# 2004-2005 National Sample Survey of Unreported Residential Fires

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## Executive Summary

This report provides information from the third national telephone probability sample survey of unreported (and non-fire department-attended) residential fires sponsored by the U. S. Consumer Product Safety Commission (CPSC). The first survey was conducted in 1974 and the second in 1984.[1] All three surveys have had the same objectives, that is, to develop an understanding of the causes of residential fires, the ignition sources, what objects ignited first and the behavioral factors associated with the fires. The surveys also examined how people became aware of the fires, including the role played by smoke alarms and how fires were extinguished.

The three surveys complement the understanding of fire and fire loss from official statistics on reported fires with information on fires that were not attended by or reported to fire departments. All three surveys show that the vast majority of unwanted fires that start in residences were not attended by fire departments.

Statistics on fire department-attended fires have shown that fire incidence and fire loss in general have decreased during the last 20 years. Despite decreases in residential fire losses in recent years, fire is still a serious national problem. For 2005, the most recent year for which data were available when this report was written, there were an estimated 375,100 unintentionally caused fire department-attended residential structure fires, resulting in 2,630 fire deaths, 12,820 fire injuries, and $6.22 billion in property loss.[2]

The current survey, conducted between June 2004 and September 2005, contained data from 916 households that reported to the telephone interviewers that they had experienced at least one fire during the previous 90 days. Households were selected from across the nation as a probability sample using random digit dialing. The sample was stratified by region of the country and demographic composition of the population. Fires were defined in a manner similar to the two previous surveys as

> *… any incident large or small that you have had in or around your home…that resulted in unwanted flames or smoke, and could have caused damage to life or property if left unchecked.*

In addition to the sample of fire households, there was a second probability sample of 2,161 households that did not have a fire during the previous 90 days. These non-fire households were asked questions about their demographic and socioeconomic characteristics. Also, these households were asked about the types of fire defenses in their homes including smoke alarms and fire extinguishers. The purpose for selecting

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[1] U.S. Consumer Product Safety Commission (1978), "Special Report: Results of National Household Fire Survey." HIA Special Report, U.S. Consumer Product Safety Commission, Washington, DC. Audits and Surveys, Inc. (1985), "1984 National Sample Survey of Unreported, Residential Fires." Final Technical Report Prepared for the U.S. Consumer Product Safety Commission. Princeton, NJ.

[2] Chowdhury R, Greene M and Miller D (2008), "2003-2005 Residential Fire Loss Estimates," U.S. Consumer Product Safety Commission, Washington, DC.

this second sample was to compare the fire and non-fire households and to examine the factors that might be associated with the risk of fire.

The response rates in the survey were either 22.5 percent or 31.6 percent, depending on how unknown eligibility was allocated.[3] Unknown eligibility occurs when it could not be determined if the location dialed was a residence (eligible) or a business (not eligible) because the phone was not answered, it was answered by an answering machine, or the call was actually answered and the respondent hung up before identifying the phone line as residential or business.

The first task of the survey, to estimate the number of unreported fires from information reported by survey respondents, required correcting for the possibility that respondents may have forgotten some fire incidents that occurred during the previous 90 days. An analysis in this report showed that recall of fire incidents among fire households decreased with increasing time between interview and fire. Also, incidents that respondents characterized as more severe or involving more fire damage were recalled longer than less severe incidents. Accordingly, estimates of the number of fires (reported and unreported) were made using a 14-day recall period for less severe incidents and a 21-day recall period for the more severe incidents. This was similar to the 1984 survey where fire estimates were based on the previous month although respondents were asked to recall fire incidents over the previous three-month period.

An important finding of the survey is that the number of reported and unreported residential fires declined substantially from the 1984 estimates of 25.2 million fires of which 23.7 million were residential structure fires. This was a rate of 28.3 residential structure fires per 100 households. In the present survey, it was estimated that there were 7.4 million fires in the U. S. (annualized rate for 2004-2005) and a rate of 6.6 residential structure fires per year per 100 households. This was a decrease of 68.7 percent in the number of residential structure fires and a decrease of 76.8 percent in the household fire rate. These decreases were much greater than the 43 percent decrease in the number of residential structure fires that were reported by fire departments over the same period.

According to survey results, about 3.4 percent of residential fires were attended by fire departments. This is essentially unchanged from the 1984 survey, where 3.7 percent of residential fires were attended by fire departments.

Fires involving cooking appliances were associated with the largest single type of fire incident, accounting for 4.7 million fire department-unattended fires (65 percent) in the present survey. This represented a 62 percent decrease from the 1984 survey estimate

[3] The lower response rate is calculated by assuming that all respondents where eligibility is unknown are non-responses, while the higher response rate is calculated by assuming that the non-response rate is the same as the rate among the respondents with known eligibility. The calculations are based on methods developed by the American Association for Public Opinion Research and are in widespread usage. See American Association for Public Opinion Research (2000), "Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys," AAPOR, Ann Arbor, MI.

of 12.3 million fire department-unattended fires. The decrease in cooking fires accounts for much of the decrease in all types of fires during the twenty years between the surveys.

Although fewer in number, fires involving matches, lighters, and smoking materials as the heat sources – collectively non-appliance fires -- decreased by 84 percent between the two surveys. This was a larger percentage decrease than all fires. The decrease in these types of fires may be a result of decreases in the number of smokers over the past 20 years.

A number of comparisons were made between fire and non-fire households. The differences that were statistically significant were type of ownership, where 34 percent of fire households were renters in contrast to 23 percent of non-fire households that were renters. The average size of fire households was significantly larger than non-fire households; and in particular, fire households averaged more people under 18 and fewer members over 65 than non-fire households. Race and ethnicity did not appear to be associated with whether a household was a fire or non-fire household.

Another finding of the survey was that an estimated 97 percent of U.S. households had at least one smoke alarm, an increase from 62 percent in the 1984 survey. Over 80 percent of households had two or more alarms, and 84 percent had alarms on all floors. However, only 31 percent had alarms in all bedrooms, and 19 percent had alarms that were interconnected. Moreover, fire households and non-fire households differed in their alarm configurations. Fire households were significantly less likely than non-fire households to have alarms on all floors, in all bedrooms, and with interconnections.

Overall, people were home and smoke alarms sounded in an estimated 30 percent of fires, alerting residents to the fire in 12 percent of incidents, and providing the only alert of the fire in 10 percent of incidents. People were home and the alarms sounded in 53 percent of incidents for fires in households with interconnected alarms, providing the only alert of the fire in 26 percent of incidents. For fires in households that did not have alarms on all floors, the alarms sounded in 4 percent of incidents, alerting people in 2 percent of incidents, and providing the only alert of the fire in those 2 percent of incidents.

Fires originating on the stove set off the alarm more frequently than other fires, at 41 percent of incidents, providing an alert of the fire in 16 percent of incidents and the only alert in 13 percent of incidents. In fires associated with lighters, cigarettes, and matches, the alarm sounded in 28 percent of incidents, alerting people and providing the only alert to the fire in 8 percent of incidents.

In 55 percent of fires, someone was home when the fire began but the alarm did not sound. In almost all cases, survey respondents attributed the lack of alarm operation to not enough smoke reaching the alarm. When enough smoke had reached the smoke alarm but it still did not operate, almost all respondents reported that they believed that before the fire, the alarm had been in working condition.

The survey also showed that more smoke alarms were better than fewer alarms because in homes with alarms on all levels, residents were alerted to fires more frequently than in homes that did not have alarms on all floors. Interconnected alarms, however, appeared to be the best for warning residents of fires and, in particular, in providing the only alert of the incident.

Residents reported that most fires were put out by using water, turning off power to the equipment, smothering the fire, or separating the burning item from the source of heat. Fire extinguishers were used in 5 percent of incidents and, put out the fire completely in about half the incidents when used. Extinguishers were used most frequently in cooking fires. Fire extinguishers were also more likely to be used if they were in the same room where the fire started (most frequently the kitchen) rather than in a different room.

## Acknowledgements

The primary motivation for the survey came from Linda Smith, a staff member of the Division of Hazard Analysis at CPSC, who retired in 2005. Linda was involved in the design and analysis of the 1984 survey and believed that such a survey would provide valuable insights beyond official fire statistics. She proposed conducting this survey, wrote the documents supporting the survey, led the team selecting the survey contractor, participated in the design of the questionnaire and the testing, redesign and retesting. Linda was still at CPSC during the initial phase of the data collection and she provided leadership through that phase.

The CPSC staff study team consisted of Linda Smith during her tenure at CPSC, the two co-authors, and William W. Zamula of the Directorate for Economic Analysis. Drafts of the report were read and commented on by Kathleen A. Stralka, Director, Division of Hazard Analysis, and Russell H. Roegner, Associate Executive Director, Directorate of Epidemiology. Assistance with interpreting fire data was provided by Rohit Khanna, Fire Protection Engineer, Directorate for Engineering Sciences. Erlinda Edwards of the Office of Hazard Identification and Reduction provided extremely helpful editorial comments.

The telephone survey was conducted by Synovate, Inc. Alan Roshwalb designed the sampling plan, the sample weighting, and prepared the SAS®[4] dataset used for the final analysis. Tim Amsbury and John Lavin were instrumental along with CPSC staff in the design of the questionnaire and supervised the data collection. The project was supervised by Corporate Vice President, W. Burleigh "Leigh" Seaver.

[4] SAS® is a service mark of the SAS Institute, Cary, NC.

In addition to funding from the Consumer Product Safety Commission, survey funding was also provided by the Division of Unintentional Injury Prevention of the National Center for Injury Prevention and Control in the Centers for Disease Control and Prevention (CDC), and the United States Fire Administration, a component agency of the Department of Homeland Security.

## Table of Contents

## Chapter 1
## Introduction to the 2004-2005 Residential Fire Survey

In 2004-2005, U.S. Consumer Product Safety Commission (CPSC) staff conducted a national telephone survey of fire department-attended and unattended residential fires. [5] This is the third such national telephone survey of this type that has been sponsored by CPSC. The first survey was conducted in 1974 and the second in 1984.[6] All three surveys have had the same objective, that is to develop an understanding of the causes of residential fires, especially among fires that are not attended by the fire service and therefore do not enter the official statistics. The three surveys also focused on how people became aware of household fires including the role played by smoke alarms and how such fires were extinguished.

The three surveys complement the understanding of fires and fire losses from official statistics with information on fires that were not attended by or reported to fire departments. Since the 1970s there have been two main national sources of information on fire department-attended fires. These are the National Fire Protection Association's (NFPA) Annual National Fire Experience Survey[7] and the United States Fire Administration's National Fire Incident Reporting System (NFIRS).[8] Information from these surveys on fire department-attended fires is useful in helping CPSC staff devise and evaluate strategies to reduce residential fire deaths, one of the agency's strategic goals. The information is also useful to CPSC's federal partners, the U.S. Fire Administration and the Centers for Disease Control and Prevention, in focusing efforts to reduce fire losses. Information from the NFPA Survey and NFIRS is widely used by other

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[5] The U.S. Consumer Product Safety Commission is an independent federal regulatory agency charged with protecting the public from unreasonable risks of serious injury or death from thousands of consumer products. Deaths, injuries, and property damage from consumer product incidents cost the nation more than $800 billion annually. The CPSC is committed to protecting consumers and families from products that pose a fire, electrical, chemical, or mechanical hazard or can injure children. Jurisdictional authority for the CPSC related to fire hazards is from the Consumer Product Safety Act, the Federal Hazardous Substances Act, the Flammable Fabrics Act and the Children's Gasoline Burn Prevention Act. Agency regulations associated with fire prevention include regulations for cigarette and multi-purpose lighters; flammability of mattresses, children's sleepwear and general wearing apparel; and the resistance of portable gasoline containers to children opening them. The agency also works with interested stakeholders to establish and promote voluntary standards.

[6] U.S. Consumer Product Safety Commission (1978), "Special Report: Results of National Household Fire Survey." HIA Special Report, U.S. Consumer Product Safety Commission, Washington, DC. Audits and Surveys, Inc. (1985), "1984 National Sample Survey of Unreported, Residential Fires." Final Technical Report Prepared for the U.S. Consumer Product Safety Commission. Princeton, NJ.

[7] Karter MJ Jr. (2008), "Fire Loss in the United States 2007," National Fire Protection Association, Quincy, MA. This series is published annually. CPSC staff estimates use both NFIRS and the NFPA survey for estimates of residential fire losses. The most recent staff estimates are for 2005 found in Chowdhury R, Greene M and Miller D (2008), "2003-2005 Residential Fire Loss Estimates," U. S. Consumer Product Safety Commission, Washington, DC.

[8] U.S. Fire Administration (1997), "The Many Uses of the National Fire Incident Reporting System." U.S. Fire Administration, Emmitsburg, MD. United States Fire Administration (1997),"Fire in the United States 1985-1994," Ninth Edition. U.S. Fire Administration, Emmitsburg, MD

organizations, and together, these constitute the source of official fire statistics in the United States.

These official statistics have shown that fire incidence and fire loss in general have decreased during the last 20 years. Despite decreases in residential fire losses in recent years, fires are still a serious national problem. For 2005, the most recent year for which the NFPA survey and NFIRS data were available at the time this report was written, CPSC staff estimated that there were 375,100 unintentionally caused fire department-attended residential structure fires, resulting in 2,630 fire deaths, 12,820 fire injuries, and $6.2 billion in property loss.[9] However, fire department-attended fires are not the complete picture. In the 1984 Residential Fire Survey, for example, it was estimated that there were 23.7 million unintentional and unwanted residential structure fires of which 22.9 million (96.7 percent) were not reported to or attended by fire departments.[10]

Like the 1984 survey, the present survey was limited to residential structure fires, including fires that started in the home or, if started outside the home, ultimately spread to the home. Similar to the 1984 survey, fires were defined in the beginning of the survey questionnaire to include *any incident, large or small, that occurred in or around the home, resulted in unwanted flames or smoke, and that could have caused damage to life and property if left unchecked*. This definition included cooking and other types of fire incidents that took some action to extinguish, but excluded "friendly fires" such as barbecues and bonfires unless those fires got out of control. Also excluded were motor vehicle fires and brush fires unless they spread to the home.

One of the reasons for studying fires that were not attended by the fire department is to try to understand the process of how residents became aware of an unwanted fire and ultimately brought it under control without requiring fire department involvement. All fires begin small from contact between a heat source and a fuel; some fires are controlled, while others grow causing injury and property damage. The survey can reveal the role of smoke alarms in alerting people to the fire as the fire develops, as related to the type of fire and the location of the smoke alarms. Also such a study can describe how household fire extinguishers were used among other methods for putting out fires.

A second reason to study unattended fires is to help explain the decrease in reported fires over the period between the two surveys. In 1980, there were an estimated 655,500 fire department-attended residential structure fires; thus, fire department-attended fires decreased by 43 percent between 1980 and 2005.[11] Some have conjectured that the total number of fires (i.e., both attended and unattended) has not decreased, but that earlier warning of the incidents provided by smoke alarms, which surveys have

[9] Chowdhury R, Greene M and Miller D (2008), "2003-2005 Residential Fire Loss Estimates," U.S. Consumer Product Safety Commission, Washington, DC, page 1.
[10] Audits and Surveys, Inc. (1985), *op cit.*, page 22.
[11] Mah J (2001), "1998 Residential Fire Loss Estimates: U.S. National Estimates of Fires, Deaths and Property Losses from Non-Incendiary, Non-Suspicious Fires." U.S. Consumer Product Safety Commission, Washington, DC, Table 6. Data for 2004 from Chowdhury, et al, (2008), *op cit.*

shown to have become almost universal, has allowed residents to extinguish fires before they got out of control and required fire department assistance.[12] If this conjecture is true, it would suggest that the percentage decrease in fire department-attended fires would have been greater than unattended fires in the 20 year period between the surveys.

Third, official statistics show that the largest single category of fires begins in the kitchen and involves cooking equipment. For example, 2005 statistics show there were 137,500 residential cooking fires, involving 210 fatalities, 3,250 injuries, and $412.7 million in property loss.[13] Cooking fires account for the largest percentage of fires. A study of unattended fires should also be dominated by cooking fires and should provide additional insights into these incidents, especially those that are able to be controlled by household residents. Because there are so many of these fires, reducing the total number of fires involves reducing the number of cooking fires.

Fourth, during the past 20 years, there have been substantial changes in the types of appliances in homes. Computers and home office equipment, home entertainment systems, multiple televisions per household, electric heat pumps and central air conditioning, microwave ovens, batteries of all kinds and sizes, and other small kitchen appliances are new and, for the most part, have not resulted in substantial numbers of fire department-attended fires. It is not known if they have resulted in substantial numbers of unattended fires.

Fifth, smoke alarms are now almost universal in residences.[14] This may also have altered the ratio of attended to unattended fires.

Finally, such a study can contribute to the knowledge of household fire risk. All previous surveys and the current survey collected data on a comparison group of households that did not report fires during the previous three months. Such a comparison includes differences in housing and demographic characteristics, the presence or absence of smokers, young or older household members, and other factors.

Four sections follow in this chapter. The next section describes the two previous surveys. It is followed by some background information on how the 2004-05 survey was developed. Major findings of the survey are discussed next. The last section outlines the chapters and describes the organization of the report.

## Previous Surveys

The first survey was conducted by the U.S. Bureau of the Census on April 15, 1974 as part of the monthly Current Population Survey. The survey report was delivered in February 1978. The sample consisted of respondents from 33,856 households in the

[12] See Audits and Surveys, Inc., (1985), *op cit.,* page 20.
[13] Fire losses from Chowdhury R, Greene M and Miller D (2008), *op cit.,* pages 5-8.
[14] For example, see Ahrens M (2007b), "U.S. Experience with Smoke Alarms and Other Fire Detection/Alarm Equipment." National Fire Protection Association, Quincy, MA.

U.S. In face-to-face interviews, Census Bureau staff asked respondents if a fire had occurred in or around their home, or whether a household member had been killed or injured by fire at any location between April 1, 1973 and April 15, 1974.[15] 2,233 respondents indicated that at least one fire occurred during that period. These respondents were then asked a series of questions including the location of the fire, characteristics of the fire, consumer products involved, fire losses, and other details. After applying survey weights to the responses, it was estimated that there were 4.5 million residential fire incidents during the 54-week survey period from April 1, 1973 to April 15, 1974.[16]

In 1977, the Statistics Department of the University of Wisconsin was asked to reanalyze the survey. It had been suspected that the survey underestimated the number of residential fires because there was some evidence in the survey that respondents did not remember all the fires during the 12-month recall period, especially those fires occurring many months before the interview. This suspicion was borne out by the analysis of the data. The University of Wisconsin report, issued in November 1977, made adjustments for the lack of recall. As a result of those adjustments, they estimated the number of unreported residential fires at 11.8 million, more than double the original estimate.[17] Using this corrected number of fires, they estimated that 91 percent of residential fires were not reported to U.S. fire departments.[18]

The 1984 survey was developed on the basis of the 1974 survey, but with some important distinctions. These were as follows: (1) there was a small difference in the definition of a fire,[19] (2) the 1984 survey was conducted by telephone rather than with face-to-face interviews, (3) the length of the recall period was different between the two surveys (three months rather than one year), and (4) the 1974 survey was conducted during a single month (April), while the 1984 survey was conducted during 12 consecutive months. Of these differences, probably the most important distinction between the surveys was the length of the recall period. It is also the most important distinction between the 1984 survey and the present survey.

The 1984 survey also collected information on a sample of households that had not had a fire during the three-month period. These non-fire households were used to compare various demographic factors and other factors with fire households.

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[15] In all three surveys, the term "their home" refers to where people are living regardless of whether the home is owned or rented by the residents.
[16] U.S. Consumer Product Safety Commission (1978), *op cit.,* pages 2-7.
[17] Audits and Surveys (1985), *op cit.,* page 11.
[18] *Ibid.,* page iii.
[19] Audits and Surveys (1985), *op cit.,* page 3. Page 67 of the 1974 survey (U.S. Consumer Product Safety Commission, 1978, *op cit.)* shows that the initial screening questions about whether a fire had occurred were similar between the two surveys. Respondents in the 1974 survey were asked, "We are interested in all types of fires, no matter how small they might have been…" Respondents who did not indicate that a fire had occurred were then prompted with types of fires such as "Grease or something else flaming on the stove or oven, Burning Clothing," etc. The screening questions in the 1984 survey were similar but defined the residence to include home, vacation home, or on the respondent's property.

In the 1984 survey, telephone interviews were conducted between December 1983 and November 1984. Respondents were interviewed during the first two weeks of the month and asked about fires that occurred in the past three calendar months. The three-month period was chosen because the University of Wisconsin analysis of the 1974 survey had demonstrated that one year was too long a period for respondents to recall fire incidents. However, when the 1984 survey data became available, an analysis of the number of incidents reported by month from the interview showed that the most fires were reported for the month before the interview and the fewest fires were reported for the month three months before the interview. From this finding, it appeared that even three months was too long a period for recall of fire incidents. This led the authors of the 1984 survey to estimate fire incidence using only those incidents that occurred during the month before the interview.

Accordingly, using this one-month recall period, it was estimated that in 1984 there were 25.2 million residential fires, of which 24.3 million (96.4 percent) were not reported to U.S. fire departments.[20] This was an incidence rate of about 30 unattended fires per hundred U.S. households per year. This represented more than a doubling in the number of fire incidents from the 1974 survey. Thus, one key finding from both surveys was that the vast majority of unwanted residential fires was not reported to fire departments and therefore was not reflected in official fire statistics.

