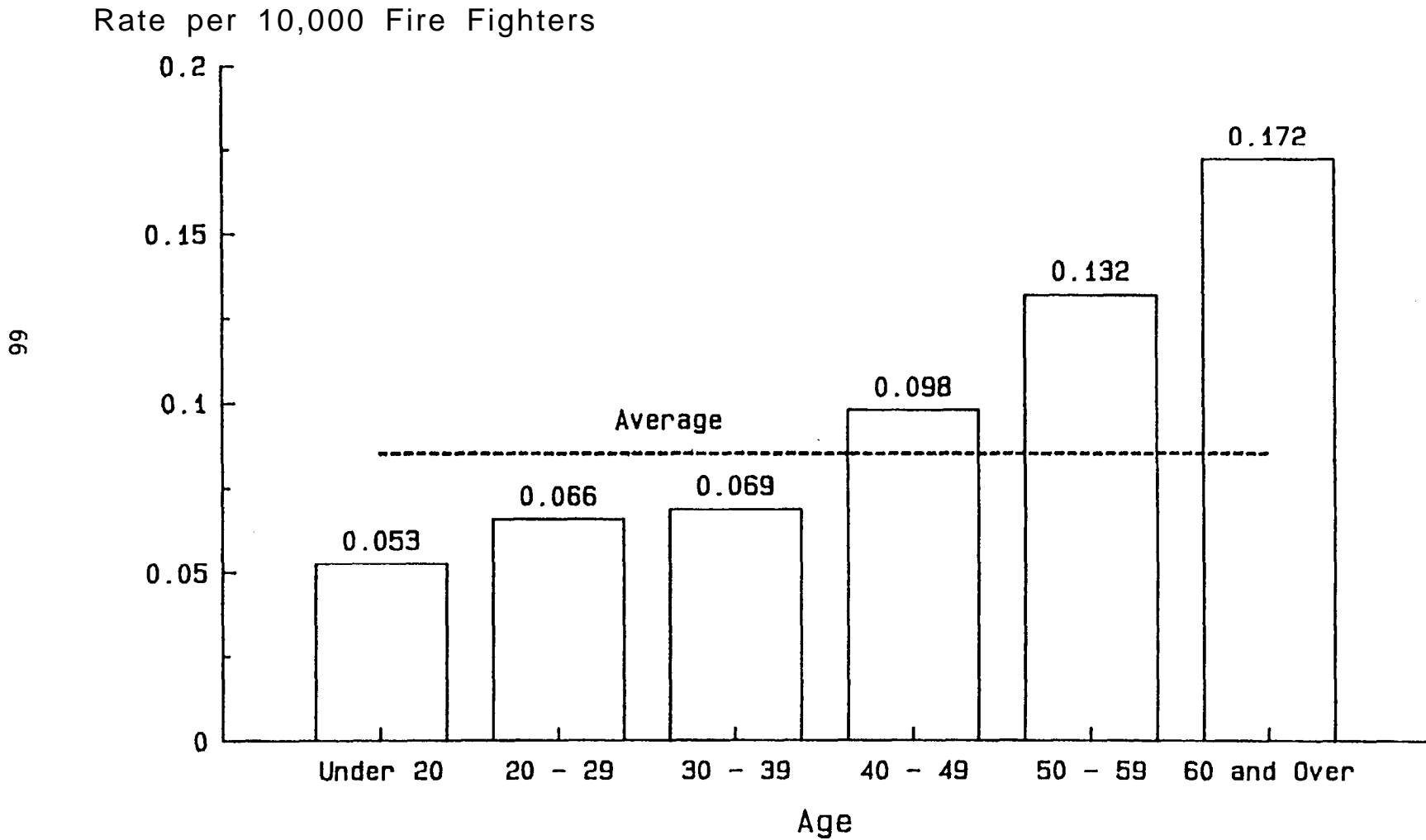


Figure 31
Death Rates per 10,000 Fire Fighters
During Training-Related Activities
1984 - 1993



fighters get older. Fire fighters age 60 and over have a rate of death in training-related incidents that is double the average.

Conclusion

Training is an area where needless deaths occur. As for all other types of duty, heart attacks make up the major share of training deaths and many of the victims had had prior heart attacks, bypass surgery or heart disease. Motor vehicle accidents while traveling to and from training sessions represent an area where ordinary precautions and attention to driving rules and road conditions should have an impact. Training exercises themselves, since they are conducted in controlled settings, should be designed so as not to endanger the participants. This requires that recommended safety procedures be followed. That, in combination with competent instruction, should result in the level of safety necessary to protect lives.

VI. Conclusions and Recommendations

We have now had two consecutive years where the number of deaths has been substantially below 100. We are apparently seeing the effects of improvements in fire fighter protective equipment, apparatus design and fire fighter fitness and training, as well as an increased awareness throughout the fire service that *the vast majority of fire fighter deaths do not have to occur*, in spite of the very real, inherent dangers of the profession.

There remain, however, two very important areas where improvements must be made. The first, where the largest number of deaths occurs each year, is the heart attack problem. Half the deaths in 1993 were due to heart attacks, and where medical documentation was available, it indicated in almost every case that the victim had had at least one prior heart attack, bypass surgery or a detectable level of arteriosclerotic heart disease. 'Clearly, too many fire fighters are continuing to actively engage in fire fighting activities after they have experienced health problems that should preclude their participation.

The other area is motor vehicle accidents. In 1993, almost one quarter of the deaths were the result of motor vehicle accidents. Half of these accidents involved fire fighters responding to alarms in their personal vehicles. Factors in the accidents were not reported for every incident, but among those that were cited were driver inattention, speeding and failure of the drivers to observe the rules of the road. These are all issues that can be addressed by a written, enforced policy and better training.

Training itself is an area where needless deaths occur. As for all other types of duty, heart attacks make up the major category of training deaths and many of the victims had had prior heart attacks, bypass surgery or heart disease. Motor vehicle accidents while traveling to and from training sessions represent

an area where ordinary precautions and attention to driving rules and road conditions should have an impact. Training exercises themselves, since they are conducted in controlled settings, should be designed so as not to endanger the participants. This requires that recommended safety procedures be followed. That, in combination with competent instruction, should result in the level of safety necessary to protect lives.

The U.S. fire service has made remarkable progress in the past few years in dramatically reducing the number of fire fighter deaths, demonstrating the effectiveness of recent advances in fire fighter safety and health. These efforts need to continue to further reduce the annual death toll.

References

1. Michael J. Karter, Jr., *U.S. Fire Department Profile through 1991*, Quincy, MA: National Fire Protection Association, Fire Analysis and Research Division, October 1992.
2. Michael J. Karter, Jr., "U.S. Fire Loss in 1993," *NFPA Journal*, Vol. 88, No. 5, (September 1994).
3. The four regions defined by the U.S. Census Bureau are as follows:

Northeast: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

Northcentral: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

South: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia.

West: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.
4. *Statistical Abstract of the United States - 1992*, U.S. Bureau of the Census, 112th Edition, 1992.