Before the 1984 survey was conducted, other surveys had shown that the proportion of U.S. households with smoke alarms was steadily increasing and, in particular, had increased from 5 percent or less in 1974 to more than half the U.S. households by 1984.[21] The authors of the 1984 survey conjectured that if fires were detected earlier as the result of a smoke alarm sounding, residents would discover the fire in a smaller, more manageable state and could extinguish such fires without needing to call the fire department. That would then lead to an increasing proportion of all fires not being reported to fire departments.[22] This was one explanation offered by the authors of the 1984 survey for the more than doubling of the number of unattended residential fires between the 1974 and 1984 surveys. The other explanations were the 20 percent increase in the number of households from 1974 to 1984, and the increased rigor of the 1984 survey methodology.[23]

It is unknown as to the extent that the University of Wisconsin adjusted 1974 survey underestimated fire incidence, but it is very likely that the 1984 survey was an underestimate. This is because of the way that the questions were posed about residential

[20] Although denoted as Residential Fires in Table 3-4, Audits and Surveys (1985), page 18, these include fires in a personal motor vehicle. Contemporary procedures for fire data analysis would count motor vehicle fires separately. Removing the motor vehicle fires leaves 23.7 million residential structural fires of which 22.9 million (96.7 percent) were not reported to U.S. fire departments (*ibid.,* page 22). On a per household basis, using the 23.7 million fires and an estimate of 83.8 million households, there were 28.3 fires per 100 households.
[21] Audits and Surveys (1985), *op cit.,* page 1.
[22] Audits and Surveys (1985), *loc cit*.
[23] Audits and Surveys (1985), *op cit.,* page 22.

fires. During the first two weeks of each month beginning in December 1983 and ending in November 1984, respondents were asked the following question:

> *Have you had a fire in or around your home, vacation home or your property during the past 3 months – that is during _____, _____ or _____?*

where the telephone interviewers filled in the blanks with the names of the previous three months.[24] Fires occurring between the beginning of the month of the interview and the interview, a period of up to two weeks, were not captured in the survey. As shown in Chapter 3 of this report and in the growing literature on recall of injury incidents, survey respondents tend to forget incidents that occurred more than a few weeks before the interview. Had the 1984 survey interviewers asked about incidents that occurred during the interview month, without doubt, the estimated number of fire incidents would have been higher than estimated in the survey report.

Even though the 1984 survey asked about fires over a period of three months, it used only the first month before the interview to estimate fire incidence. However, the remainder of the 1984 report used fire incidence estimates differently. In analyses that drew contrasts between fire and non-fire households, the 1984 survey defined households as fire households if a fire occurred any time during the three-month period. In later chapters examining fires in consumer products, fires over the entire three- month period were used again, but the estimates were scaled to the annual estimates from the one-month fire incidence estimates.[25]

Some of the major findings of the 1984 survey were as follows:

- There were 25.2 million residential fires of which about 3 percent (925,000) were reported to fire departments. Of the residential fires, 23.7 million were residential structure fires; the remaining incidents were vehicle or outside fires. This was more than a doubling of the number of residential structure fires from the 1974 survey.

- The survey identified fire risk factors by comparing fire and non-fire households. Non-fire households (households that did not have a fire in

[24] *Ibid.,* page 5 for the interviewing plan. The survey instrument is in the Appendix of that document.
[25] There are a number of methodological issues associated with the samples occurring from different length survey periods that are discussed in some detail in Chapters 3, 4, and 6 of this report. First, since it is logical to assume that people are more likely to recall incidents of greater seriousness (however defined) for a longer time, a sample based on a three-month recall period is likely to contain a larger proportion of serious incidents than one based on a one-month recall period. Consequently, even though the 1984 report scaled the three-month estimates to the one-month estimates, the distribution of the types of fires was biased toward more severe incidents than actually occurred. Second, identifying fire households as those with fires in the three-month period is certainly correct, but it is likely that some of the non-fire households may have had fires during the three-month period that they were unable to recall. This contaminates the comparison between fire and non-fire households, making the distinctions less sharp. Third, while it is desirable to use as short a recall period as possible, short recall periods result in smaller sample sizes, which among other things would increase the amount of sampling error in various estimates.

the previous three months) did not differ significantly from fire households in the type of area where the household was located (urban or rural), region of the country, type of dwelling, home ownership as compared with rental occupancy, age of the structure, household income or whether or not smoke alarms were present. Significantly different attributes were as follows: fire households had more members, more members under the age of 18, more smokers, and the heads of households tended to have higher educational levels.

- More residential fires (43 percent) occurred between 1 and 6 pm than any other time, fewer occurred between midnight and 6 am.

- The majority of residential fires (69 percent) were associated with human carelessness. A minority (20 percent) were attributed to equipment failure.

- Fires produced illness or injury in 6 percent of the cases.

- Household appliances were involved in 68 percent of incidents; 78 percent of these appliance-related fires occurred in the kitchen and 78 percent involved cooking or kitchen appliances. Other consumer products involved in fires included electrical components such as wiring, lamps, cords or plugs (6 percent); heating appliances (4 percent); and miscellaneous other appliances (13 percent).

- Electrical wiring fires resulted in some property damage in 80 percent of the incidents, heating appliances in 61 percent of the incidents, and kitchen/cooking fires in 36 percent of the incidents. Most of the property damage was valued by respondents as less than $100. Injury or illness resulted from 5 percent of the cooking fires, 3 percent of the heating fires, and 2 percent of the electrical wiring fires.

- About 62 percent of U.S. households were estimated to have smoke alarms; more households were likely to have them in the Northeast and fewer were likely in the West.

**Development of the 2004-2005 Residential Fire Survey**

CPSC staff began designing the survey in 2002. Staff prepared a request for proposal for a survey contractor in May 2002 and staff evaluated bids selecting Synovate, Inc. of McLean, Virginia as the survey contractor in Fall 2002. Between that time and June 2004, agency staff and Synovate staff designed the survey questionnaire, building upon the 1984 Residential Fire Survey; pilot tested survey questions; prepared the documents for Office of Management and Budget clearance; trained the telephone interviewers; and designed the Computer-Assisted Telephone Interviewing (CATI)

system for collecting the results. During that period, Synovate staff also conducted cognitive tests of the survey questions, to discover if respondents understood the questions to mean the same as the survey designers intended. Following revisions to the survey questionnaire that were informed by the cognitive testing, telephone interviewing began in June 2004 and was completed in September 2005. Later that year, Synovate delivered a SAS® dataset containing the raw survey result to CPSC staff.[26] Synovate also provided sampling weights for each case.

The final survey dataset contained more than 1600 variables. CPSC staff wrote the computer programs for analyzing the survey data and performed the statistical analyses and interpretations that are found in this report.

The sampling design had a requirement for both fire and non-fire households so that comparisons could be made between the two. The design involved a Random Digit Dialing (RDD) probability sample of the United States, with oversampling of selected areas to obtain adequate sample sizes in order to characterize the fire problem among subsets of the population that were considered to be high-risk. These included rural households and low socioeconomic households and households with minority ethnic and racial group members.

Like the 1984 survey, the design specified selecting all the households with a qualifying fire in the previous three months. Respondents were asked at the very beginning of the survey:

> *We are interested in learning about any fires – large or small – that you have had in or around your home. By "fire" I mean any incident – large or small – that resulted in unwanted flames or smoke, and could have caused damage to life or property if left unchecked.*

If the respondent was unsure of what was meant by "home," the interviewer was instructed to continue as follows:

> *By "home," I mean your house, apartment, or other residence where you live.*

To provide a better definition of fires, respondents were then asked if any of the following incidents occurred during the past three months.[27]

> *Unwanted flaming or smoking on the stove or another cooking appliance*
> *A smoldering electrical appliance*
> *Burning or smoldering clothing, either being worn or not being worn*
> *Smoldering fabric, mattress, rug or upholstered furniture*
> *A child igniting something with a match or lighter*

[26] SAS® is a service mark of the SAS Institute, Inc., Cary, NC.
[27] The actual date of the beginning of the three-month period was read to the respondent. For example, if the survey was being taken on July 15, 2005, the three-month period would have extended back to April 15, 2005.

*A candle igniting something*
*A fire that started outside your home, and spread to the home*
*Any other fire – large or small – that produced unwanted flames or smoke*

Respondents answering any of these affirmatively were then defined as "fire households," and the full questionnaire was then administered. Fire households were asked about the type of the fire, the cause of the fire, the products involved in starting the fire, and the items that burned. Also asked were questions about injuries and deaths, medical treatment required for fire victims, property damage, and if the fire was attended by the fire service. Fire households were also asked about the performance of smoke alarms, fire extinguishers, and sprinklers during the fire.

For the respondents who did not have a fire in the past three months, 1/40$^{th}$ were randomly selected as a comparison group. This was similar to the 1984 survey. An abbreviated form of the questionnaire was administered that included demographic questions in order to be able to compare fire risk by demographic group. Non-fire households were also asked about the number, type, and location of smoke alarms, and the availability of fire extinguishers and home sprinkler systems.

## Chapter Outline

This report contains 8 chapters. This section briefly describes the content of Chapters 2-8.

*Chapter 2 Survey Methodology*

This chapter is a technical description of the sample design, management, and weighting of the survey. It does not deal with fire incidence or other substantive issues. The reader can skip this chapter on the first reading and return later to learn more about the survey design.

The chapter begins with a description of how the sample was designed. This includes information about how the survey was stratified, the use of the GENESYS® system to generate samples of telephone numbers, the anticipated sample size and allocation by stratum, and estimated sampling error for that design. The chapter continues with how the telephone interviewing process was managed including interviewer training, data collection, qualifying respondents, and procedures utilized to maximize response rates.

During the telephone interview, more than a half million telephone numbers were dialed. Using the formulas developed by the American Association for Public Opinion Research (AAPOR), the response rate was either 22.5 percent or 31.6 percent depending on how phone numbers with unknown eligibility were allocated.

The next section of Chapter 2 presents the number of survey responses actually obtained in the survey, by stratum, race, ethnicity, and demographic group. This is followed by a discussion of how sample weights were calculated. Those weights were used in all analyses found in subsequent chapters. An appendix to this chapter provides details on the AAPOR procedures.

*Chapter 3 Fire Incidence*

The purpose of this chapter is to develop and explain the methodology for estimating the annual number of residential fires, including both fire department-attended and unattended fires and to present those estimates.

The chapter begins with a review of the methods used to make fire estimates in the 1974 and 1984 surveys, in particular, concerning how memory recall issues were handled. The surveys asked respondents to recall fire incidents up to one year from the interview (1974 survey) and up to three months from the interview (1984 survey). The analyses in both surveys clearly indicated that respondents did not recall fire incidents and, as expected, recall decreased with increasing time from the interview. This is then followed by a review of the literature on retrospective recall of illness and injury incidents, especially on methods for estimating injury and incident rates in such studies.

In addition to completely forgetting incidents that occurred, respondents may have remembered that a fire occurred, but may not have been able to remember the date it occurred. While many respondents in this survey were able to provide the interviewers with the date of the fire, some were able to identify only the month, and others could not recall either the month or day, but asserted that the incident occurred during the 91-day recall period. These missing dates must be allocated to the 91-day recall period using a statistical procedure (imputation). The methodology for imputing missing fire dates and estimation is outlined in this chapter. Part of the methodology involved classifying fires on the basis of characteristics associated with the severity of the fire incident. Using fire severity in the imputation process took into account that respondents would be more likely to remember dates when more severe fire incidents occurred.

Following imputation of the missing dates, the chapter applies a statistical procedure for selection of the most appropriate recall period. Various possibilities for the recall period were examined leading to selection of the recall period as that with the smallest amount of statistical error. Separate analyses by incident severity were conducted with the result that a 14-day recall period was chosen for the less severe incidents and a 21-day period for more severe incidents. In this chapter, then, household fire incident rates were computed using only the incidents that fell into the 14- or 21-day period.

Results for the number of attended and unattended fires are then presented. It was estimated that there were 7.43 million residential fires annually of which 7.18 million were not reported to fire departments. Reported and unreported fires amounted to 6.6

attended fires per 100 households. These estimates represented a decrease of 71 percent in the number of fires from the 1984 survey estimates, and a decrease of 78 percent in the per household fire incident rate from the 1984 survey. Between 1980 and 2005, official statistics on fire department-attended residential structure fires showed that such fires decreased by 43 percent.

One of the questions motivating the present survey was to compare the decrease in fire department-attended fires with the decrease in fires not attended by fire departments. As mentioned earlier in this chapter, it has been suggested that the almost universal adoption of household smoke alarms in the last 20 years has resulted in people becoming aware of fires at an earlier point in the fire development. This would allow them to extinguish the fire without notifying the fire department. The implication is that over the past 20 years, fire department-attended fires would have decreased much faster than unattended fires. As that was not found in the survey, there does not seem to be support for this conjecture.

*Chapter 4 Comparison of Fire and Non-Fire Households*

This chapter evaluates fire risk factors by comparing characteristics of fire households with non-fire households. As mentioned above, fire households were defined as the survey respondents who had at least one fire during the three-month recall period, while non-fire households were the households that did not so indicate.

Some of the factors analyzed in the chapter include region of residence, type of housing unit, ownership versus renting, house age, household size, age composition, presence of smokers, income, education, race, and ethnicity. Factors that were significantly different between fire and non-fire households were as follows:

- Fire households were more likely to be renters and less likely to be owners
- Fire households had on average more members and, in particular, more people under 18 but fewer people over 65
- The head of fire households tended to have a higher educational level than the head of non-fire households.

Different from the 1984 survey, the presence of at least one smoker in the household did not appear to differ significantly between fire and non-fire households. The difference in the average number of smokers in fire and non-fire households was borderline significant. In this present survey, the percent of households with smokers was lower than in the 1984 survey.

*Chapter 5 Characteristics of Households with Smoke Alarms and Fire Extinguishers*

The purpose of Chapter 5 is to compare characteristics of survey respondents that had (1) different smoke alarm installations (including alarm location and alarm interconnection) and (2) fire extinguishers. Fire and non-fire households were compared as well as households with and without risk factors that were suggested by the analysis in Chapter 4.

In contrast to the 1984 survey where 62 percent of households had smoke alarms, 96.7 percent of households had at least one smoke alarm in the present survey. With that large a proportion having smoke alarms, it would be unlikely to find significant differences in the presence of smoke alarms by many household characteristics, but both region variables (South with the lowest proportion of households with alarms) and community type (non-urban with fewer alarms) were significant.

More than 75 percent of households had at least one fire extinguisher. There were significant differences in the percent having at least one extinguisher by type of dwelling (mobile homes and multifamily less likely to have fire extinguishers) and also renters were less likely to have at least one extinguisher in the residence than homeowners.

The chapter then examines the differences in smoke alarms between fire and non-fire households. Non-fire households were significantly more likely to have smoke alarms than fire households, and the difference in the average number of smoke alarms between fire and non-fire households was statistically significant. Controlling for the difference in the size of the dwelling showed that non-fire households had more smoke alarms per floor on average than fire households. In addition, non-fire households were more likely to have smoke alarms on all floors, in all bedrooms, and alarms that were interconnected.

Non-fire households had a larger number of extinguishers than fire households, on average.

The chapter concludes by comparing the two recommended smoke alarm configurations, smoke alarms on all floors and smoke alarms in all bedrooms by some of the risk factors developed in Chapter 4. Non-urban households were significantly less likely to have smoke alarms on all floors, while households with at least one person under 18 were significantly more likely to have smoke alarms on all floors. Non-urban households, households with smokers, and households with at least one person over 65 were less likely to have smoke alarms in all bedrooms, while households with at least one person under 18 were significantly more likely to have alarms in all bedrooms.

*Chapter 6 Characteristics of Residential Fires*

Chapter 6 returns to the same dataset used in Chapter 3, the fire incidents from the 14- and 21-day recall periods. This chapter and Chapter 7 examine the types of fires, the characteristics of households where they occurred, and the associated fire losses. A particular focus in this chapter is the ratio of unattended to attended fires, in order to shed some light on the differences in fire and household characteristics where attended and unattended incidents occur.

The chapter begins with the demographic breakdown of the estimated 7.4 million attended and unattended fires. Fires are broken down by region of the country, showing that the West region had the highest per household fire incidence and the lowest ratio of unattended to attended incidents. The chapter continues comparing fires in owner occupied and rental housing, single family and other types of housing, urban and non-urban regions, and other characteristics. One important finding noted in this chapter is that the per household fire incidence rate increased with an increasing number of members in the household. Also, households with at least one member under 18 had almost twice as many fires per household as those without a family member under 18. Although households with members 65 and over had a lower household fire incidence rate than households with only younger members, when fires occurred in households with older members, it was more likely to result in fire department attendance than a fire in a household with only younger members.

The chapter continues with descriptions of the fire characteristics, showing that most fires (4.8 million fires or 64 percent of the total) involved cooking appliances. The next largest source of heat was small open flames, such as candles, matches, lighters and other devices (783,000 fires or 10.7 percent). Consistent with the number of cooking fires, most fires were found to start in the kitchen (68 percent), followed by the bedroom (7.5 percent). The highest hourly fire rate was between 5 and 9 pm, which is the time when many cooking fires happen.

The remainder of the chapter focuses on fire losses. Substantial property damage, injuries to household members, and other fire consequences tended to be the exception in these incidents. For example, in 74 percent of incidents there was no smoke damage, in 93 percent of incidents there was no flame damage or flame damage only to the item first ignited, and in 81 percent of incidents the property damage was under $100. In less than 1 percent of incidents, the conditions after the fire required families to stay out of the household for one day or longer.

The chapter also develops an approximate method for determining the uncertainty associated with any of the estimates presented in this chapter, Chapter 7 and Chapter 8. This method, a generalized coefficient of variation, is described in the appendix of Chapter 6.

*Chapter 7 Consumer Products Involved in Unattended Residential Fires*

Chapter 7 treats some of the same issues as Chapter 6, but the focus in this chapter is unattended fires and consumer products. In Chapter 3, it was estimated that 3.4 percent of total fires were attended by fire departments. As a result, almost all analyses of both attended and unattended fires taken together will be the same as analyses of unattended fires. The exceptions are in any measures associated with the severity of the incident because fire department-attended fires tend to have much larger fire losses than unattended incidents. To develop a better understanding of unattended fires, fire losses and consumer products, the analyses in this chapter only consider unattended incidents.

Another reason to focus on unattended incidents is to be able to compare the results with the 1984 survey. More specifically, one of the main objectives in Chapter 7 is to account for the 69 percent decrease from an estimated 22.9 million unattended fires in 1984 to 7.2 million unattended fires in the current survey. A key issue is if the decrease occurred in all types of fires or just certain types of fires.

One unique feature of this chapter is an estimate of the percentage decrease in the number of unattended fires from the 1984 survey by various characteristics of the fire. This comparison requires modifying the estimation method for the current data to match the 1984 survey. The statistical approach is outlined in the chapter and presented in some detail in an appendix.

Like Chapter 6, Chapter 7 analyzes the room where the fire incident began, the source of heat, item first ignited, damage, injury, and property loss. The analysis focuses on appliance (synonymous with equipment) fires, distinguishing them from non-appliance fires by time of day and item first ignited. Then specific types of fires are studied. These include cooking fires by type of cooking appliance, electrical lighting and wiring fires, heating and cooling appliance fires, other household appliances, and small open flame and cigarette fires.

With respect to the item first ignited, most cooking-related fires (83 percent) involved cooking materials. The second largest category involved linens, probably kitchen towels, and napkins. Most cooking-related fires (81.2 percent) involved ranges, with about twice as many electric ranges involved in fires than gas ranges. The third highest ranking appliance involved in cooking-related fires was microwave ovens (7 percent). Electrical lighting-related and wiring-related fires were most likely to involve light fixtures (23 percent) or lamps (11 percent); the item first ignited most frequently was bedding (24 percent), none reported (22 percent), or electrical wire (21 percent). Heating and cooling appliance-related fires were most often associated with fixed heaters (30 percent of heating fires) and portable heaters (35 percent), and ignited electrical wire (41 percent) or the appliance itself (29 percent).

When the heat source was cigarettes or small open flames, the largest single source was candles (52 percent of cigarette/open flame incidents). When cigarettes were

involved, bedding was the most frequently ignited item, while with other open flame incidents, paper was the most frequent item first ignited.

In comparison with the results of the 1984 survey, cooking fires and heating and cooling equipment associated fires decreased at about the same rate as all incidents, other household appliances decreased by a larger percent, and electrical lighting/wiring fires declined less. Non-appliance fires decreased more than the overall decrease, at 84 percent. As the most frequently occurring heat source for non-appliance fires was fires with cigarettes and small open flames, this decline in non-appliance fires probably reflects an overall decrease in smoking-related incidents.

*Chapter 8 Operation and Effectiveness of Smoke Alarms and Fire Extinguishers*

To examine how smoke alarms and extinguishers reduce fire losses, this chapter uses the fire incidents from the 14/21-day recall period. For the most part, only unattended fires are considered in this chapter.

The chapter opens with a discussion of different ways to characterize the operation of smoke alarms. Smoke alarm operation is described as follows: (1) the alarm sounded, but did not alert anyone to the fire, (2) the sounding alarm alerted residents to the fire, and (3) the alarm provided the only alert of the fire. When residents reported that they were not alerted when the alarm sounded because they were already aware of the fire, the sounding alarm may provide some benefit by confirming the seriousness of the fire or the location of the fire. An alarm that alerts people to the fire first is of greater benefit in providing them with an early warning. If the sounding alarm provides the only alert, a situation that may occur when residents are not near to the fire, this is of even greater benefit.

In the chapter, it was estimated that from the survey data that smoke alarms sounded in 30 percent of the fire incidents (40 percent of attended fires), alerted residents in 11.8 percent of the incidents, and provided the only alert in 9.8 percent of incidents.

Why did the alarm not sound or alert residents more frequently? The main explanation for the alarm not sounding provided by survey respondents was that insufficient smoke reached the alarm. This not only involves the characteristics of the fire but also where alarms were located in the residence. In most cases when the alarm did not sound, residents reported that before the fire, they believed that the alarm was working.

Some highlights of the chapter are as follows. In fires starting in the kitchen, the alarm sounded in 36.9 percent of incidents, alerted residents in 14.9 percent of incidents, and provided the only alert in 12.0 percent of incidents. In fires starting in the bedroom, the alarm sounded in 16.7 percent of incidents, alerting people and providing the only alert in 11.6 percent of fires. In fires involving heating and cooling equipment, the alarm sounded in 17.9 percent of incidents, alerting residents in 4.1 percent and providing the

only alert in less than 1 percent of incidents. The alarm sounded in 19.5 percent of candle fires and 27.7 percent of lighter, cigarette, and match fires; alerting people in 6.9 percent of candle fires and 7.9 percent of lighter, cigarette, and match fires; and providing the only alert in 6.2 percent of candle fires and 7.9 percent of lighter, cigarette, and match fires.

Another aspect of this chapter was to analyze alarm operation by how the alarms were configured in the residence. Interconnected alarms sounded in 53.3 percent of incidents as compared with 27.0 percent with non-interconnected alarms, alerted people in 26.0 percent of incidents as compared with 10.0 percent with non-interconnected alarms, and interconnected alarms provided the only alert in 26.0 percent of incidents as compared with 7.6 percent with non-interconnected alarms. Most fires occurred in residences that did not have interconnected alarms.

There also were large differences between alarm responses in residences where the alarms were on all floors in contrast to alarms not on all floors. As shown in Chapter 5, 82 percent of fire households had alarms on all floors. Overall the alarms sounded in 37.1 percent of incidents when the alarms were on all floors as compared with 4.1 percent in residences without alarms on all floors. With alarms on all floors, people were alerted in 14.5 percent of incidents and this was the only alert in 11.9 percent of incidents. In contrast, in residences without alarms on all floors, people were alerted in 1.9 percent of incidents and in each case, this was the only alert.

The other issue considered in the chapter is the use and effectiveness of fire extinguishers. Fire extinguishers were used in 4.5 percent of unattended fire incidents and 17.7 percent of attended fires, often in combination with other methods. Most unattended fires were put out by removing power, putting water on the fire, separating the fuel from the heat source, or other such actions. The most frequent use of extinguishers was in unattended bedroom fires (8.6 percent of incidents), kitchen fires (5.2 percent), candle fires (9.5 percent), and fires in cooking equipment other than stoves (9.9 percent of incidents). There was a somewhat higher chance of the extinguisher being used when it was in the room where the fire started.

*Appendix*

The survey questionnaire is reprinted in the Appendix at the end of this report.

## Chapter 2
## Survey Methodology[28]

This chapter describes the technical aspects of how the survey was designed and conducted.

The chapter is organized into five sections. The first section, Sampling Plan, discusses the survey design (including construction of strata), sample size and allocation, sample selection, and collapsing the strata. The second section, Questionnaire Design, briefly describes the development and testing of the survey questionnaire. This is followed by a section on Survey Management, including interviewer training, data collection, determining respondent eligibility, and maximizing response rates. The next section, Responses to the Survey, describes the characteristics of the actual sample and the construction of the weights used in analyzing the data. The last section describes the response rate methodology and presents the response rates.

### Sampling Plan

The sampling frame for this survey consisted of all U.S. residential telephone numbers, i.e., all U.S. households with at least one land-line telephone in the home. The frame was developed using the GENESYS[29] sampling system.

GENESYS is a computer program and data system that is used to create random digit dialing (RDD) single-stage probability samples of telephone numbers. It generates each random telephone number by first randomly selecting a block of telephone numbers. A block consists of the area code and the first five digits of the phone numbers. Then a number from 01 to 99 is computer generated and appended to the end of the block number for the full specification of the phone number to be called.

One of the advantages of using this system is that much is known about each block of telephone numbers. This includes whether it contains at least one residential telephone number, so that blocks of phone numbers assigned exclusively to businesses or not-yet assigned blocks will not be called. Additionally, the GENESYS system contains telephone exchange level estimates for over 48 demographic variables such as age, income, home ownership, education, race, whether the block belongs to a metropolitan (urban) or non-metropolitan (non-urban) region, etc. This feature then allows designing a sample that can be stratified to over- or under-sample households along certain demographic variables.

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[28] This chapter was drafted by Synovate, Inc, then edited and reformatted by CPSC staff. Under contract Number GS-23F-8039H and Order Number CPSC-F-02-1316, Synovate participated in the design of the survey questionnaire, tested the questionnaire, and conducted the telephone survey. Synovate also designed the sampling plan.

[29] GENESYS is a product of the Marketing Systems Group, Fort Washington, PA.

The sampling frame of households was stratified to meet the goals of the sampling plan. The strata were constructed such that the resulting sample would accomplish the following:

- Provide a nationally representative probability sample of U.S. households in the 50 states and the District of Columbia.

- Provide sufficient representation of key demographic subgroups including but not limited to: Native Americans, African Americans, households in rural areas, households of Hispanic origin, and the elderly. Race and ethnicity in this report refer to the head of the household only.

- Provide sufficient representation of other demographic and housing characteristics, such as: type of dwelling, age of dwelling, rental versus owned properties, household income, education of head of household, cause of fire and room of origin, and age of occupants.

Sufficient representation meant that there would be adequate numbers of respondents within these subgroups to make comparisons along two important dimensions as follows: (1) if there were differences in fire incidence by subgroup, that is, if the risk of fire was elevated in certain subgroups above the population risk and (2) to determine if there were differences in the number and types of smoke alarms and fire extinguishers by subgroup.

Synovate, Inc., the survey contractor, with the help of Marketing Systems Group, compiled area code and exchange combinations along with key population statistics updated from the 2000 U.S. Census. All area codes/combinations were assigned to 16 strata that were defined and compiled by geographic region of the country, incidence of ethnic/racial categories, and urban/non-urban designations.

Specifically, the sampling design uses these definitions:

- The urban/non-urban strata are determined by whether or not counties are assigned to a Metropolitan Statistical Area (MSA). MSAs are a geographic entity used by federal statistical agencies for collecting, tabulating, and publishing statistical information. MSAs contain a core urban area of at least 50,000 people with at least one county and includes the surrounding counties that have a high degree of geographic or social interaction with the urban core.[30]
- The Native American strata have at least a 25% incidence of Native Americans in this small area definition as reported in the 2000 Census.[31]
- The African American strata have at least a 50% incidence of African Americans in this small area definition as reported in the 2000 Census.

[30] For more information including the formal definition of Metropolitan Statistical Areas (MSAs), see www.census.gov/population/www/estimates/metroarea.html.

[31] The sampling plan was based on the U.S. Census Bureau's ZCTA—ZIP Code Tabulation Areas. These are approximately equivalent to the definition of U.S. Postal Service ZIP Codes. The final sample was drawn from a frame of area code and telephone exchanges mapped to Census blocks.

- The Asian American strata have at least a 25% incidence of Asian Americans in this small area definition as reported in the 2000 Census.
- The Hispanic American strata have at least a 30% incidence of Hispanic Americans in this small area definition as reported in the 2000 Census.

On the basis of these definitions, 16 strata were defined. Eight of these were defined by race or ethnicity (Native American, African American, Hispanic American, and Asian American) of the head of household and whether the stratum was an urban or non-urban region. The other eight strata were defined by region (East, Midwest, South, and West) crossed with urban/non-urban region.[32] Strata that satisfied two or more of the above regional, ethnic, or racial criteria were defined in the following order: Native American, Asian American, Hispanic American, African American, and then region of the country. This meant that the eight region strata (the East, Midwest, South, and West strata by urban/non-urban) represented area code/exchanges (telephone blocks) that did not have high incidence of the four ethnic/racial groups.

Table 2-1 shows the definition of the strata.

32 Regions were defined as follows: Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT; South: AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV; Midwest: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI; West: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, WY.

Table 2-1
Stratum Definitions and Incidence of Population Subgroups

| Stratum Number and Definition | | | Number of Households | Percent of Population in Stratum | Percent Composition by Race or Ethnicity of Head of Household: White | African American | Asian American | Native American | Hispanic American |
|---|---|---|---|---|---|---|---|---|---|
| | All | | 105,475,618 | 100.00 | 75.14 | 12.32 | 3.78 | 0.88 | 12.54 |
| 1 | Native Amer. | Urban | 31,717 | 0.04 | 32.17 | 0.81 | 0.25 | 62.45 | 5.79 |
| 2 | Native Amer. | Non-urban | 224,938 | 0.26 | 27.37 | 3.13 | 0.37 | 68.02 | 4.21 |
| 3 | African Amer. | Urban | 5,937,032 | 5.77 | 19.76 | 74.03 | 1.41 | 0.24 | 5.47 |
| 4 | African Amer. | Non-urban | 694,098 | 0.70 | 35.63 | 62.48 | 0.30 | 0.28 | 1.69 |
| 5 | Hispanic Amer. | Urban | 10,532,587 | 11.79 | 54.29 | 10.21 | 4.72 | 0.51 | 55.05 |
| 6 | Hispanic Amer. | Non-urban | 796,905 | 0.86 | 69.53 | 3.38 | 0.91 | 0.69 | 53.95 |
| 7 | Asian American | Urban | 1,654,980 | 1.69 | 39.66 | 6.25 | 41.2 | 0.24 | 12.94 |
| 8 | Asian American | Non-urban | 109,739 | 0.11 | 30.48 | 0.47 | 42.0 | 0.40 | 8.88 |
| 9 | East | Urban | 15,277,910 | 14.16 | 84.49 | 6.69 | 3.98 | 0.18 | 6.34 |
| 10 | East | Non-urban | 2,132,718 | 1.96 | 95.38 | 1.86 | 0.76 | 0.30 | 1.81 |
| 11 | Midwest | Urban | 15,976,528 | 14.63 | 87.62 | 6.34 | 2.37 | 0.36 | 3.88 |
| 12 | Midwest | Non-urban | 6,457,380 | 5.92 | 95.06 | 1.72 | 0.55 | 0.65 | 2.13 |
| 13 | South | Urban | 22,257,623 | 20.37 | 79.13 | 13.29 | 2.65 | 0.50 | 6.81 |
| 14 | South | Non-urban | 8,197,684 | 7.56 | 81.56 | 14.04 | 0.51 | 0.94 | 3.65 |
| 15 | West | Urban | 12,736,284 | 11.87 | 78.74 | 3.87 | 6.91 | 0.82 | 13.02 |
| 16 | West | Non-urban | 2,457,495 | 2.31 | 88.94 | 0.80 | 1.12 | 2.32 | 7.93 |

Notes: Source: 2000 Census Data Note that although the first eight strata are defined by race, ethnicity, and urban/non-urban communities, they contain members of all races, ethnicities, urban locations, and non-urban locations. Racial groups are mutually exclusive. Two other race categories are not included: Native Hawaiian or Other Pacific Islander and Some Other Race. Race categories do not add to 100 percent because of the two omitted race categories and also because, in some cases, respondents did not specify their race to the census interviewers. Also, note that Hispanic ethnicity overlaps racial groups.

Table 2-1 shows the distribution of U.S. households for the 16 strata along with the incidence of each group within each stratum. The goal of the stratification is to increase the sample incidence of key population subgroups as well as to reduce sampling variance. For example, the incidence of Native American-headed households is approximately 65 percent in the Native American strata, compared to 0.88 percent in the U.S. population overall. The incidence of African American-headed households is 74 percent in urban areas and 62 percent in non-urban high incidence African American

strata, compared to 12 percent overall. Thus, within each stratum, one or more race or ethnic group is represented at a rate that is higher than their representation in the U.S., but each stratum contributes people from all racial and ethnic groups. The stratum definitions cover the entire United States and District of Columbia.

*Sample Design Fundamentals*

Stratified sample designs are efficient because they have lower sampling variance for the same number of survey respondents as simple random samples or cluster samples. Using population information compiled from the Census Bureau and commercial demographic sources, and mapping Census blocks to area code and telephone exchange areas, the strata were constructed to over-sample African American, Native American, and Hispanic American households. Stratified designs developed using these procedures have the following characteristics:

- Known probabilities of selection
- Single-stage design without clustering
- Well defined formulas for estimating parameters and variances

Each stratified sample is a collection of simple random samples – one simple random sample within each stratum.

*Sample Size and Allocation*

The sample design specified screening approximately 76,650 households for occurrences of fire incidents during the previous 90 days. The plan was designed to provide approximately 1,810 interviews of households that had at least one fire. This estimate was made by assuming an average incidence of 2.36 fires per 100 households during the previous 90 days, an assumption that was based on the 1984 survey.[33] An abbreviated interview was to be administered to a $1/40^{th}$ (2.5 percent) random selected subset of non-fire households to obtain a sample of about 1,500 households. The purpose of the interview with non-fire households was to capture information on demographics, housing characteristics, and numbers and types of smoke alarms and fire extinguishers of non-fire households for comparison with fire households.

The final anticipated sample specifications were as follows:

[33] In the 1984 survey, it was estimated that there were 28.3 (fire department-attended and unattended) residential structure fires per 100 households per year, or approximately 7.1 fires per 100 households per 90 days (Audits and Surveys (1985), *op cit.,* page 18). The estimate of 2.36 fires per 100 households took into account that respondents would not recall some incidents during the 90-day recall period and also that there was a decrease in household fires between 1984 and 2004 that was somewhat commensurate with the decrease in reported fires. For more details on household fire incidence rates and recall issues, see Chapter 3.

- Brief screening interviews with 76,650 households
- Extensive interviews with 1,810 fire households
- Abbreviated interviews with 1,500 non-fire households

The demographic distribution of the final sample was based on the actual heads of households that were contacted and, as a result, could not be known until the completion of the study. The anticipated demographic distribution was calculated using Census data. Table 2-2 provides the anticipated sample sizes for the key demographic groups. These numbers were calculated by first allocating the number of households in the sample to each stratum (see Table 2-3) to provide an estimate as to how many households would be in each stratum. Then the number of households in each stratum was multiplied by the percent incidence of each demographic subgroup in that stratum (as shown in Table 2-1). Finally, the number of households in each demographic group was then added across the strata to provide an estimate for the number of households in the sample by demographic, ethnic, or racial group membership.

Table 2-2

Target Sample Number and Percent of Fire Households
by Race, Ethnicity or Demographic Group

| Racial, Ethnicity or Demographic Group | Sample Size | Percent |
|---|---|---|
| All | 1,810 | 100.0 |
| White | 1,093 | 60.4 |
| African American | 224 | 12.4 |
| Asian American | 174 | 9.6 |
| Native American | 176 | 9.7 |
| Hispanic | 203 | 11.2 |
| Urban | 1,336 | 73.8 |
| Non-urban | 474 | 26.2 |
| Household Income under $25,000 | 569 | 31.4 |
| Households with at Least One Member | | |
| Age 65 and over | 215 | 11.9 |
| Age 18 and under | 280 | 15.5 |
| Home Owner | 1,249 | 69.0 |
| Renter | 561 | 31.0 |
| Single Family | 1,265 | 69.9 |
| Multiple Family | 422 | 23.3 |
| Mobile Homes | 123 | 6.8 |

Notes: Race and ethnicity characterize only the head of the household; income is defined as household income and may involve more than one family member; age characteristics mean that a household contains at least one member in that age group. The target sample sizes for racial categories do not add to 1,810 households because they are based on Table 2-1, where the percentage composition by race does not add to 100 percent. That was because some people did not specify their race in the Decennial Census and also because two race categories are not included in Table 2-2. See the notes for Table 2-1. The Hispanic category overlaps all races.

It is important to understand that this was not a quota sample in the sense that the sample was designed to select exactly 224 African American-headed households, 203 Hispanic American-headed households, etc. In a quota sample, sampling of each ethnic group would stop as soon as the desired number of households was obtained. The procedure here was different. The sample sizes were defined based on the allocation of

the total number of households to strata as shown below in Table 2-3. That allocation was designed to yield the samples sizes specified in Table 2-2. However, the actual number of households in the sample in each particular race, ethnicity, or demographic group would be likely to differ from the targets in Table 2-2 because of sampling variability.

Table 2-3
Allocation of Total Sample to Strata

| Stratum Number | Stratum Definitions | | Sample Size |
|---|---|---|---|
| | Race/Ethnicity | Urban/Non-urban | |
| | All | All | 1,810 |
| 1 | Native American | Urban | 31 |
| 2 | Native American | Non-urban | 219 |
| 3 | African American | Urban | 134 |
| 4 | African American | Non-urban | 16 |
| 5 | Hispanic | Urban | 139 |
| 6 | Hispanic | Non-urban | 11 |
| 7 | Asian American | Urban | 309 |
| 8 | Asian American | Non-urban | 21 |
| 9 | East | Urban | 167 |
| 10 | East | Non-urban | 23 |
| 11 | Midwest | Urban | 171 |
| 12 | Midwest | Non-urban | 69 |
| 13 | South | Urban | 238 |
| 14 | South | Non-urban | 87 |
| 15 | West | Urban | 147 |
| 16 | West | Non-urban | 28 |

Notes: Race, ethnicity, and urban/non-urban characteristics predominate in each stratum, but each stratum contains households with all races, ethnicities, urban and non-urban locations. See Table 2-1 for details.

*Sample Selection*

The sample was designed to be selected using random digit dialing. Telephone numbers were generated using the GENESYS sampling system. The GENESYS system produces equal probability selection method samples without a clustering effect.

As mentioned above, the GENESYS system constructs a frame of all known telephone area codes, exchanges, and blocks of telephone numbers with at least one listed telephone number. The frame was then mapped onto Census Blocks, and the known Census information was used to assign blocks of telephone numbers to the strata. Samples were then able to be generated from telephone blocks associated with those Census Blocks.

Before starting the telephone interviews, Synovate staff pointed out that it would be difficult to manage telephone interviewing for the strata where the desired sample sizes were very small. As a result, the urban and non-urban strata for the Native American, African American, Hispanic, Asian American, and East strata were collapsed together. By collapsing the strata, the urban/non-urban mix in the final sample was likely to be proportional to the distribution of urban and non-urban households in the collapsed strata. Table 2-4 shows the final sampling plan for the resulting 11 strata.

Table 2-4
Final Sample Allocation

| Stratum Number | Stratum Definition | | Sample Size |
|---|---|---|---|
| | Race/Ethnicity | Urban/Non-urban | |
| | All | All | 1,810 |
| 1 | Native American | Both | 250 |
| 2 | African American | Both | 150 |
| 3 | Hispanic | Both | 150 |
| 4 | Asian American | Both | 330 |
| 5 | East | Both | 190 |
| 6 | Midwest | Urban | 171 |
| 7 | Midwest | Non-urban | 69 |
| 8 | South | Urban | 238 |
| 9 | South | Non-urban | 87 |
| 10 | West | Urban | 147 |
| 11 | West | Non-urban | 28 |

**Questionnaire Design**

Early drafts of the survey instrument were based on the 1984 survey and designed to be similar enough to permit comparisons of results. Pilot testing of the instrument and procedures took place in four phases. The first two phases of pilot testing were conducted prior to Office of Management and Budget (OMB) clearance, and the last two were completed after clearance.[34]

In the first phase of pilot testing, the survey instrument was tested using staff from Synovate and CPSC. The purpose of this pretest was to evaluate question wording, logic flow, prompts, and the list of responses to some questions that would be read to survey respondents. The interview length was estimated during the pretest. Staff members with

[34] U.S. Government agencies initiating a new survey or developing a major revision of an existing survey that will ask identical questions, or have identical record keeping or disclosure requirements imposed on 10 or more respondents are required to submit information clearance requests describing the anticipated survey to the Office of Management and Budget for clearance.

recent fires in their homes were recruited by letter. Persons identified through public sources as having experienced recent fires were also asked to participate in the pretest.

During the second phase of testing, cognitive interviews took place to assess whether respondents understood the questions as intended and if the alternatives presented supported valid responses. Nine in-depth telephone interviews were completed with respondents from low-income areas who had experienced recent residential fire events. The interviews were conducted by telephone to reflect the telephone interviewing method during the actual survey.

Synovate's TeleNation omnibus was used for the third phase of the survey pretest. The purpose was to test a number of different approaches to asking the key screening questions about whether the respondents had experienced a fire event in the previous three months. Because respondents may not remember such events, different versions of the screening questions were tried to test how well the form of the question elicited recall of fire events.[35] Synovate staff interviewed 2,000 persons who were randomly assigned to one of up to four versions of the screening questions.

To assure that all aspects of the survey instrument and protocol were working as designed, the final phase of pilot testing involved trained interviewers and the fully developed survey instrument programmed into Synovate's Computer Assisted Telephone Interviewing System (CATI). The pilot test involved a random digit dialing sampling frame from the general population.

The final survey questionnaire was also translated into Spanish. A copy of the English language questionnaire appears at the end of this report.

[35] Both the 1974 and 1984 surveys displayed problems with people recalling fire events. See Audits and Surveys (1985), *op cit.,* pages 11-16 and Chapter 3 of this report.

## Survey Management

*Interviewer Training*

Synovate staff trained a group of interviewers at their facility in Fresno, California. Interviewers were briefed extensively on the content and format of the survey, including the use of skips and prompts. In addition, interviewers were supplied with a manual that provided information about CPSC and the purpose of the study. A list of answers to commonly asked questions and objections was provided. Also, each interviewer was provided with a list of reasons explaining why respondents may refuse to participate and detailed ways to gain the respondent's cooperation. The briefing was conducted in an interactive manner, allowing interviewers to raise questions and make suggestions for the successful completion of the survey.

The interviewing effort was managed by data collection supervisors. They maintained records on the sample and the numbers of completed interviews, callbacks, and refusal conversions, and they managed the staffing requirements. All interviewers were monitored throughout the project by quality control supervisors. If an interviewer had a high refusal rate, corrective measures were taken, and interviewers with a low refusal rate were selected for refusal conversion calls.

*Telephone Data Collection*

Interviewing began on June 4, 2004 and continued through September 7, 2005. Interviews were conducted from Synovate's Fresno, California facility. Respondents were called between 9:00 a.m. and 9:00 p.m. Monday through Friday, between 10:00 a.m. and 9:00 p.m. on Saturdays, and between 11:00 a.m. and 9:00 p.m. on Sundays (all times were local to the area telephoned). Weekday dialing was limited so there would not be an over-representation of homemakers or retirees. Each month a sample was drawn for each stratum, and the monthly sample was divided into equal sized groups by stratum (replicates) to allow managers to control release of the sample in response to differences in response rates by strata.

Interviewers were monitored for the quality of the information elicited from respondents, and provided with guidance and correction when necessary. In addition, project management reports were generated by computer on a daily basis in order to track sample disposition and production rates.

Synovate's Computer Assisted Telephone Interviewing (CATI) system was used for data collection. Questionnaires were programmed into the system, and telephone interviewers read questions as they were logically fed in predetermined order from the computer to a viewing screen. The answers were sent back to the computer through the keyboard. This system reduced interviewer error, such as not adhering to skip patterns, thus enhancing the quality of the data.

*Respondent Eligibility*

To be eligible to participate in the study as a fire household, the respondent had to be 18 years of age or older and to have reported an eligible fire within the past 90 days. Eligible fires were defined in a question in the beginning of the survey as follows:

> *We are interested in learning about any fires – large or small—that you have had in or around your home. By "fire" I mean any incident – large or small—that resulted in unwanted flame or smoke and could have caused damage to life or property if left unchecked.*[36]

Home was further defined to mean "… house, apartment or other residence where you [the respondent] live…" Respondents who answered that they did not have a fire were then asked if they had at least one or more of common fire type incidents such as unwanted flaming or smoking on the stove or another cooking appliance, a smoking electrical appliance, burning or smoldering clothing, etc.

Of the households screened that did not report having a fire in the past 90 days, a subset of 2.5 percent (1 in 40) were selected randomly for an abbreviated interview that captured information on demographics, housing characteristics, and fire defenses.

If the household had more than one adult aged 18 or older, the "head of the household" was selected for the interview. This required that the person answering the phone know which adult was responsible for the home and be willing to pass the telephone to him/her. Those households that failed to identify the "head of the household" were called at different times in order to maximize the chance of reaching an individual who could identify the correct person within the household.

*Procedures to Maximize Response Rates*

Several procedures were undertaken in order to increase the response rates as much as possible and reduce the chance of interpretive error or bias associated with low response rates. The procedures were as follows:

- Highly experienced interviewers were assigned to the project. Interviewers with experience conducting interviews for government studies received extensive training and were used for this study.

- Telephone interviews were conducted at different times of the day and days of the week in order to increase the likelihood of locating available respondents at times convenient for them. When possible, callbacks were scheduled at specific times requested by respondents.

[36] See page 1 of the survey instrument in the Appendix to this report.

- Several interviewers had the ability to conduct interviews in Spanish using a Spanish language version of the questionnaire.

- Every telephone number that did not result in contact with a respondent (excluding disconnects, fax numbers, and modems) was dialed up to 40 attempts on successive days in order to increase the chances of finding a potential respondent.

- Production rates, interview length, and sample dispositions were monitored closely every other day to detect potential problems with the sample so they could be addressed and resolved immediately.

- Project management personnel received weekly reports containing the number of refusals received and hours dialed by each interviewer. These reports were closely monitored by supervisory staff. Interviewers with a high refusal to hours-dialed ratio were removed from dialing or provided corrective feedback and monitored more closely. In addition, those who demonstrated the lowest refusal to hours-dialed ratio were selected for refusal conversion interviewing. These interviewers called households that had on previous calls refused to participate.

*Non-response Follow-up Results*

All non-respondents were re-contacted by telephone one to two weeks following the initial contact in order to secure their cooperation. Those respondents who requested that they not be contacted again were excluded from this effort. The contact was made by more experienced interviewers, who were specially trained in refusal avoidance techniques.

In order to assess the extent of any bias due to non-response, a random subset of those who refused for a second time during the conversion attempt answered a few key demographic questions. This allowed the characterization of any differences between respondents and those who chose not to participate.

**Responses to the Survey**

Table 2-5 provides the actual number of survey fire households compared with the projections from the sample design.

Table 2-5
Projected and Actual Number of Fire Households in the Survey

| Stratum Definition (Stratum Number) | Projected | | Actual | |
|---|---|---|---|---|
| | Responses | Percent | Responses | Percent |
| All | 1,810 | 100.0 | 916 | 100.0 |
| Native American (1) | 250 | 13.8 | 152 | 16.6 |
| African American (2) | 150 | 8.3 | 70 | 7.6 |
| Hispanic (3) | 150 | 8.3 | 60 | 6.6 |
| Asian American (4) | 330 | 18.2 | 161 | 17.6 |
| East (5) | 190 | 10.5 | 105 | 11.5 |
| Midwest - Urban (6) | 171 | 9.4 | 67 | 7.3 |
| Midwest – Non-urban (7) | 69 | 3.8 | 39 | 4.3 |
| South – Urban (8) | 238 | 13.1 | 113 | 12.3 |
| South – Non-urban (9) | 87 | 4.8 | 38 | 4.1 |
| West - Urban (10) | 147 | 8.1 | 93 | 10.2 |
| West – Non-urban (11) | 28 | 1.5 | 18 | 2.0 |

As shown in the table, there were 916 actual fire households in the survey compared with a projected 1,810 fire households from the survey design. That projection, as noted previously, was based on a fire incidence rate of 2.36 fires per 100 households in a three-month period (approximately 9.5 fires per 100 households per year) developed on the basis of the 1984 survey. The projection was about twice as high as what was found in the data, resulting in an actual sample of fire households that was about half that projected.

Despite the difference between the actual and projected sample sizes, the proportional distribution of the sample among strata was maintained in the sample, indicating that the racial, ethnic, and demographic distribution would be likely to be as planned. That distribution is shown in Table 2-6 below.

Table 2-6
Projected and Actual Demographic Distribution of the Fire Households in the Survey

| Demographic Factor | Projected | | Actual | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Total | 1,810 | 100.0 | 916 | 100.0 |
| White | 1,093 | 60.4 | 601 | 65.6 |
| African American | 224 | 12.4 | 99 | 10.8 |
| Asian American | 174 | 9.6 | 37 | 4.0 |
| Native American | 176 | 9.7 | 98 | 10.7 |
| Hispanic | 203 | 11.2 | 106 | 11.6 |
| Urban | 1,336 | 73.8 | 646 | 70.5 |
| Non-urban | 474 | 26.2 | 270 | 29.5 |
| Household Income under $25,000 | 569 | 31.4 | 198 | 21.6 |
| At Least One Household Member | | | | |
| Age 65 and over | 215 | 11.9 | 42 | 4.6 |
| Age 18 and under | 280 | 15.5 | 488 | 53.3 |
| Home Owner | 1,249 | 69.0 | 571 | 62.3 |
| Renter | 561 | 31.0 | 334 | 36.5 |
| Single Family | 1,265 | 69.9 | 552 | 60.3 |
| Multiple Family | 422 | 23.3 | 255 | 27.8 |
| Mobile Homes | 123 | 6.8 | 93 | 10.2 |

Notes: The survey question about annual household income had different categories than in the planning documents. The estimated survey proportion for the number and percent of households with income under $25,000 is estimated as all responding households with income under $15,000 plus half the households who reported income between $15,000 and $35,000. Detail lines may not add to totals because of non-response, omitted categories, or in the case of race and ethnicity, that a household head may specify membership in more than one race or ethnic group or no race or ethnic group.

Table 2-6 shows that the sample met the survey design projections in percentage terms by the race and ethnicity breakdowns, except that there were fewer households headed by Asian Americans than expected. The distribution of urban/non-urban households, owners and renters, and dwelling types were fairly close to the projections.

The survey sample was different from the projections in that there was a smaller proportion of households with members 65 or older and more households with members 18 years or younger. The survey also had relatively fewer households with household income under $25,000.

*Sample Weighting*

Samples are weighted to be able to extrapolate to a target population, in this case all U.S. households. The procedure followed the standard approach of constructing weights that are the inverse of the probability of selecting an element in the sample. Weights were constructed as follows:

The initial weight $w_{ih}$ was defined as the weight associated with the screening process for household *i* in stratum *h*. It was defined as follows:

$w_{ih} = 1/L_{ih}$ if household *i* in stratum *h* was a fire household,
$= [(T_h)/(V_h)] * 1/L_{ih}$ if household *i* was a non-fire household in stratum *h*.

where

$L_{ih}$ was the number of telephone lines receiving calls in household *i*, stratum *h* (i.e., distinct telephone numbers ringing in the household). This corrects for the fact that households with more lines have a higher probability of being selected for the survey.

$T_h$ was the total number of non-fire households (households with no eligible fires) in stratum *h*, and

$V_h$ was the sample number of non-fire households in stratum *h*.

The initial weights are proportional to the inverse of the sampling probability, but are not yet the inverse of the sampling probability. The next stage was to make them scale to the total sample size. This was called the design weight, as follows:

$$DesignWeight_{ih} = K_h \, w_{ih}$$

where $K_h$ was a constant assigned to stratum *h* to bring the sum of the initial weights into proportion across the strata, i.e.,

$$K_h = \frac{N_h}{\sum_{h=1}^{H} N_h} \Bigg/ \frac{\sum_{i \in h} w_{ih}}{\sum_{h=1}^{H} \sum_{i \in h} w_{ih}}.$$

In the above equation $N_h$ is the number of households in the U.S. in stratum *h*.

The design weights are intended to sum to the sample size, which in this study was the 3,077 households (916 fire households and 2,161 non-fire households).

The final step was to calculate the expansion weight, the weight that would be applied to the survey responses to make estimates. The expansion weight allows the results to represent the total number of households in the United States. The formula for the expansion weight is

$$ExpansionWeight_{ih} = \frac{N}{\sum_{i \in h} DesignWeight_{ih}} DesignWeight_{ih},$$

where $N$ is the total number of households in the United States (113,343,000).[37]

Table 2-7 presents descriptive statistics on the expansion weights. On average, each fire household in the survey represents 1,409 U.S. households and each non-fire household represents 51,852 households.

[37] The estimated number of households is from the U.S. Bureau of the Census. See www.census.gov/population/socdemo/hh-fam/cps2005/tabH2-all.csv. Note that this differs from the estimated number of households shown in Table 2-1 from the 2000 Census that was used to design the sample.

Table 2-7

Descriptive Statistics for Expansion Weights

| | Fire Households | Non-fire Households |
|---|---|---|
| Mean | 1,409 | 51,852 |
| Median | 1,242 | 45,408 |
| Standard Deviation | 1,193 | 52,036 |
| Sum | 1,290,329 | 112,052,669 |
| Minimum | 11 | 14 |
| Maximum | 3,443 | 149,742 |
| Number of Households | 916 | 2,161 |

## Response Rate Computations

*Final Sample Dispositions and Response Rates*

As mentioned previously, the final sample size was 916 fire households and 2,161 non-fire households. The number of fire households was about half the projected number. The difference was a result of lower household fire incidence rates than the rate of 2.36 fires per hundred households that had been projected based on the 1984 survey.

Table 2-8 shows the final dispositions for the entire survey sample. Response rates, shown in that table, were computed using the method proposed by the American Association for Public Opinion Research (AAPOR).[38]

[38] American Association for Public Opinion Research (2000), "Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys," AAPOR, Ann Arbor, MI, pp. 35-37.

In computing the response rates, people who were telephoned were classified as follows:

- Interview
- Eligible/non-interview
- Unknown eligibility
- Not eligible

The interview category included all who were screened, both with full and partial interviews. The eligible/non-interview category was the non-respondents (i.e., those who refused to be interviewed). Unknown eligibility includes telephone lines that were always busy, never answered, or were always answered by answering machines, and those interviews with respondents where it was impossible to complete the screening part of the questionnaire in order to determine eligibility. Not eligible includes fax and data lines, business lines, disconnected numbers, nobody living in the home 18 years old or older, and other such categories. Table 2-8 contains a complete list of these categories.

The formulas for calculation of the response rates specify a fraction where the numerator is the number of screening interviews and the denominator is the number of phone numbers associated with eligible respondents. The four different response rate calculations construct numerators and denominators slightly differently. The formulas are as follows (with RR indicating response rate):

$$RR\ 1 = \frac{Completed\ Screening\ Interviews}{Completed\ Screening\ Interviews + Partial\ Interviews + Eligible\ NonInterviews + UnknownEligibility}$$

$$RR\ 2 = \frac{Completed\ Screening\ Interviews + Partial\ Interviews}{Completed\ Screening\ Interviews + Partial\ Interviews + Eligible\ NonInterviews + UnknownEligibility}$$

$$RR\ 3 = \frac{Completed\ Screening\ Interviews}{Completed\ Screening\ Interviews + Partial\ Interviews + Eligible\ NonInterviews + e * UnknownEligibility}$$

$$RR\ 4 = \frac{Completed\ Screening\ Interviews + Partial\ Interviews}{Completed\ Screening\ Interviews + Partial\ Interviews + Eligible\ NonInterviews + e * UnknownEligibility}$$

*where*

$$e = \frac{Completed\ Screening\ Interviews + Partial\ Interviews}{Completed\ Screening\ Interviews + Partial\ Interviews + Eligible\ NonInterviews}$$

RR1 and RR3 use Completed Screening Interviews as the numerator, while RR2 and RR4 use Completed and Partial Interviews as the numerator. In this survey, as shown in Table 2-8, there were very few partial responses, so that the difference between RR1 and RR2 was negligible as was the differences between RR3 and RR4.

RR1 and RR2 differ from RR3 and RR4 in the way that unknown eligibility was handled. RR1 and RR2 assume that unknown eligible responses were non-responses (non-interviews). RR3 and RR4 consider the possibility that some of the cases with unknown eligibility may have been business lines or other ineligible categories. RR3 and RR4 estimate the proportion of unknown eligible responses from the known responses and non-responses and then apply that proportion to the unknown eligibility category. That proportion is symbolized in the formulas above as *e*.

Table 2-8 contains the distribution of the responses and the response rate calculations.

Table 2-8
Overall Sample Disposition

| Response Category | Number of Responses | Percent |
|---|---|---|
| **Interview** | | |
| Completed Screening Interviews | 76,826 | **13.2** |
| Partial Interviews | 66 | 0.0 |
| **Total** | **76,892** | **13.2** |
| **Eligible/Non-interview** | | |
| Refusal and Break Off | 95,604 | 16.5 |
| **Total** | **95,604** | **16.5** |
| **Unknown Eligibility/Non-interview** | | |
| Always Busy | 2,526 | 0.4 |
| No Answer | 65,405 | 11.3 |
| Answering Machine-Don't Know if Household | 22,160 | 3.8 |
| Call Blocking | 4,580 | 0.8 |
| Housing Unit, Unknown if Eligible Respondent | 486 | 0.1 |
| No Screening Interview Completed | 73,851 | 12.7 |
| **Total** | **169,008** | **29.1** |
| **Not Eligible** | | |
| Fax/Data Line | 21,416 | 3.7 |
| Disconnected Number | 130,674 | 22.5 |
| Non-working Number | 21,788 | 3.8 |
| Temporarily Out of Service | 3,428 | 0.6 |
| Number Changed | 10 | 0.0 |
| Cell Phone | 1,091 | 0.2 |
| Business, Gov't Office, Other Organization | 48,315 | 8.3 |
| Group Quarters | 1,449 | 0.2 |
| No Eligible Respondent | 10,665 | 1.8 |
| **Total** | **238,836** | **41.2** |
| **TOTAL PHONE NUMBERS USED** | **580,340** | **100.0** |
| **AAPOR Response Rates** | | |
| Response Rate 1 | | 22.5 |
| Response Rate 2 | | 22.5 |
| Response Rate 3 | | 31.6 |
| Response Rate 4 | | 31.6 |

Table 2-8 shows that more than one-half million telephone numbers were called for the survey. There were 76,892 interviews; most of which were with non-fire households, and most were in the 39/40$^{th}$ group that were not used for the survey. More than 95,000 households who were contacted began the interview, were determined to be eligible from the initial screening questions, but then decided against participation. Slightly more than 169,000 households were not able to be reached for various reasons; these count as being of unknown eligibility. Finally, almost half the numbers contacted were ineligible because they were disconnected, business lines, non-working numbers, fax or data lines, or in some other way did not represent a household.

Using this data, it was possible to compute the response rates as 22.5 percent for Response Rates 1 and 2, which consider unknown eligibility as non-responses, and 31.6 percent for Response Rates 3 and 4, where it was estimated that 42 percent of those with unknown eligibility would have been eligible.

Response Rate 3 and Response Rate 4 were considerably lower than the 80 percent response rate for the 1984 survey calculated in the same way.[39] That decline was not unexpected given the decline in response rates to random digit dialing (RDD) telephone surveys over the past 20 years.[40]

## Conclusion

This chapter has outlined the construction and management of the survey. The basis for the survey was the 1984 survey. Questions were designed from that survey and then modified after pretesting and cognitive testing. An important aspect of the questionnaire design process was to refine the screening questions to help respondents recall if they had a fire in the previous 90 days.

The survey sample was developed from the GENESYS sampling system and census data. The strata were designed to over-sample ethnic and racial groups to provide reasonable estimates from households. The sample also contained an urban/non-urban breakdown. Sample size was allocated to strata on the basis of expected numbers of cases in the ethnic, racial, and geographic breakdowns.

The sample of fire households was about half the number expected. This was because the planning factor for fire households assumed 2.86 fires per 100 households, whereas in fact, there were about half as many households with fires. The smaller number of fire households signaled that the household fire rate had dropped substantially from 1984. Estimates of the household fire rates are presented in the next chapter.

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[39] Audits and Surveys (1985), *op cit.,* Appendix A.

[40] There is an extensive literature on the decreasing response rates. Some authors believe that the decline is probably associated also with caller id, answering machines, and the response to telemarketing. See for example Khare, M (2006), "Sample Design and Issues with Telephone Multi-Mode Surveys." Paper presented at the National Center for Health Statistics Data Users Conference, Washington, DC.

## Chapter 3
## Fire Incidence

This chapter presents the methods used to estimate fire incidence and then presents the estimates using data from the survey. The methods are examples of techniques for adjusting for lack of recall that is present in many retrospective surveys. The literature indicates that people are often unable to recall recent events. As a result, rates (i.e. incidents divided by time) estimated from retrospective surveys tend to decrease with increasing recall periods. Short recall periods, on the other hand, have smaller sample sizes, with larger sampling variance in the rate estimates. An important decision in these analyses is how much of the recall period to use for making estimates. This chapter applies a method for finding the length of the recall period that balances the bias from the underestimates associated with longer recall periods with the increased variance associated with smaller sample sizes from shorter recall periods.[41]

Following the discussion of the methods for making estimates from recalled events, the chapter presents the annual fire incidence estimates. From the survey, it was estimated that there were 7.4 million annual household fires in 2004-2005, of which 254,441 (97 percent) were fire department-attended and 7.2 million were unattended. This was 6.56 fires per 100 households.

This chapter begins with a discussion of the analytical methods followed by the results of the survey and the CPSC staff's conclusion. Of particular interest in this chapter is the decrease in residential structure fires between this survey and the 1984 residential fire survey.

### Methods

*Memory and Recall Issues*

The analysis of fire incidence rates was based on a series of questions designed to prompt the respondent to recall all home fire incidents that occurred up to 90 days before the interview. The questionnaire defined "fire" as

> *…any incident large or small that resulted in unwanted flames or smoke and could have caused damage to life or property if left unchecked...*

Home was defined as

> *…house, apartment or other residence where you live…*

[41] This tradeoff between bias and variance is described in Warner M, Schenker N, Heinen MA and Fingerhut LA (2005), "The Effects of Recall on Reporting Injury and Poisoning Episodes in the National Health Interview Survey," *Injury Prevention*, 11, pp. 282-287.

The survey respondent was then offered a series of examples of fire incidents such as

> *unwanted flaming or smoking on the stove or another cooking appliance*
> *a smoking electrical appliance*
> *burning or smoldering clothing, either being worn or not worn*
> *smoldering fabric, mattress, rug or upholstered furniture*
> *a child igniting something with a match or lighter*
> *a candle igniting something*
> *a fire that started outside your home, and spread to the home*
> *any other fire – large or small – that produced unwanted flames or smoke*

If the respondent said there was one or more such incidents in the past three months, the next question asked how many incidents occurred. This was then followed by a request for the date and time of the fire. Finally, the respondent was again prompted to answer if the fire involved the home.[42]

The purpose of these questions was to elicit information on residential fires, attended by fire departments or unattended by fire departments, that occurred in a 91-day period.[43] If respondents had perfect recall of incidents then, as a 91-day period covers one-fourth of the year, an estimate of annual fire incidence would be approximately four times the weighted number of incidents reported by the respondents. As anticipated, respondents did not have perfect recall. Of the 961 fire incidents cited as occurring up to 90 days before the interview, respondents could recall the month and day of the incident for 668 incidents (70 percent). This raised the concern that there might have been other incidents that the respondents could not recall at all.

Memory and recall problems are among the most common non-sampling errors encountered in surveys.[44] In addition to recall delay, where respondents forget the incident and/or believe it occurred earlier than the end of the recall period, there is also telescoping. Telescoping is the opposite error of putting the incident into the recall period when it actually happened before the recall period.

### *Previous Residential Fire Surveys*

The authors of the 1984 National Sample Survey of Unreported, Residential Fires were aware of problems associated with memory decay, i.e., recall of fire incidents

[42] For details, see the survey questionnaire in Appendix, question 2-10.
[43] The period is 91 days because fires occurring on the day of the interview also count. Recall that in Chapter 2, respondents were called as late as 9:00 p.m. The data contains fires that were reported to have occurred on the day of the interview. The recall period will occasionally be described as three months in the text, but it is almost 91 days long, and covers up to 90 days before the day of the interview.
[44] For example see Tourangeau R, Rips U and Rasinski K (2000), Chapter 4, "The Role of Memory in Survey Responding" in *The Psychology of Survey Response,* New York, Cambridge University Press.

during the period covered by the survey.[45] They raised this issue in the context of the 1974 National Household Survey, the first survey of household fires that included fires not reported to fire departments.[46] In the 1974 survey, respondents were asked to provide information on all fire events occurring up to 12 months before the interview. From these data, estimates were made of 5.6 million annual household fires using the full 12-month recall period. A reanalysis of this study was conducted by the University of Wisconsin, several years later.[47] In the reanalysis, they concluded that respondents were likely to have failed to recall fire incidents and that failure to recall increased with increasing time from the interview. For example, in reviewing the number of fire events reported for each of 12 months, they estimated that one fire in eight that had occurred 12 months before the interview was reported by the respondent to the interviewer. Correcting the estimates for memory issues led to an estimate of 13 million annual household fires in 1974, more than twice the original estimate.[48]

The 1984 survey interviewed respondents in the first two weeks of the month and asked for information on all fire incidents occurring during the previous three calendar months.[49] The authors analyzed the number of incidents by calendar month and by the number of months from the interview. They found that the number of incidents reported as occurring two calendar months before the interview was about two-thirds of the number reported for the calendar month before the interview. Also, the number of incidents reported in the third calendar month before the interview was about half of the number of incidents reported in the first month. As a result, the authors of the survey made estimates of annual household fire incidence only using incidents reported to have occurred in the calendar month before the interview and scaled to a calendar year.[50]

In addition, in the 1984 survey, there were 106 incidents (5.8 percent of the 1,819 total incidents) where the respondents knew that the incident had occurred in the three-month period before the interview, but did not remember in which month the incident occurred. To make estimates, the authors allocated one-third of these incidents to each month before the interview.[51] As only the first month was used in the estimates, only

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[45] Audits and Surveys (1985), *op cit.,* pages 6-9.

[46] U. S. Consumer Product Safety Commission (1978), *op cit.* The University of Wisconsin reanalysis is in Department of Statistics, University of Wisconsin (1977), "Statistical Analysis of the National Household Fire Survey," Madison, WI.

[47] Ibid.

[48] Quoted in Audits and Surveys (1985), *op cit*., page 11.

[49] The question was, "*Have you had a fire in or around your home, vacation home, or your property during the past 3 months—that is during _____, _____, or _____?"* The interviewer filled in the blanks with the names of the past three months. Incidents occurring during the same month as the interview were not included in the survey. For example, if the interview took place on July 10, the blanks would be filled in as May, April or March. Incidents occurring between July 1 and July 10 would not be included. See Audits and Surveys (1985), *op cit*., Appendix B, page 2.

[50] *Ibid*., page 12-17.

[51] *Ibid*., page 15. The usual strategy would be to allocate the unknown incidents in proportion to the known incidents, which would have put 46 percent of these incidents in the first month. The survey authors reasoned that since the first month was least subject to memory decay, incidents where the date was not recalled would be less likely to be in the first month. Putting 46 percent of the unknown incidents in the first month would then overestimate the number of incidents in that month.

one-third of the incidents with unknown months were used in the calculations for the estimated annual incidence rates.

Thus, like in the 1984 survey, in the 2004-2005 survey there were two problems to be solved before estimating fire incidence rates. These were as follows: (1) how to impute missing fire dates, where the respondent knew that an incident had occurred during the recall period but did not know the actual date, and (2) what length recall period to use for estimating annual fire incidence rates. The fire date problem was somewhat more complicated in the present survey, because respondents were asked about the day as well as the month of the fire, not just the month as in the 1984 survey. Both day and month could be missing in the present survey and would need to be imputed.

*Issues in Imputation and Estimation*

Because retrospective household surveys are the main source of information on events occurring in households that are not reported in official statistics, there is an emerging literature about how to deal with memory issues, specifically about the length of recall periods, imputation of missing dates, and factors associated with failure to recall actual events. Some examples follow.

Harel et al (1994) compared childhood injury estimates from the National Health Interview Survey (NHIS) with estimates from the Child Health Supplement (CHS). The NHIS used estimates from a two-week recall period, while the CHS asked about incidents occurring during the previous year. Annual estimates were made by scaling the estimates obtained by the inverse of the fraction of the year represented by that period. The analysis showed that estimates of annual injuries declined with increasing length of the recall period, clear evidence that incidents occurring further from the date of the interview were less likely to be remembered. When separating injuries by severity, injuries involving surgery or hospitalization, and injuries resulting in at least one full bed day or one school day loss showed almost no change in estimates with length of recall period, suggesting that more serious injuries were more likely to be remembered.[52]

In another study of injuries to children, Cummings et al (2005) telephoned a sample of parents of children under 6 years of age. The sample was drawn from members of a Health Maintenance Organization (HMO) in Washington State from children who had at least one injury in the last year. Parents were asked to recall injuries during the year before the interview, and the injuries were compared with the HMO's computerized records. The authors found that recall decreased with time from the

[52] Harel Y, Overpeck MD, Jones DH, Scheidt PC, Bijur PE, Trumble AC and Anderson J (1994), "The Effects of Recall on Estimating Annual Nonfatal Injury Rates for Children and Adolescents," *American Journal of Public Health,* 84,4, 599-605. Massey and Gonzales found a similar result using injuries in the 1975 Health Interview Survey (HIS). They recommended the HIS use a 2-4 week recall period. See Massey JT and Gonzalez JF (1976), "Optimum Recall Periods for Estimating Accidental Injuries in the National Health Interview Survey." Proceedings of the American Statistical Association, Social Statistics Section, Boston, MA, pp. 584-588.

interview. As in other analyses, more severe injuries were recalled better than less severe injuries.[53]

Landen and Hendricks (1995) compared different length recall periods for estimates of annual at-work injuries in the 1988 Occupational Health Supplement of the National Health Interview Survey. They found that estimates based on a four-week recall period were 32 percent higher than estimates based on a one year-period. Injuries with lost workdays were less likely to be under-reported than those with no lost workdays.[54] In a similar project in Ghana, Mock et al (1999) concluded that longer recall periods resulted in underestimates of injury rates for non-fatal injuries, but periods of 12 months may be used for reliable estimates of severe injuries.[55] Moshiro et al (1999), in another study about recall of injuries, concluded that long recall periods underestimated injury rates as compared with shorter periods, but for severe injuries a recall period of up to 12 months could be used. They recommended a recall period of no more than 3 months for non-severe injuries.[56]

While a shorter recall period results in more accurate recall, according to the literature above, there is a tradeoff. As longer observations are discarded from the data, the sample size goes down and the sampling variance increases. Moshiro et al (2005), in recommending a shorter recall period, called for larger sample sizes to reduce the amount of sampling error.[57]

Warner, Schenker, Heinen and Fingerhut (2005, hereafter WSHF) formalized the tradeoff between the increased sampling error (sampling variance) associated with short recall periods and the memory decay associated with the longer periods into a single quantity, the Mean Square Error (MSE).[58] Defining the loss due to recall delay as the "bias," the MSE is the sum of the square of the bias and the sampling variance. They recommended that the recall period be selected to minimize the MSE.

Using the National Health Interview Survey, WSHF estimated the annual number of injury episodes using different length recall periods between one and 13 weeks. Estimates were made by weighting the sample and then scaling to annual totals by

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[53] Cummings P, Rivara FP, Thompson RS and Reid RJ (2005), "Ability of Parents to Recall the Injuries of Their Young Children," *Injury Prevention*, 11, pp. 43-47.

[54] Landen DD and Hendricks S (1995), "Effect of Recall on Reporting of At-Work Injuries," *Public Health Reports,* 110:3, pp. 350-354.

[55] Mock C, Acheampong F, Adei S and Koepsell T (1999), "The Effect of Recall on Estimation of Incidence Rates for Injury in Ghana," *International Journal of Epidemiology*, 28, 4, pp. 750-755.

[56] Moshiro C, Heuch I, Astrom AN, Setel P and Kvale G (2005), "Effect of Recall on Estimation of Non-Fatal Injury Rates: A Community Based Study in Tanzania," *Injury Prevention,* 11, pp 48-52.

[57] Moshiro (2005), *op cit*., page 52. The sampling error increases because the sample size decreases. For example, suppose a sample of size $n$ is collected to estimate a sample mean. Assuming simple random sampling with replacement, the standard error of the sample mean is $\sigma/\sqrt{n}$. If the sample size is reduced from $n$ to $n/a$ ($a>1$), then the standard error of the mean is then $\sqrt{a}(\sigma/\sqrt{n})$, i.e., it is increased by a factor of $\sqrt{a}$. For example, if ¼ of the sample is used, the standard error is doubled.

[58] Warner M, Schenker N, Heinen MA and Fingerhut LA (2005), *op cit.*

multiplying by the inverse of the fraction of the year covered by the recall period.[59] As expected, the estimates of annual injuries decreased with increasing length recall periods, but there were occasional small increases in the estimate as the period increased. To smooth out this fluctuation, the authors fit a regression line to the estimates. The fitted value (i.e., the point on the regression line) was used in place of the estimated values. The fitted value for two weeks was defined as the reference value, essentially as "the truth." [60] To estimate the loss due to recall delay, the fitted value for any particular recall period was subtracted from the reference value. The result, the difference in estimates from a particular recall period and from the two week fitted reference value was defined as the bias for the particular recall period.

The variance of the period was estimated using standard statistical software programs that correct for the survey design.[61] The sum of the variance and the square of the bias was computed as the estimated MSE. A recall period of five weeks was selected because it had the lowest estimated MSE.

WSHF addressed another problem found in retrospective surveys, that of missing incident days. In their study, 75 percent of the incidents had the date fully specified, 22 percent had only month specified, and respondents could not recall the day or month for 3 percent of the incidents. Incident days needed to be imputed (i.e., estimated) to complete the recall period analysis. WSHF adopted a two-stage imputation strategy as follows:

- Stage 1: For the 22 percent of incidents with month but not day specified, the day was chosen randomly in that month so that the elapsed time from the interview to the injury was no greater than 91 days.
- Stage 2: For the 3 percent of incidents with missing month and day, elapsed times between interviews and incidents were randomly selected from the stage 1 imputed elapsed times stratified by year of incident and hospitalization status.

WSHF pointed out that the stage 2 imputations followed the theory that the distribution of missing days would look more like the partially specified days in stage 1 than the completely specified days in the rest of the sample.

Another innovation in the WSHF paper was the use of a multiple imputation procedure. Five datasets were made using the complete cases and stage 1 or stage 2 imputed dates. The imputed dates varied in each dataset because of the random selection of days in the month (stage 1) or the random selection from the stage 1 imputations (stage

[59] For example, if the recall period was 1 week, the estimates would be multiplied by 52, two weeks 26, 3 weeks 17.3, etc.

[60] The first week was disqualified as the reference value because it was "…estimated to be affected the most by the possible discrepancy between the recorded interview date and the date the respondent completed the injury section…" Warner M, Schenker N, Heinen MA and Fingerhut LA, (2005), *op cit*., page 283.

[61] Warner M, Schenker N, Heinen MA and Fingerhut LA , (2005), *op cit.,* page 283. SUDAAN® is described in Shah BV, Barnwell BG, Bieler GS (1996), *Sudaan User's Manual, Release 7.0*, Research Triangle Park, NC). Similar routines are found in the SAS® System.

2). This allowed including the variance associated with imputation along with the sampling variance in computation of the MSE.

To summarize the literature, most of the articles point out that respondents cannot be expected to remember all incidents during retrospective recall periods, and in particular, earlier incidents are more difficult to recall than more recent incidents. Recall delay also varies with incident severity, where more severe incidents are more likely to be recalled. Finally, some of the authors pointed to the other source of inaccuracy in making estimates in addition to bias, i.e., greater sampling variation was associated with smaller samples when short recall periods were used.

*Imputation and Estimation Methods for the 2004-2005 Residential Fire Survey*

A modified form of the approach in WSHF was used in this report for imputation of missing days and for selection of the recall period. The imputation procedure was as follows:

1. To assess if there was a different recall pattern associated with incidents with different characteristics, the fire incident records with month and date of incident specified were separated into two categories, those fires with characteristics that were thought to make it more likely that the incident would be recalled and those with characteristics that were thought to make it less likely that the incident would be recalled. As a shorthand description, the more likely to be recalled category was defined as "high severity" and the less likely as "low severity." A variety of different indicators was examined. The final set of indicators that distinguished high severity from low severity was that at least one of the following events occurred at a fire: a smoke alarm sounded, somebody attempted to put out the fire using a fire extinguisher, people left or tried to leave the residence during the fire, the fire department attended the incident, or there was any flame damage.

2. Missing fire dates were imputed by selecting an elapsed time between interview and fire date and then computing the fire date from the possible elapsed times. Similar to WSHF (2005), a two stage strategy was used as follows:

    a. Stage 1. When respondents reported a single fire where the month but not the day of fire was known, the elapsed time between interview and fire date was selected randomly (i.e., following a uniform distribution) out of the possible elapsed times between the beginning of the month (or the day of the interview, whichever was closer) and the end of the month (or the end of the 91-day recall period, again whichever was closer). The imputed fire date was then calculated by subtracting the imputed elapsed time from the interview date. These imputed dates were classified as belonging to high or low severity incidents based on the definition above, but severity did not play a role in this stage of imputation.

b. Stage 2. For respondents who reported a single fire where the month and day were unknown, imputed elapsed times were selected at random with replacement by severity level from the imputed elapsed times in stage 1. The imputed fire date was then also calculated by subtracting the elapsed time from the interview date.

c. Special Handling for Exceptions. Six survey respondents reported two fires with neither month nor day specified for either fire. Missing fire dates were imputed by sampling from the uniform distribution from the possible elapsed times. The shortest elapsed time from the date of interview that was sampled was used in computing the date of the most recently occurring fire, and the second shortest elapsed time was used for the earlier fire.[62]

The imputation process described above was repeated 15 times, producing 15 datasets with imputed dates. The literature suggests a minimum of five imputation datasets, but more datasets are useful when the imputation variance might be large.[63] The dataset with non-missing dates was attached to each imputation dataset, to produce 15 datasets with complete dates. Only the imputed dates differed between datasets, and that difference was used to compute the imputation variance, a part of the overall sampling variance. The imputation software described above was written in the R language.[64]

Analysis of the multiple imputation data sets then proceeded by computing the Mean Squared Error (MSE) for various recall periods and then selecting the recall periods with the lowest value of the MSE. Separate computations were made for the two different severity levels, to allow the possibility of different recall periods for high and low severity incidents. Annual estimates were made by recall period and severity level by adding the weighted estimates where the elapsed time between interview and fire date fell into the recall period, then scaling by the proportion of the year in the recall period. A cubic smoothing spline with four degrees of freedom was fit to the plot of annual fires against recall period length.[65] The fitted value of the smoothing spline for the 14-day recall period was used as the reference value for making the bias estimate. The choice of the 14 day reference period was in keeping with WSHF and much of the literature. The use of the smoothing spline instead of a linear regression was a departure from WSHF.

The MSE was then calculated from the bias estimate and the variance (including both the sampling variance and the imputation variance). Calculations for annual estimates and the sampling variance were made in SAS® using Proc Surveymeans. The

[62] These 12 missing fire dates were about 3.8 percent of the missing dates and about 1.2 percent of the total dates. There were more complicated imputation approaches available for imputation of these dates, but they did not seem warranted because of the small number of cases involved.
[63] See Schaefer JL (1997), *Analysis of Incomplete Multivariate Data*, Chapman and Hall, New York, pp. 134-135.
[64] R is a freely available language and environment for statistics and statistical computing. See http://www.r-project.org/.
[65] Hastie TJ and Tibshirani RJ (1990), *Generalized Additive Models*, Chapman and Hall, NY.

total variance, including the imputation variance was calculated in SAS® using Proc MIAnalyze.[66]

## Results

The data consisted of 3,077 survey responses, where 916 households reported a total of 961 fire incidents and 2,161 non-fire households had abbreviated interviews. Of the fire incidents, complete fire dates were provided for 649 incidents (67.5 percent). Month but not day was specified for 230 incidents and neither day nor month in 82 incidents. Respondents were interviewed between June 4, 2004 and September 7, 2005.

Of the 312 incidents with incomplete fire dates, 293 were from households that reported a single fire incident. The remaining 19 missing dates were from households that had two fire incidents.

Using the definition of severity from the previous section, 671 fire incidents (70 percent) were classified as high severity and 290 fire incidents (30 percent) were classified as low severity.

### *Pre-imputation Analysis*

Figures 3-1 and 3-2 show the weighted number of fires reported by survey respondents by week from the time of the interview. Both figures use only the 649 incidents with complete fire dates. Week 1 includes all fires reported on the day of the interview up to day 7 from the interview, week 2 covers days 8-14, week 3 covers days 15- 21, etc. In both figures, the dotted line illustrates the average number of estimated weekly incidents. The solid line in both figures is a smoothing spline, a smoothed line that is useful to help the eye follow the trend in the data.

If there were no issues about memory recall, the solid lines in both Figures 3-1 and 3-2 would be flat. That is, there is no reason to expect a fire would be more likely in the first week before the interview than the twentieth week before the interview. However, this is not the case in either figure.

[66] SAS Institute Inc. (2004), *SAS/STAT® 9.1 Users Guide.* SAS Institute, Cary, NC.

Figure 3-1 shows the estimated number of high severity fire incidents. The weighted average number of fires per week was 46,769 (Standard Deviation = 15,002, Range 25,505 – 86,135, Coefficient of Variation = 32.1 percent). This is shown by the dashed line. The solid line shows the smoothing spline. The largest estimated number of fires was 86,135 was estimated from the data from the first week after the interview. It then declined to 49,201 in using the data from weeks 1 and 2, then back up to 56,379 with data from weeks 1-3. After reaching the minimum in week 6, the points then tend to oscillate around 40,000 fires per week.

Figure 3-1 Estimated High Severity Fires by Weeks from the Interview

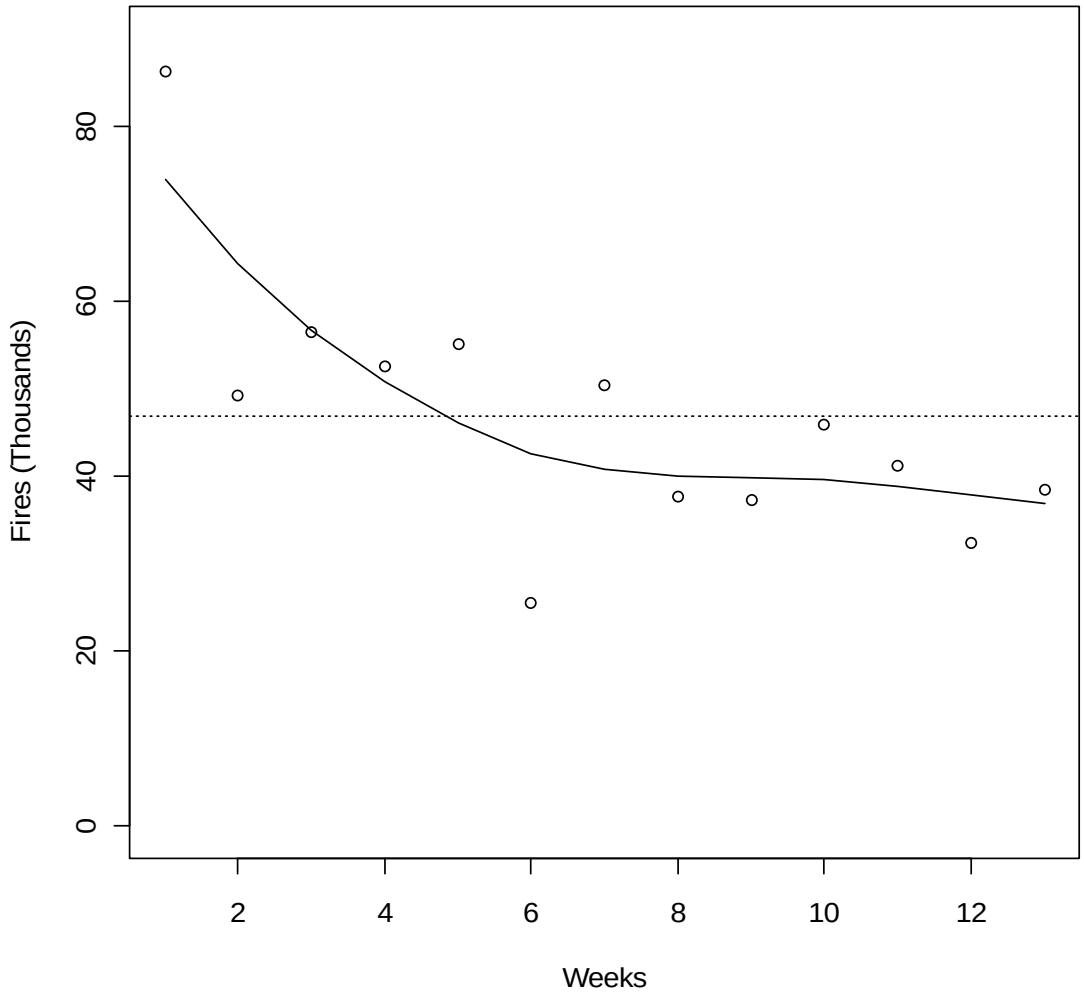
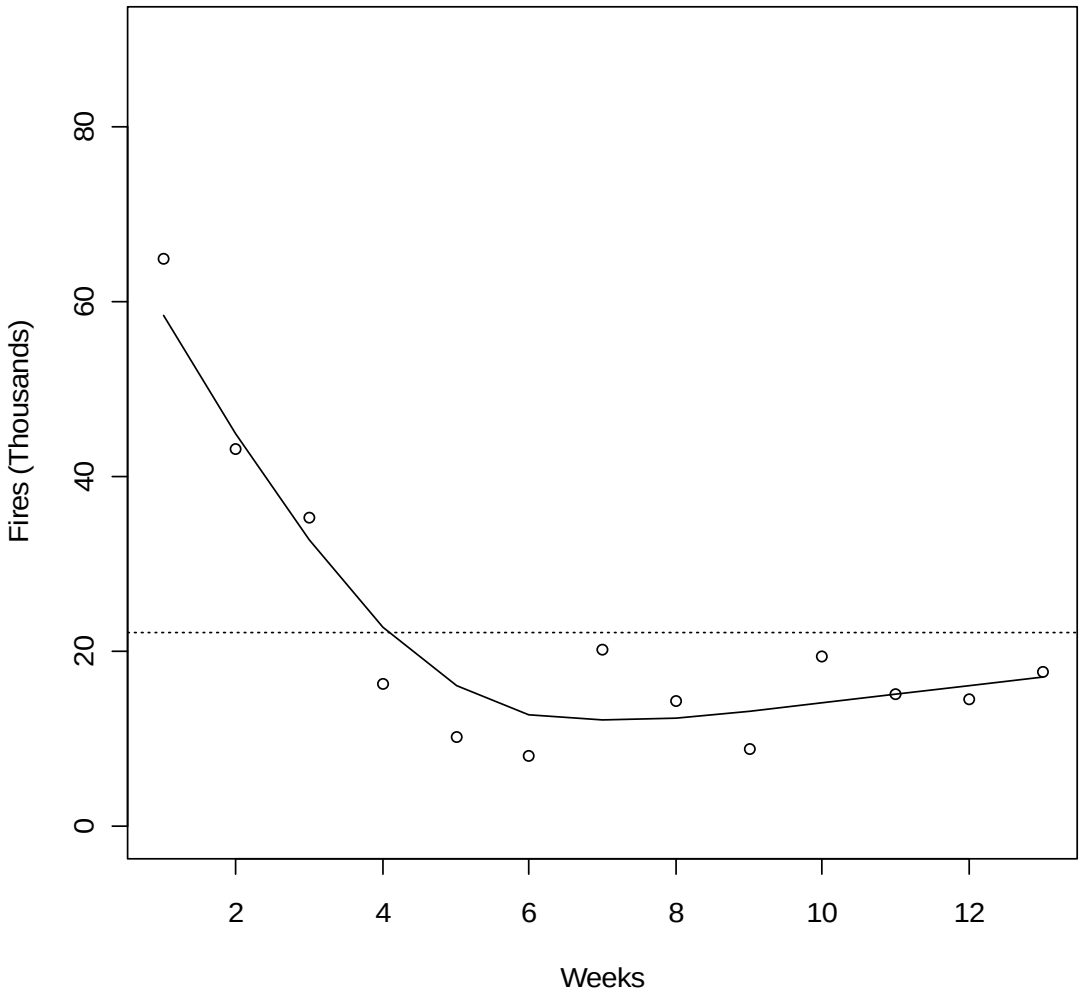


Figure 3-2 shows the same plot for the low severity fires. The estimated weighted average number of fires was 22,150, about 47 percent of the average of the high severity fires (Standard Deviation = 16,290, Range 8,143 – 64,774, Coefficient of Variation = 73.5 percent). Like Figure 3-1, the largest number of incidents, 64,774, was reported for the data from week 1 (one week from the interview). The plot descends steeply for weeks 2 and 3, then the plot oscillates around 15,000 from week 4 on.

Figure 3-2 Estimated Low Severity Fires by Weeks from the Interview




Both plots illustrate the existence of problems with retrospective recall of incidents, that is, if recall were perfect both plots would have been flat all the way out to week 13. The low severity plot decreases more steeply, suggesting that low severity incidents are less likely to be recalled than high severity incidents.

*Mean Square Error Analysis*

Following the imputation procedure, a mean square analysis was conducted separately for high and low severity incidents. As discussed in the methods section of this chapter, the variance calculation combines both the sampling variance and the variance from the multiple imputations. The bias was calculated under three different specifications of the reference period, i.e., the particular week or group of weeks that provided the "true rate." These were week 1 alone, weeks 1-2, or weeks 1-3. Data are provided in the tables below as the square roots of the variance (the Standard Error or SE) and the root mean square error (RMSE), respectively. These are in the original units, i.e., fires, rather than the square of fires.

Table 3-1
Estimated Annual High Severity Fire Incidents, Bias, and Root Mean Square Error by Cumulative Weeks from the Interview and Reference Period
(Thousands of Fires)

| Cumulative Weeks from Interview | Fire Incidents | | | Reference Period: 1 week | | 1-2 weeks | | 1-3 weeks | |
|---|---|---|---|---|---|---|---|---|---|
| | Estimated | Fitted | SE | Bias | RMSE | Bias | RMSE | Bias | RMSE |
| 1 | 5418 | 5094 | 851 | 0 | 851 | 365 | 926 | 676 | 1087 |
| 1-2 | 4507 | 4728 | 552 | -365 | **662** | 0 | 552 | 310 | 633 |
| 1-3 | 4268 | 4418 | 434 | -676 | 803 | -310 | **534** | 0 | **434** |
| 1-4 | 4112 | 4184 | 377 | -910 | 985 | -544 | 662 | -234 | 444 |
| 1-5 | 4098 | 4021 | 324 | -1073 | 1121 | -708 | 779 | -397 | 513 |
| 1-6 | 3861 | 3909 | 280 | -1185 | 1217 | -819 | 866 | -509 | 581 |
| 1-7 | 3884 | 3838 | 260 | -1256 | 1283 | -891 | 928 | -580 | 636 |
| 1-8 | 3809 | 3792 | 241 | -1301 | 1324 | -936 | 967 | -626 | 670 |
| 1-9 | 3753 | 3763 | 221 | -1330 | 1349 | -965 | 990 | -655 | 691 |
| 1-10 | 3770 | 3745 | 209 | -1349 | 1365 | -984 | 1006 | -673 | 705 |
| 1-11 | 3754 | 3730 | 197 | -1363 | 1378 | -998 | 1017 | -688 | 715 |
| 1-12 | 3690 | 3718 | 186 | -1376 | 1388 | -1010 | 1027 | -700 | 724 |
| 1-13 | 3725 | 3708 | 176 | -1386 | 1397 | -1020 | 1036 | -710 | 732 |

Notes: The number of fires was estimated by applying the sampling weights, including imputed missing days, and scaled to a calendar year. Those values are in the column labeled "Estimated." The column labeled "Fitted" contains values resulting from applying a smoothing spline to the values in the "Estimated" column. The RMSE values in **bold** are the respective minimum RMSE values for each reference period. Data may not add due to rounding.

As noted previously, the estimated fire incidents (column 2 of the table) were derived from the actual data with both known and imputed fire dates, using the sampling weights. A smoothing spline was fitted to those values and is shown in the third column. The

fitted values are then used as the reference values and in the bias calculations. Thus for example, 5094 (5,094,000 estimated fires) is the reference value for the week 1 fire estimate. Details of the calculation are found in the footnote.[67]

In Table 3-1, the RMSE is U-shaped, decreasing with increasing cumulative weeks from the date of the interview, and then usually increasing again. The point where it turns around is one week later than the reference period in the first three periods shown. This is the result of the SE of the fire incidence estimate decreasing with increasing sample size and the bias increasing with increasing weeks from the reference week.

Note that the minimum RMSE occurs in the 1-3 week reference period (434), but additional calculations with reference periods of 1-4 weeks and higher show that the minimum RMSE usually occurs either at the week defined by the reference period or the next week. This is a result of relatively small changes in the SE that are not offset by the increase in bias. To put it another way, of the two factors that contribute to the RMSE, sampling variance and bias, bias is the greater contributor.

[67] For example, 5094 is the reference value for the week 1 estimate. The bias in the first week is zero, for the second week is 4728-5094 = -365, and for the third week is 4418-5094 = -676. (The calculations occasionally appear to be off by 1 due to rounding.) Bias estimates are shown in the fifth column. Using the 1-2 week fire estimate (4728) as the reference period shows a bias of 5094-4728=365 for week 1 (column 7). The root mean square error calculation uses the bias and the standard error (SE), which also includes the variance associated with multiple imputation. So for example, using a week 1 reference period and testing 1-3 weeks, the RMSE estimate is the square root of $(676^2 + 434^2) = 803$. This is shown in column 6.

Table 3-2
Estimated Annual Low Severity Fire Incidents, Bias, and Root Mean Square Error by Cumulative Weeks from the Interview and Reference Period
(Thousands of Fires)

| Cumulative Weeks from Interview | Fire Incidents | | | Reference Period: 1 week | | 1-2 weeks | | 1-3 weeks | |
|---|---|---|---|---|---|---|---|---|---|
| | Estimated | Fitted | SE | Bias | RMSE | Bias | RMSE | Bias | RMSE |
| 1 | 3701 | 3574 | 704 | 0 | 704 | 367 | 794 | 711 | 1001 |
| 1-2 | 3162 | 3207 | 462 | -367 | **590** | 0 | **462** | 344 | 576 |
| 1-3 | 2855 | 2863 | 358 | -711 | 796 | -344 | 496 | 0 | **358** |
| 1-4 | 2508 | 2558 | 294 | -1015 | 1057 | -648 | 712 | -304 | 423 |
| 1-5 | 2250 | 2307 | 241 | -1266 | 1289 | -899 | 931 | -555 | 606 |
| 1-6 | 2066 | 2113 | 208 | -1460 | 1475 | -1093 | 1113 | -749 | 777 |
| 1-7 | 1998 | 1971 | 189 | -1602 | 1614 | -1235 | 1250 | -891 | 911 |
| 1-8 | 1891 | 1868 | 170 | -1706 | 1714 | -1339 | 1350 | -995 | 1009 |
| 1-9 | 1778 | 1792 | 156 | -1781 | 1788 | -1414 | 1423 | -1070 | 1082 |
| 1-10 | 1751 | 1739 | 147 | -1835 | 1841 | -1468 | 1475 | -1124 | 1134 |
| 1-11 | 1706 | 1699 | 138 | -1875 | 1880 | -1508 | 1514 | -1164 | 1172 |
| 1-12 | 1676 | 1667 | 131 | -1906 | 1911 | -1540 | 1545 | -1195 | 1203 |
| 1-13 | 1654 | 1639 | 124 | -1935 | 1939 | -1568 | 1573 | -1224 | 1230 |

Notes: See Table 3-1.

Table 3-2 shows that, aside from week 1, the optimum estimation period is the reference period week. The bias tends to be larger (in absolute value) than the high severity incidents in Table 3-1. This indicates that the low severity incidents were more difficult to recall than high severity incidents, as also shown in comparing Figures 3-1 (high severity) and 3-2 (low severity).

In analyzing Tables 3-1 and 3-2, it is clear that one can only choose a recall period after having chosen a reference period. The choice of 1-2 weeks as a reference period was made in keeping with WSHF. Using the lowest value of the RMSE for the high and low severity incidents resulted in a 1-3 week recall period for the high severity fire incidents and a 1-2 week recall period for the low severity incidents.

*Annual Residential Fire Estimates*

Table 3-3 shows the annual fire estimates based on the recall periods from the last section.

Table 3-3
2004-2005 Fire Estimates by Fire Department Attendance

| Fire Department Attendance | Estimated Fires per Year (95% Confidence Interval) | Fires per 100 Households (95% Confidence Interval) |
|---|---|---|
| Both | 7,430,069 ( 6,195,938 - 8,664,199) | 6.56 (5.46 - 7.64) |
| Attended Only | 254,441 ( 65,165 - 443,716) | 0.22 (0.06 - 0.39) |
| Unattended Only | 7,175,628 (5,933,397 - 8,417,859) | 6.33 (5.23 - 7.42) |

Notes: Number of fires per household based on 113,343,000 households. Household estimates from http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH2-all.csv.

Table 3-3 shows that there were an estimated 7.4 million household fires per year, which translates to 6.56 fires per 100 households per year. Of these fires, 7.2 million fires were not fire department-attended, according to the survey respondents, and 254,000 were fire department-attended. The NFPA estimates of 410,000 fire department-attended residential structure fires in 2004 and 396,000 in 2005 are within the 95 percent confidence interval for the number of fire department-attended fires.[68] Note that 3.4 percent of fires, or one in 29.2 fires was fire department-attended.

Table 3-4 shows the distribution of estimated total residential fires and per household fire rates by region of the country.[69]

[68] Karter MJ (2005), "Fire Loss in the United States in 2004," National Fire Protection Association, Quincy, MA, and Karter MJ (2006), "Fire Loss in the United States in 2005," National Fire Protection Association, Quincy, MA. The NFPA survey is a probability sample of all U.S. fire departments and typically samples more than 2,500 departments. It is considered the most accurate national sample of fire department-attended fires.

[69] Regions were defined as follows: Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT; South: AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV; Midwest: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI; West: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, WY.

Table 3-4
2004-2005 Fire Estimates by U.S. Region

| Region | Estimated Fires per Year (95% Confidence Interval) | Fires per 100 Households (95% Confidence Interval) |
|---|---|---|
| All | 7,430,069 ( 6,195,938 - 8,664,199) | 6.56 (5.46 - 7.64) |
| West | 2,271.425 (1,911,500 - 2,631,350) | 9.09 (7.65 - 10.53) |
| South | 2,822,345 (2,436.329 - 3,208,362) | 6.85 (5.91 -7.78) |
| Midwest | 1,065,578 (837,943 - 1,293,212) | 4.11 (3.23 - 4.99) |
| Northeast | 1,270,721 (1,063.596 - 1,477,845) | 6.00 (5.02 - 6.98) |

Notes: Number of fires per household based on 113,343,000 households. Household estimates from http://www.census.gov/population /socdemo/hh-fam/cps2005/tabH2-all.csv.

Table 3-4 shows the distribution of fires by region of the country. The West region is shown to have the highest per household fire rate at 9.09 fires per 100 households, followed by the South, Northeast, and Midwest. Interestingly, this differs from fire department-attended fires. NFPA statistics, based on their probability sample of U.S. fire departments, show the West has the lowest per capita fire incidence and the South has the highest.[70]

One of the objectives for the 2004-2005 survey was to compare the decrease in unreported fire incidence with the decrease in reported fire incidence. Some have suggested that newer technology, such as more and better smoke alarms, would make it possible for residents to detect and extinguish fires when the fire was smaller, thus reducing or eliminating the need for fire department assistance.[71] This would then result in a greater decrease in fire department-attended fires than unattended fires. The results from the survey suggest that this conjecture may not be true. In 1980, using estimates based on the NFPA survey and NFIRS, CPSC staff estimated there were 655,500 fire department-attended residential structure fires, while in 2005, there were 375,100

[70] Karter MJ (2003), "U.S. Fire Experience by Region." National Fire Protection Association, Quincy, MA, Table 3, page 8.
[71] This conjecture has appeared in a number of places. For example, see Audits and Surveys (1985), *op cit.*, page 20.

unintentional residential structure fires.[72] This is a decrease of 43 percent. On the other hand, the number of unreported fires has dropped from 22.9 million in the 1984 survey to 7.2 million, a decrease of 68.7 percent.[73]

The decrease in the number of unreported fires is even more interesting because the number of households has increased from 84 million to 113.3 million, an almost one-third increase in the number of households in the last 20 years.[74] Taking this into account with rates, the 1984 survey estimated an annual household incidence rate of 28.3 (reported and unreported) fires per 100 households per year. The 2004-2005 survey showed that the household fire incidence estimate dropped by 76.8 percent to 6.6 fires per 100 households per year.

## Conclusion

Estimation of events from retrospective surveys immediately confronts the analyst with problems associated with recall. This occurred in the 1974 survey, with a one-year recall period and the 1984 survey where the recall period was three months. In the 1984 survey, because of recall problems, fire incidence rates were estimated only from the previous month's data. To determine the length of the recall period for the current survey, a method was adapted from WSHF that involved a tradeoff between sampling variance and recall bias.

The tradeoff is as follows: lower sampling variance is associated with longer recall periods, but longer recall periods have fewer events recalled per week leading to a downward bias in the estimate of annual fire incidence rates. In keeping with WSHF, the two-week period was defined as the reference period. Applying the WSHF method required finding the recall period with the smallest mean square error, defined as the sum of the square of the bias and the sampling variance.

The particular refinement of the WSHF method involved stratifying the recall period by the severity of fire incidents. It seemed plausible that incidents that were more severe would be remembered more easily. A severity indicator was developed that defined higher severity cases as those where a smoke detector operated, an attempt was made to extinguish the fire, there was obvious flame damage, the fire department-attended, or people had to leave the residence during the fire. The analysis showed that

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[72]The 1980 estimates are in Mah J (2001), *op cit.*, Table 6. 2005 estimates from Chowdhury R, Greene M and Miller D (2007), *loc cit.* page 21. Statistics for 1984 were not available. As fires have been decreasing over time, the number of fires in 1984 were likely to have been less than in 1980, and as a result, the percentage decrease in reported fires had we been able to use the 1984 estimates, would have been lower than reported above.

[73] The most appropriate comparison in the 1984 survey was unreported residential structure fires. That excludes brush fires and motor vehicle fires that were sampled in the 1984 survey, but were not in the 2004-2005 survey. See Audits and Surveys, *op cit.,* page 22.

[74] The 1984 survey was based on a population of 83,815,800 households and on 23.7 million (reported and unreported) residential structure fires in the 1984 survey. See Audits and Surveys, *op cit.,* page 22. The increase from 1984 to 2004-2005 was 35 percent.

the best (lowest mean square error) recall period was 21 days for these higher severity incidents. For the other, lower severity incidents, a 14-day recall period was best. This made sense because one would expect lower severity incidents to be more difficult to recall.

Using the 14-day low severity and 21-day high severity recall periods, annual fire incidence was estimated at 7.4 million fires, of which 7.2 million were unattended by fire departments and 254,000 were fire department-attended. The estimate of fire department-attended was lower than the comparable estimate from the NFPA annual survey, but the sample size for attended fires in the Residential Fire Survey was small and the confidence interval was large. On a per household basis, the estimates were 6.56 total fires per 100 households. When broken down by region, the West had the highest per household fire incidence rate and the Midwest had the lowest.

The estimates in this survey are substantially lower than the "recall adjusted" 1984 survey. The earlier survey estimated 25.2 million total residential fires (23.7 million residential structural fires) on an estimated U.S. population of 83.8 million households. This was a household incidence rate of 28.3 residential structure fires per 100 households per year. The current survey shows that to have decreased to 7.4 million residential structural fires, a decrease of 76.8 percent.

Although the 1984 survey and the present survey differ in the estimation methodology and in some of the survey questions, the difference in the household fire incidence estimates is too large to be explained by differences in methodology or survey questions. As a result, it seems safe to conclude that there has been a substantial change in the number of household fires. Factors associated with those changes are the explored in Chapter 6 and Chapter 7 of this report.

## Chapter 4
## Comparisons of Fire and Non-fire Households

In Chapter 3, it was estimated that the annual household fire incidence rate was 6.56 fires per 100 households per year. The purpose of Chapter 4 is to identify the socioeconomic characteristics that differ between fire and non-fire households. Previous research has identified presence of smokers, mobile home housing type, presence of young and old household members, minority status, low income, and alcohol use as more likely to characterize fire households, that is, these characteristics are risk factors for fires.[75]

Fire households are defined in this chapter and in Chapter 5 as households with at least one fire in the 91-day recall period. This definition is somewhat different from the definition used in Chapters 3, 6, 7, and 8 where only fires occurring in the 14- and 21-day recall periods were used in the analysis. The 1984 survey in comparing fire and non-fire households also used the full three-month period in the comparisons even though fire incidence rates were estimated from a one-month recall period. Reasons for this different definition are discussed in the next section.

The tables in this chapter contrast fire and non-fire households according to region of residence, housing characteristics, household size and age distribution, number of smokers, and other demographic characteristics.

Some of the differences between fire and non-fire households in the present survey were as follows:

- Fire households were more likely to be renters and less likely to be owners of their residences than non-fire households.
- Fire households had more members than non-fire households. In comparing household sizes by age group (under 18, 18-64, 65 and over), fire households had more members under 18 and between 18 and 64 than non-fire households. Non-fire households had more people 65 and over.
- The heads of fire households tended to have higher educational levels than heads of non-fire households.

The following variables differed significantly between fire and non-fire households: type of dwelling, age of residence, race or ethnicity, whether or not there was at least one smoker in the household, and household income. On average, there were a larger number of smokers in fire households than non-fire households, with a difference that was almost

[75] For example, see Runyan CW, Bangdiwala SI, Linzer MA, Sacks JJ and Butts J (1992), "Risk Factors for Fatal Residential Fires," *New England Journal of Medicine, 12,* 327: 859-863. Mobley C, Sugarman JR, Deam C and Giles L (1994), "Prevalence of Risk Factors for Residential Fire and Burn Injuries in an American Indian Community," *Public Health Reports, 109,* 5, 702-705. Warda L, Tenenbein M, Moffatt MEK (1999), "House Fire Injury Prevention Update. Part I. A Review of Risk Factors for Fatal and Non-fatal House Fire Injury." *Injury Prevention* 5: 145-150.

statistically significant. This is different from the 1984 survey, where there was a significant difference in the proportion of fire households with smokers than non-fire households. The newer finding about smokers might reflect the overall decline in smoking rates in the U.S. over the past 20 years.

The next section describes the methods used in this chapter. The results and conclusion sections follow.

## Methods

*Defining Fire Households*

An issue arising in this chapter and in Chapter 5 is how to define fire and non-fire households. In Chapter 3, in estimating the annual household fire incidence rate, the only fires that were counted were those low severity fires in the 14-day recall period and the high severity fires in the 21-day recall period. Extending this idea would result in defining households with fires in the 14 or 21 days before the interview as fire households and all other households as non-fire households. This would have resulted in defining 257 households as fire households.[76] The issue, then, is how to assign the remaining 659 households that had fires between 22 and 91 days before the interview. The following choices were considered:

- Include these cases with the non-fire households
- Exclude the cases from the analysis, that is, treat them neither as fire households nor non-fire households
- Include the cases with the fire households.

The last choice, to include these cases with the fire households, was selected. The reasons are discussed below.

The analyses in Chapter 3 suggested that some of the non-fire households may actually have had fires during the 14/21-day recall period but were unable to remember them. Thus, it seems extremely likely that there were non-fire households that actually had fires but were unable to recall them. The effect of these apparent misclassifications is to blur the differences in characteristics between fire and non-fire households. This meant that stronger differences in characteristics would be necessary in order to find them in the data. Therefore, including the 22-91 day fire households with the non-fire households would further contaminate the non-fire households with households known to have had fires, further weakening the ability to identify factors that distinguished between fire and non-fire households.

[76] Recall that in Chapter 3, missing dates were imputed for some fire incidents. For a given household with a missing fire date to be imputed, in one of the imputations, a fire date could fall in the 14- or 21-day recall period, while on another imputation, that same fire date might fall outside the recall period. Thus, the number of fire households would depend on the particular imputation.

The second option of discarding these cases was rejected because it reduced the size of the sample without providing any substantive benefit. There would still be non-fire households that actually had fires. The third option of including the 22-91 day fire households with the other fire households seemed to be the best option because these households were known to have had fires and, as a result, were more likely to resemble the fire households than the non-fire households.[77]

Another reason for grouping the 22-91 day fire households with the fire households was for consistency with the 1984 survey. Aware of recall issues, the authors of the 1984 survey used a one-month period for estimating fire incidence rates, but the full three-month period was used for comparing factors that differed between fire and non-fire households.[78] Using the same definition of fire households facilitates making comparisons between the two surveys.

*Statistical Analyses*

The tables in this chapter were prepared using Proc Surveyfreq, averages were computed with Proc Surveymeans, and differences between averages were estimated using Proc Surveyreg, all in the SAS® software system.[79] Two-way tables were tested for independence between the particular survey variable measuring some household characteristic and whether the household was a fire or non-fire household, i.e., whether there was an association between household fire status and the characteristic tested. The test statistic used was the Rao-Scott Likelihood Ratio *F* statistic, a test statistic that is corrected for the survey design.[80] This was different from the test statistic and the procedure used in the 1984 survey.[81]

Statistical tests were applied to the actual table shown or, when cell counts were small, to a collapsed version of the table. Table notes indicate whether the test statistic came from the original table or a collapsed version. Data in tables are shown in percentages. Missing data (not associated with survey skip patterns), responses of "don't

[77] In view of the analysis of fire severity in Chapter 3, it is likely that the fires recalled in the 22-91 day period among households that only had fires in that period would be of greater severity than those in the 14- and 21-day recall periods.

[78] Audits and Surveys (1985), *op cit.,* p. 12. The recall period for estimating fire incidence rates was the calendar month before the month of the interview. All respondents were interviewed in the first two weeks of the month.

[79] SAS Institute Inc. (2004), *SAS/STAT®, 9.1 User's Guide.* Cary, NC: SAS Institute Inc.

[80] *Ibid*., volume 9, pages 4219-4221. See also Rao, JNK and Scott, AJ (1984), "On Chi-Squared Tests for Multiway Contingency Tables with Cell Properties Estimated from Survey Data," *The Annals of Statistics,* 12, 46-60 and Rao, JNK and Scott, AJ (1987), "On Simple Adjustments to Chi-Square Tests with Survey Data," *The Annals of Statistics*, 15, 385-397. The correction for the survey design involves the proportions under the null hypothesis of independence. The *F* test is recommended as a better approximation.

[81] The 1984 survey used unweighted chi square hypothesis tests. The text does not explain the computational details, but it is likely that the chi square test was applied to the original survey data before weighting. This was a reasonable practice in the 1980s before the advent of modern sample survey software, but is no longer common practice.

know," and refusals to respond were excluded before the computation of percentages -- a procedure that essentially allocates non-responses in proportion to the responses.

## Results

*Region of Residence*

Table 4-1 shows the distribution of region of residence for fire and non-fire households.

Table 4-1
U. S. Region of Residence by Fire and Non-fire Households (Percent)

| U. S. Region | Fire Households | Non-fire Households |
|---|---|---|
| Northeast | 18.9 | 19.3 |
| South | 35.3 | 36.8 |
| Midwest | 18.8 | 23.2 |
| West | 26.9 | 20.8 |

Notes: Based on n = 3077 observations. Test statistics for the table contrasting fire and non-fire households by region, $F$ =3.1390, $p$ = 0.0243. Weighted distribution of the survey (i.e., fire and non-fire households) was as follows: *Northeast* 19.3 percent, *South* 36.7 percent, *Midwest* 23.2 percent, and *West* 20.8 percent. Census data by region are as follows: *Northeast* 18.7 percent, *South* 36.4 percent, *Midwest* 22.9 percent, and *West* 22.0 percent. Source: U.S. Bureau of the Census, Table H2. Households, by Type, Age of Members, Region of Residence, and Age, Race and Hispanic Origin of Householder for 2005, are available at http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH2-all.csv. Regions are defined in the footnote below.[82]

In comparing fire and non-fire households by region, note that there were relatively more fire households than non-fire households in the West (i.e., 26.9 percent vs. 20.8 percent), about the same balance between fire and non-fire households in the South and Northeast, and fewer fire households than non-fire households in the Midwest. The difference between fire and non-fire households by region was statistically significant. This pattern is similar to the difference in per capita household fire rates shown in Table 3-4 of Chapter 3, where the West had the highest rates, the Midwest had the lowest rates, and the South and Northeast were in the middle. As noted in Chapter 3, the regional distribution was different from statistics on fire department-attended fires as reported by the NFPA, where the West had the lowest per capita rates.[83]

[82] Regions were defined as follows: Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT; South: AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV; Midwest: IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI; West: AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, WY. The same definitions were used in Table 3-4.

[83] See Karter MJ (2003), *op cit.*

As noted in Chapter 2, the definition of urban and non-urban in this survey is from the 16 original strata, eight that were defined as urban, and eight as non-urban. Among fire households, 82 percent were in urban strata and 18 percent were in non-urban strata. The distribution of non-fire households was 80 percent urban and 20 percent non-urban, just about the same as fire households.[84] These results are different from the NFPA survey that shows, for communities below 50,000 people, per capita fire department-attended fires increase with decreasing community size.[85] It may be that the urban/non-urban difference applies primarily to fire department-attended fires, or it may be that the distinction between urban and non-urban areas in this survey is not sharp enough to find differences.

The 1984 survey showed a slightly larger proportion of fire than non-fire households in the West, but the differences between regions in that survey were not statistically significant. That survey also contrasted the distribution of fire and non-fire households by city, suburb, small town, and "the country." The differences were also not statistically significant.[86]

*Housing Characteristics*

Table 4-2 shows the distribution of the percentage of fire and non-fire households by type of dwelling. While detached single family homes were the largest category of dwelling type in the survey, a smaller proportion of fire households lived in this type of housing than non-fire households. For all dwelling types other than single family homes and condominiums, the proportion of fire households exceeded the proportion of non-fire households, but the differences were not statistically significant.

[84] The difference between the proportion of fire and non-fire households by urban/non-urban region was not statistically significant ($F = 0.6943$, $p=0.4048$).
[85] For example, communities of 25,000 to 49,999 had 4.9 fires per thousand people; communities of 10,000 to 24,999 had 5.8 fires per thousand; communities 5,000 to 9,999 had 6.9 fires per thousand; 2,500 to 4,999 had 8.3 fires per thousand; and under 2,500 had 12.2 fires per thousand people. For details see Karter MJ (2003), *op cit.,* page 20.
[86] Audits and Surveys (1985), *op cit.,* pages 23-24.

Table 4-2
Fire and Non-fire Households by Dwelling Type (Percent)

| Type of Dwelling | Fire Households | Non-fire Households |
|---|---|---|
| Detached single family home | 65.1 | 71.1 |
| Mobile or manufactured home | 8.7 | 6.1 |
| Two family dwelling | 4.0 | 3.4 |
| Apartment building | 15.2 | 12.6 |
| Townhouse or row house | 5.9 | 5.2 |
| Condo | 0.8 | 1.4 |
| Other | 0.3 | 0.3 |

Notes: Based on n = 3013 respondents. Test of independence of household status and dwelling type was based on the following categories: (1) *Detached single family home*, (2) *Mobile or manufactured home*, (3) *Townhouse or row house*, (4) multifamily (*Two family dwelling*, *Apartment building*, *Condo*, and *Other*). Test statistic $F = 2.0657$, $p = 0.1025$.

The categories of dwelling types in the 1984 survey were slightly different from the present survey categories, but in that survey, there was almost no difference in the distribution of dwelling types between fire and non-fire households. For example, in the 1984 survey, 66.2 percent of fire households were in single family dwellings, while 67.1 percent of non-fire households were in single family dwellings. Townhouses, row houses, and condos were not listed as dwelling categories in the 1984 report.[87]

Table 4-3 shows that fire households were less likely to own their residences than non-fire households. The difference in tenure patterns was statistically significant.

[87] Audits and Surveys (1985), *op cit.*, page 24.

Table 4-3
Type of Ownership by Fire and Non-fire Households (Percent)

| Type of Ownership | Fire Households | Non-fire Households |
|---|---|---|
| Owner | 65.8 | 77.5 |
| Renter | 34.2 | 22.5 |

Notes: Based on n = 3010 respondents. Three responses of *Other* were included with *Renter*. Test of independence of household status and type of ownership, $F$ =19.6608, $p < 0.0001$.

Table 4-3 shows that renters accounted for a larger proportion of fire households than non-fire households. The results in the 1984 survey appear to be different. That survey showed no significant difference in the composition of fire and non-fire households by type of ownership. In the 1984 survey, 65.0 percent of fire households were owners and 66.4 percent of non-fire households were owners.[88]

Table 4-4 compares the age of residential structures by fire and non-fire households.

Table 4-4
Age of Dwelling by Fire and Non-fire Households (Percent)

| Age of Dwelling | Fire Households | Non-fire Households |
|---|---|---|
| 5 years old or less | 12.2 | 13.5 |
| 6 to 15 years old | 22.6 | 19.5 |
| 16 to 25 years old | 14.6 | 16.4 |
| 26 to 35 years old | 12.1 | 13.5 |
| 36 to 45 years old | 13.3 | 10.1 |
| 46 years or older | 25.1 | 27.0 |

Notes: Based on n = 2940 respondents. Test of independence of household status and age of residence, $F$ = 1.3603, $p$ = 0.2359.

Table 4-4 shows that there were no significant differences in the distribution of the ages of housing for fire and non-fire households. The average age of dwelling units for fire

[88] *Loc cit.*

households was 27.5 years (95 percent confidence interval 26.0 – 29.0), and for non-fire households was 27.7 years (95 percent confidence interval 26.6 – 28.7). The difference in average dwelling ages was not statistically significant ($t$=0.17, $p$=0.8617). These findings were in agreement with the 1984 survey, which also did not show any significant difference in the age distribution of dwellings.[89]

*Household Composition*

Table 4-5 shows the distribution of the number of household members by fire and non-fire household.

Table 4-5
Household Size by Fire and Non-fire Households (Percent)

| Number of People in Household | Fire Households | Non-fire Households |
|---|---|---|
| One | 11.3 | 16.4 |
| Two | 23.7 | 34.1 |
| Three | 22.9 | 18.9 |
| Four | 22.1 | 17.5 |
| Five | 13.0 | 8.9 |
| Six | 4.1 | 3.0 |
| Seven | 1.7 | 0.9 |
| Eight or More | 1.2 | 0.3 |

Notes: Based on n = 3006 respondents. Test of independence of household status and household size, $F$ =4.2735, $p < 0.0001$.

Table 4-5 shows that fire households tended to have more people than non-fire households. The difference in the distribution of household size between fire and non-fire households was statistically significant. The average household size for fire households was 3.27 people (95 percent confidence interval 3.14 – 3.40) as compared with 2.83 for non-fire households (95 percent confidence interval 2.74 – 2.91). Not surprisingly given the difference in distribution, the difference in average household size was statistically significant ($t$=5.70, $p < 0.0001$). In the 1984 survey, fire households also tended to be larger than non-fire households.[90]

The age distribution of members of fire and non-fire households is shown in Table 4-6a, Table 4-6b, and Table 4-6c. In addition to fire households having more

[89] *Ibid*., page 25.
[90] *Loc cit*.

members than non-fire households, these three tables show that the members of fire households tended to be younger than members of non-fire households.

Table 4-6a
Number of People Under 18 Years Old by Fire and Non-fire Households (Percent)

| Number of People | Fire Households | Non-fire Households |
|---|---|---|
| None | 45.4 | 60.6 |
| One | 18.9 | 15.5 |
| Two | 21.1 | 16.2 |
| Three | 9.1 | 5.4 |
| Four or More | 5.4 | 2.3 |

Notes: Based on n = 2957 respondents. Test of independence of household status and number of people under 18, $F = 7.0578$ , $p < 0.0001$.

Table 4-6a shows that fire households had more people under 18 years old than non-fire households. The average number of people under 18 in fire households was 1.13 (95 percent confidence interval 1.02 – 1.24) as compared with 0.74 in non-fire households (95 percent confidence interval 0.67 – 0.81). The difference in averages was statistically significant ($t$=5.83, $p < 0.0001$).

Table 4-6b shows the distribution of the number of people between 18 and 64 years old by fire and non-fire households.

Table 4-6b
Number of People Between 18 and 64 Years Old by Fire and Non-fire Households (Percent)

| Number of People | Fire Households | Non-fire Households |
|---|---|---|
| None | 2.5 | 13.0 |
| One | 19.3 | 17.8 |
| Two | 57.3 | 51.8 |
| Three | 14.0 | 12.1 |
| Four or More | 6.9 | 5.3 |

Notes: Based on n = 2957 respondents. Test of independence of household status and number of people between 18 and 64, $F = 13.2379$, $p < 0.0001$.

Table 4-6b again shows the effect of larger household sizes for fire households, i.e., as fire households had on average more members, it would be expected that fire households would have more members between 18 and 64 years old. The average fire household had 2.05 people between 18 and 64 years old (95 percent confidence interval 1.98 - 2.13), while the non-fire households averaged 1.82 people between 18 and 64 (95 percent confidence interval 1.75 – 1.88). The difference was statistically significant ($t$=4.76, $p$ < 0.0001).

Table 4-6c shows the number of people 65 and over by fire and non-fire households.

Table 4-6c
Number of People 65 Years Old and Older by Fire and Non-fire Households (Percent)

| Number of People | Fire Households | Non-fire Households |
|---|---|---|
| None | 94.5 | 81.2 |
| One | 3.5 | 10.1 |
| Two or More | 2.0 | 8.7 |

Notes: Based on n = 2957 respondents. Test of independence of household status and number of people 65 and over on collapsed table for *None* and *One* and *Two or More*, $F$ = 79.5634, $p$ < 0.0001.

Table 4-6c shows that fire households had relatively fewer people 65 and over than non-fire households. The average number of people 65 and over in fire households was 0.08 (95 percent confidence interval 0.05 – 0.10), while the average number of people 65 and over in non-fire households was 0.28 (95 percent confidence interval 0.24 – 0.31). This difference in averages was statistically significant ($t$ = 8.31, $p$ < 0.0001).

The results shown above are similar to the findings in the 1984 survey. In that survey, fire households were significantly larger than non-fire households, and fire households had significantly more people under 18 than non-fire households. The 1984 survey did not tabulate the 18-64 age group or the 65 and over age group.[91]

*Smokers*

Table 4-7 shows the proportion of fire and non-fire households by number of smokers in the household.

[91] *Ibid.*, pages 25-26.

Table 4-7
Number of Smokers by Fire and Non-fire Household (Percent)

| Number of Smokers | Fire Households | Non-fire Households |
|---|---|---|
| None | 68.5 | 70.8 |
| One or More | 31.5 | 29.2 |

Notes: Based on n = 3029 responses. Test of independence of household status and number of smokers, $F = 0.8949$, $p = 0.3442$.

Table 4-7 shows that there was almost the same percentage of smokers in fire and non-fire households.[92] Fire households had an average of 0.52 smokers (95 percent confidence interval 0.43 – 0.60), while non-fire households averaged 0.42 smokers (95 percent confidence interval 0.38 – 0.47). The difference between averages by type of household was almost statistically significant ($t = 1.89$, $p = 0.0586$).

The percentage of smokers by household fire status differed between the current survey and the 1984 survey. In the 1984 survey, 50.4 percent of fire households had smokers in contrast to 35.0 percent of non-fire households, a difference that was statistically significant.[93] Some decrease in proportions of both fire and non-fire households with smokers should be expected because smoking rates have decreased in the last 20 years. In 1985, according to the U.S. Centers for Disease Control and Prevention, 30.1 percent of the adult U.S. population were smokers, while in 2004, 20.9 percent were smokers, a decrease of 31 percent. Both adult male and adult female smoking rates decreased over the past 20 years.[94]

An additional reason why the results may have been significant in the 1984 survey but not the current survey is that the two surveys differ in the distribution of the types of fires. In the 1984 survey, 31.6 percent of fires were non-appliance fires (associated with candles, matches, lighters, and smoking materials), in contrast to 12.6

[92] The exact question for the fire households was, "At the time of the fire, how many people in your household smoked tobacco at least once a day." For non-fire households the question was, "How many people in your household smoke tobacco at least once a day." For households that had more than one fire, this question was asked for each fire. All except two households reported the same number of smokers by fire. Of the two households with different numbers of smokers, one had four smokers at the most recent fire and five at the previous fire; while the other had four, one, and seven, respectively. To use a single number to characterize those households, the average number of smokers was used in both cases.

[93] Audits and Surveys (1985), *op cit.*, page 26.

[94] U. S. Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Prevention (2005), "Smoking Prevalence Among U.S. Adults," available at www.cdc.gov/tobacco /research_data /adults_prev/prevali.htm. CDC(2007), "Cigarette Smoking Among Adults." *Morbidity and Mortality Weekly*, 56(4), 1157-1161. Available at http://www.cdc.gov/mmwr/preview/mmwrhtml /mm5644a2.htm, See also http://www.cdc.gov/nccdphp /publications/aag /osh_text.htm#2.

percent of the present survey. With fewer smoking-related fires in the present survey to classify households as fire or non-fire households, it seems reasonable that the presence of smokers would make less of a difference.[95]

The results in Table 4-7 and the comparison of the average number of smokers by household type raise but do not settle the question as to whether the presence of smokers is still a risk factor for fires. The role of smoking materials as associated with fires losses has been well documented.[96] Smoking may continue to be a risk factor for fire department-attended fires, types of fires such as upholstered furniture and mattress fires, or for fatal fires in general, but for the larger category of unattended fires, there seems to be less evidence than in the 1984 survey that smoking is a fire risk factor.

*Other Demographic and Socioeconomic Characteristics*

Table 4-8 compares household income between fire and non-fire households. Fire households tended to have fewer families in the $35,000 - $75,000 group than non-fire households and more in the under $35,000 group, but the differences were not statistically significant. The 1984 survey also did not show a significant difference in household income between fire and non-fire households.[97]

Table 4-8
Household Income by Fire and Non-fire Households (Percent)

| Income | Fire Households | Non-fire Households |
|---|---|---|
| Less than $15,000 | 10.4 | 8.4 |
| $15,000 - $35,000 | 25.7 | 22.4 |
| Less than $35,000 | 36.1 | 30.8 |
| $35,000 - $75,000 | 31.9 | 36.6 |
| $75,000 or more | 32.0 | 32.6 |
| $35,000 or more | 63.9 | 69.2 |

Notes: Based on n = 2,565 respondents. Income classes do not include the right endpoint, i.e., $15,000 - $35,000 is actually $15,000 - $34,999. Two categories:*Less than $15,000* and *$15,000 - $35,000* were collapsed together for the test of independence of income and household status. Test statistics, $F = 2.2612$, $p = 0.1043$.

[95] More information on the characteristics of fires in the present survey is in Chapter 7. The 1984 survey results are from Audits and Surveys (1985), *op cit*., page 36.
[96] Hall JR Jr. (2004), "The Smoking-Material Fire Problem." National Fire Protection Association, Quincy, MA.
[97] Audits and Surveys (1985), *op cit.,* page 28.

Table 4-9 shows the educational levels attained by the heads of households by household status. There was a statistically significant association between household status and educational level. In particular, heads of fire households tended to have higher educational levels than heads of non-fire households. This was also found in the 1984 survey.[98]

Table 4-9
Household Head Educational Levels by Fire and Non-fire Households (Percent)

| Educational Level | Fire Household | Non-fire Household |
|---|---|---|
| Less than High School | 1.5 | 1.6 |
| Some High School | 2.0 | 3.2 |
| High School Graduate | 18.9 | 27.0 |
| Technical/Vocational School | 2.3 | 2.3 |
| Some College | 18.2 | 18.4 |
| College Graduate | 36.9 | 31.9 |
| Postgraduate Work | 20.1 | 15.6 |

Notes: Based on n = 2967 responses. Table collapsed to the following categories for statistical testing: (1) *Less than High School*, *Some High School*, *High School Graduate*, and *Technical/Vocational School*, (2) *Some College*, (3) *College Graduate*, and (4) *Postgraduate Work*. Test of independence of household status and educational level, $F = 5.2935$, $p = 0.0012$.

Table 4-10 shows race and ethnicity of household head by fire and non-fire households. The responses were the result of two questions. The first question asked respondents if the head of household was of Hispanic or Latino descent. The second question provided respondents with a choice of racial/ethnic groups, allowing them to choose all applicable categories. Some respondents chose more than one category. The second question permitted respondents to specify a non-listed category. Some respondents mentioned Hispanic or Latin American as a category.

The table shows that fire households were headed by relatively more Black or African Americans, American Indians, or Hispanic or Latin Americans. Fire households had relatively fewer White heads of households. However, the differences were not statistically significant.

[98] *Loc cit.*

Table 4-10
Race and Ethnicity by Fire and Non-fire Households (Percent)

| Race or Ethnicity | Fire Households | Non-fire Households |
|---|---|---|
| Hispanic or Latino Descent | 11.5 | 9.4 |
| Not Hispanic or Latino Descent | 88.5 | 90.6 |
| White | 79.7 | 83.0 |
| Black or African American | 9.8 | 9.1 |
| Hispanic or Latin American | 6.0 | 4.8 |
| American Indian | 3.1 | 2.5 |
| Asian | 2.0 | 1.7 |
| Native Hawaiian or Pacific Islander | 0.9 | 0.3 |
| American/European/Canadian | 0.8 | 0.8 |
| Mixed Race or Multi-Racial | 0.6 | 0.5 |
| Alaskan Native | 0.4 | 0.1 |
| Some Other Race | 0.2 | 0.4 |

Notes: *Hispanic or Latino Descent* based on n = 2,948 responses; other designations based on n = 2879 survey respondents who indicated membership in at least one race or national origin. Percentages add to more than 100 percent because some respondents indicated membership in more than one group. Statistical tests were conducted one group at a time, e.g., *White* vs. Non-white, or *Black or African American* vs. Non-black or African American. No test of association between race or ethnicity and whether the household was a fire or non-fire household was found to be statistically significant.

Tests of the association between ethnicity/race and fire or non-fire household were also computed from a table that was collapsed into two categories as follows: (1) White, Asian, American/European/Canadian and (2) Black or African American, Hispanic or Latin American, American Indian, Native Hawaiian or Pacific Islander, Mixed Race or Multi-Racial, Alaskan Native, and Some Other Race. This was an attempt to separate possible low- and high-risk ethnic groups. The differences were not statistically significant.

How do these weighted estimates compare with the U.S. population for 2004? The comparison is inexact because we do not have national data for households broken down by the race of the head of the household. Taking the population as a whole, however, 14 percent of the population identified themselves as Hispanic or Latino, 80 percent as White, 13 percent as Black, 4 percent as Asian, and 1 percent as American

Indian or Alaskan Native.[99] As a result, it appears that the composition of the survey and the U.S. population agree fairly closely.

## Conclusion

Fire households were more likely to be renters and less likely to be owners than non-fire households. In addition, fire households had a larger number of people and the heads of fire households had more years of schooling than non-fire households. Fire households tended to be more likely to have people under 18 years old and were less likely to have people 65 years old and older. The survey also showed a regional association with household fire status. Relatively more fire households than non-fire households were in the West and relatively fewer were in the Midwest. In the 1984 survey, these differences were also found to be statistically significant, except for the renter/owner difference.

Like the 1984 survey, this survey showed no statistically significant association between household fire status and type of dwelling, age of dwelling, household income, or urban/non-urban location. Additionally, the present survey did not show any significant statistical association between household fire status and race/ethnicity.

The two surveys differed in the results regarding the presence of smokers. In the 1984 survey, fire households were more likely than non-fire households to have at least one member who smoked, while in the present survey, there was no significant difference in the prevalence of smokers in fire and non-fire households. However, the difference in the average number of smokers between fire and non-fire households was almost statistically significant. That there appears to be less evidence for smoking as a risk factor in the 2004 survey is probably a result of the large decrease in smoking nationwide during the 20 years between the surveys. As shown later in Chapter 7 of this report, a much smaller percentage of fires in the present survey involved smoking materials than in the 1984 survey. That does not mean that smoking is no longer a risk factor for fires in general. The role of smoking materials in fire department-attended fires, especially those involving upholstered furniture and mattresses, has been well documented, especially in fires that produce injury and death.[100]

[99] U.S. Bureau of the Census (2006a), "Table 3: Annual Estimates of the Population by Sex, Race and Hispanic or Latino Origin for the United States: April 1, 2000 to July 1, 2005." Available from http://www.census.gov/popest/national/asrh/NC-EST2005-srh.html

[100] Hall JR Jr. (2004), *op cit.*

## Chapter 5
## Characteristics of Households with Smoke Alarms and Fire Extinguishers

This chapter compares the characteristics of households that have smoke alarms and fire extinguishers with households that do not have these devices. The chapter is organized into four sections. The first section contains survey estimates for the proportion of households that have smoke alarms and fire extinguishers by household characteristics. The second section compares presence and absence of these devices among fire and non-fire households. Section three focuses on high-risk households, comparing the presence and absence of these devices by race and ethnicity, presence of young children or older adults, presence of smokers, and some socioeconomic characteristics. The last section draws conclusions from the analyses.

The survey included a number of questions about smoke alarms, sprinklers, and fire extinguishers. Respondents were asked if they had smoke alarms on every level in the residence, in all the bedrooms, the type of power source for these alarms, if the smoke alarms were interconnected, and if they were connected to a home security system. Respondents were also asked if they had an installed sprinkler system and about the number of fire extinguishers in their homes.

The role of smoke alarms in alerting people to fires and the effectiveness of alarms in reducing fire losses are discussed in Chapter 8.

Like Chapter 4, households are the unit of comparison in this chapter. For the most part, results are provided as percentages and thus apply to the estimated 1.3 million U.S. fire households and the 112.1 million non-fire households or, collectively, to the 113.3 million U.S. households.[101]

Some of the findings in this chapter are as follows:

- Similar to other recent surveys, 96.7 percent of U.S. households were estimated to have at least one smoke alarm in their residence. This was a major change from the 1984 survey where 62 percent of households had smoke alarms.[102]
- The breakdown by fire and non-fire households was that 92.7 percent of fire households and 96.8 percent of non-fire households had at least one smoke alarm. Fire households had an average of 2.92 alarms per household while non-fire households had an average of 3.54 alarms.

[101] Total U.S. households from the Bureau of the Census. See http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH2-all.csv. Estimates for the number of fire and non-fire households in the U.S. are found in Chapter 3 of this report.

[102] Audits and Surveys (1985), *op cit*., page 53. Information on recent surveys of smoke alarms is in Ahrens M (2007b), *op cit.*

- About 30 percent of the alarms in both fire and non-fire households used house current or house current with battery backup. The remaining 70 percent of alarms were battery powered.
- Among fire households, 13 percent had interconnected alarms while 19 percent of non-fire households had interconnected alarms. About 8 percent of fire households and 14 percent of non-fire households had alarms that were connected to home security systems.
- Fire households were less likely to have smoke alarms on all floors and in all bedrooms than non-fire households.
- In comparing households that had various fire risk factors with those that did not, the following were observed:
    - Households with at least one family member under 18 years old were more likely to have smoke alarms on all floors and in all bedrooms than households without a family member under 18.
    - Urban households were more likely than non-urban households to have smoke alarms on all floors and in all bedrooms.
    - Households with at least one person 65 years old or older and households with at least one smoker were less likely to have smoke alarms in all bedrooms.
- Non-fire households were more likely than fire households to have at least one fire extinguisher in the house.

Although originally intended to be included in this chapter, results for home sprinkler systems are not included because it appeared that survey respondents had not answered the question accurately. Households were asked, "Do you currently have a sprinkler system installed in your home?" According to the survey data, 6.7 percent of households answered that their homes had installed sprinkler systems. This was composed of 15.1 percent of households in townhouses or row houses, 16.1 percent in multifamily houses, 13.1 percent in rental occupancies, 11.9 percent of households in buildings 0-5 years old, and 12.2 percent in buildings 6-15 years old. These statistics conflict with what is known about the number of homes with sprinklers.[103] It is possible that some people in multifamily dwellings answered yes to the sprinkler question when the buildings had sprinklers in public areas, but not in apartments. Also, it is possible that some households may have confused home sprinkler systems with installed lawn sprinkler systems.

## Methods

Similar to Chapter 4, the tables in this chapter were prepared using Proc Surveyfreq, averages were computed with Proc Surveymeans, and differences between

[103] According to the National Residential Fire Sprinkler Initiative Meeting at the U.S. Fire Administration in 2003, no more than 2 percent of new residences are built with sprinkler systems. See Rohr K and Hall JR Jr. (2005), "U.S. Experience with Sprinklers and Other Fire Extinguishing Equipment," National Fire Protection Association, Quincy, MA, page 1.

averages were tested using Proc Surveyreg, all in the SAS® software system.[104] Two-way tables were tested for independence between the particular survey variable and whether the household was a fire or non-fire household, i.e., whether there was an association between household fire status and the characteristic tested. The test statistic used was the Rao-Scott Likelihood Ratio *F* statistic, a test statistic that is corrected for the survey design.

Statistical tests were applied to the actual table shown, or, when cell counts were small, to a collapsed version of the table. Table notes indicate when the test statistic came from a collapsed version. Data in tables are shown in percentages. Missing data, responses of "don't know," and refusals to respond were excluded before the computation of percentages. That procedure allocates non-responses in proportion to the responses.

Households with at least one fire were asked questions about the presence of smoke alarms and fire extinguishers immediately before each fire and if they had changed the number of these devices after the fire. If respondents said they had changed the number of smoke alarms or extinguishers after the fire, then the number of smoke alarms or extinguishers reflect those changes; otherwise they are the number of smoke alarms present before the most recent fire.

## Results

### *Household Characteristics*

Smoke Alarms. From the survey, it was estimated that 96.7 percent of U.S. households (95 percent confidence interval 95.8 – 97.7 percent) had smoke alarms.[105] Survey households averaged 3.53 smoke alarms in their households (95 percent confidence interval 3.36 – 3.70). As expected, the proportion of households with alarms was much larger than that from the 1984 survey, where 62 percent of households (52 million households) were estimated to have had smoke alarms.[106]

Table 5-1 contains additional information on the characteristics of households with smoke alarms.

[104] SAS Institute Inc. (2004), *SAS/STAT®, 9.1 User's Guide.* Cary, NC: SAS Institute Inc. See Chapter 4 for details on the statistical procedure.
[105] This equates to 109.6 million households. Percentages and household estimates are based on $n = 3030$ respondents who indicated the presence or absence of smoke alarms.
[106] Audits and Surveys (1985), *op cit.*, page 53.

Table 5-1
Characteristics of Households with Smoke Alarms

| Household Characteristic | Percent with Smoke Alarms |
|---|---|
| All | 96.7 |
| Type of dwelling | |
| Detached single family home | 97.0 |
| Mobile or manufactured home | 90.9 |
| Townhouse or row house | 97.9 |
| Multifamily | 97.0 |
| Type of ownership | |
| Owner | 97.0 |
| Renter/Other | 95.7 |
| Region | |
| Northeast | 97.1 |
| South | 95.4 |
| Midwest | 98.9 |
| West | 96.3 |
| Community type | |
| Urban | 98.0 |
| Non-urban | 91.4 |
| Age of dwelling | |
| 5 years old or less | 95.2 |
| 6 to 15 years old | 97.4 |
| 16 to 25 years old | 97.8 |
| 26 to 35 years old | 96.1 |
| 36 to 45 years old | 95.4 |
| 46 years or older | 97.3 |

Notes: *Type of dwelling* based on n = 3,004 respondents, $F = 2.3056$, $p = 0.0747$; *Type of ownership*, n = 3,003, $F = 0.9761$, $p = 0.3232$; *Region*, n = 3,030, $F = 2.9022$, $p = 0.0335$; *Community type*, n = 3,030, $F = 22.4274$, $p < 0.0001$; *Age of dwelling*, n = 2,937, $F = 0.7023$, $p = 0.6217$. Multifamily housing includes two family dwelling, apartment, condo, and other dwelling categories.

Although the differences in the proportions of households with smoke alarms were not statistically significant by dwelling type, Table 5-1 shows mobile or

manufactured homes had a smaller proportion with smoke alarms than other types of residences. A significantly larger proportion of households in urban communities had smoke alarms than households in non-urban communities. The differences in the proportions of households with smoke alarms by region were statistically significant, with the South having the smallest percentage and the Midwest having the highest.

Table 5-1 shows that there were no statistically significant associations between ownership type and presence of alarms and age of residence and presence of alarms.

Fire Extinguishers. It was estimated that 76.4 percent of households had at least one fire extinguisher (95 percent confidence interval 73.8 percent – 78.9 percent). Households averaged 1.35 extinguishers (95 percent confidence interval 1.28 – 1.42).[107]

Table 5-2 contains additional information on households with fire extinguishers.

[107] Based on $n$ = 3015 respondents. This equates to 86.6 million households with extinguishers.

Table 5-2
Characteristics of Households with Fire Extinguishers

| Household Characteristic | Percent with Extinguishers |
|---|---|
| All | 76.4 |
| Type of dwelling | |
| Detached single family home | 81.2 |
| Mobile or manufactured home | 71.7 |
| Townhouse or row house | 77.2 |
| Multifamily | 59.3 |
| Type of ownership | |
| Owner | 81.0 |
| Renter/Other | 61.1 |
| Region | |
| Northeast | 76.7 |
| South | 78.4 |
| Midwest | 75.3 |
| West | 73.8 |
| Community type | |
| Urban | 76.1 |
| Non-urban | 77.6 |
| Age of dwelling | |
| 5 years old or less | 76.8 |
| 6 to 15 years old | 76.1 |
| 16 to 25 years old | 77.2 |
| 26 to 35 years old | 81.6 |
| 36 to 45 years old | 79.9 |
| 46 years or older | 76.7 |

Notes: *Type of dwelling* based on n = 2,988 respondents, $F = 11.2566$, $p < 0.0001$; *Type of ownership*, n = 2,994, $F = 30.0116$, $p < 0.0001$; *Region*, n = 3,016, $F = 0.6277$, $p = 0.5971$; *Community type*, n = 3,016, $F = 0.2669$, $p = 0.6054$, *Age of dwelling*, n = 2,923, $F = 0.4308$, $p = 0.8275$.

Table 5-2 shows that townhouses, row houses, and detached single family homes were most likely to have had at least one fire extinguisher, while multifamily homes were

least likely. The differences were statistically significant. With respect to the type of ownership, renters were less likely to have fire extinguishers than owners, also a statistically significant difference.

There were no statistically significant differences in the proportions of households with fire extinguishers by region of the country, community type, or by the age of the dwelling.

*Fire and Non-fire Households*

Smoke Alarms. Table 5-3 shows that 92.7 percent of fire households had smoke alarms while 96.8 percent of non-fire households had smoke alarms. The difference was statistically significant.[108] There were relatively more fire households with no alarms or one alarm than non-fire households, while there were more non-fire households with two or more alarms. Further details are shown in Table 5-3.

[108] n = 3,030, $F = 7.8523$, $p = 0.0051$. This is essentially the same result as Table 5-3 collapsed to two rows, None and One or more. 95 percent confidence intervals for the proportion of fire households with smoke alarms 90.5 – 94.9; non-fire households with alarms 95.8 – 97.7.

Table 5-3
Number of Smoke Alarms by Fire and Non-fire Households (Percent)

| Number of Smoke Alarms [109] | All Households | Fire Households | Non-fire Households |
|---|---|---|---|
| None | 3.3 | 7.3 | 3.2 |
| One | 15.8 | 19.5 | 15.7 |
| Two | 23.6 | 24.7 | 23.5 |
| Three | 19.3 | 19.9 | 19.3 |
| Four | 13.0 | 11.8 | 13.1 |
| Five or more | 25.1 | 16.8 | 25.2 |
| At least one alarm | 96.7 | 92.7 | 96.8 |

Notes: Based on n = 3,030 respondents. Test of independence of number of alarms and household status $F = 4.8618$, $p = 0.0002$. Percentages computed using survey weights. Because the weights are much larger for the Non-fire Households (i.e., each Non-fire Household represents a larger number of households than each Fire Household), the Non-fire Households column in this table and the next few tables will differ from the All Households column only by a small amount.

Fire households averaged 2.92 smoke alarms (95 percent confidence interval 2.72 – 3.11) while non-fire households averaged 3.54 alarms (95 percent confidence interval 3.37 – 3.71). The difference was statistically significant ($t$=4.67, $p < 0.0001$).

The difference in the average number of smoke alarms may have resulted from differences in housing characteristics between fire and non-fire households. Fire households had, on average, fewer floors (or levels) in their residences than non-fire households (1.75 as compared with 1.86).[110] Moreover, fire households had fewer smoke alarms per floor with an average of 1.86 (95 percent confidence interval 1.87 – 2.09) than non-fire households, which averaged 2.20 (95 percent confidence interval 2.10 – 2.30).[111]

[109] Responses in this table were constructed from several survey questions. First, respondents were asked if they had any smoke alarms. A response of *None* was recorded if they responded "No" to the question. If they responded "Yes" to having at least one smoke alarm, the next question asked about the number of levels in the home. Respondents who said that they had smoke alarms but didn't specify the number of floors in the home were assumed to have one smoke alarm. Respondents were then asked about the number of alarms on each level, and these were added to produce the results in the table. If a respondent said they did not know or refused to supply the number of alarms on any particular level, the number of alarms on that floor was counted as zero. As a result, Table 5-3 may understate the number of alarms in U.S. households.

[110] The difference in the number of levels between fire and non-fire households was statistically significant, n = 2,899, $t = 2.39$, $p = 0.0171$.

[111] The difference in the average number of alarms per floor was also statistically significant, n = 2,899, $t = 2.94$, $p = 0.0033$.

Table 5-4 shows that a larger proportion of non-fire households had smoke alarms on some or all floors than fire households did. For example, 84.0 percent of non-fire households had alarms on all floors in contrast to 82.4 percent of fire households.

Table 5-4
Levels in the Home with Smoke Alarms by Fire and Non-fire Households (Percent)

| Floors with Alarms | All Households | Fire Households | Non-fire Households |
|---|---|---|---|
| No alarms | 3.3 | 7.3 | 3.2 |
| Some floors | 12.7 | 10.3 | 12.8 |
| All floors | 84.0 | 82.4 | 84.0 |

Notes: Based on n = 3,030 respondents. Test of independence of number of floors with alarms and household status $F = 5.6875$, $p = 0.0034$.

In addition to having a smoke alarm on all floors of the home, it is also recommended that there are smoke alarms in all rooms where people sleep.[112] Table 5-5 compares fire and non-fire household as to whether all or some bedrooms in the home had smoke alarms.

[112] Ahrens M (2007b), *op cit.*, page xii.

Table 5-5
Alarm Locations by Fire and Non-fire Households (Percent)

| Location of Alarms | All Households | Fire Households | Non-fire Households |
|---|---|---|---|
| No alarms | 3.3 | 7.4 | 3.2 |
| In home but not in respondent's bedroom | 51.0 | 57.2 | 51.0 |
| Only in respondent's bedroom | 15.0 | 13.7 | 15.0 |
| In all bedrooms | 30.7 | 21.7 | 30.8 |

Notes: Based on n = 3,008 responses. Test of independence of alarm location and household status $F = 7.3859$, $p < 0.0001$. The responses in the table were constructed from two questions as follows: (1) Is there a smoke alarm in the bedroom where you sleep and (2) Do you have a smoke alarm in every bedroom in your home or apartment. A positive response to both questions was counted as *In all bedrooms*. The category *Only in respondent's bedroom* was derived from a negative response to every bedroom and a positive response to the bedroom where you sleep. Negative responses to both questions for survey respondents who indicated the presence of alarms in other questions were counted in the category *In home but not in respondent's bedroom*. The percent of households with *No alarms* in this table is different from other tables because of non-response to the question about location in bedrooms.

Table 5-5 shows that less than one-third of non-fire households and less than one-quarter of fire households had smoke alarms in all bedrooms. About 15 percent of each group had one alarm that was located in the respondent's bedroom.

The location of the smoke alarms is an issue because sleeping occupants in the home may not have adequate warning when a fire starts in a different area of the home. In 1993, the National Fire Protection Association recommended that in new construction smoke alarms be placed in all bedrooms.[113]

Another way to alert occupants who are remote from the origin of a fire is to have all smoke alarms connected so that when one alarm sounds, all sound. Table 5-6 shows the proportion of fire and non-fire households with interconnecting smoke alarm systems. The table includes only households that had two or more smoke alarms.

[113] See Public/Private Fire Safety Council (2006), "Home Smoke Alarms." Washington, DC. Available at http://www.firesafety.gov/programs/alarms.shtm. The NFPA requirement is in NFPA 72, National Fire Alarm Code. See NFPA (2007), National Fire Alarm Code, 2007 Edition. National Fire Protection Association, Quincy, MA.

Table 5-6
Interconnected Alarms by Fire and Non-fire Households (Percent)

| Type of Connection | All Households | Fire Households | Non-fire Households |
|---|---|---|---|
| No alarms | 3.6 | 8.1 | 3.6 |
| One alarm | 17.4 | 21.5 | 17.3 |
| Stand alone | 59.9 | 57.6 | 59.9 |
| Interconnected | 19.1 | 12.9 | 19.2 |

Notes: Based on n = 2797 responses. The sample for this table excludes households that did not know if they had smoke alarms or did not know if the alarms were interconnected. Test of independence of household status and type of connections in collapsed table includes only *Stand alone* and *Interconnected* alarms, n = 2,045, $F = 5.5018$, $p = 0.0191$. The percent of households with *No alarms* in this table is different from other tables because of non-response to the question about alarm interconnection.

Table 5-6 shows that 19.2 percent of non-fire households had interconnected alarms in contrast to 12.9 percent of fire households. The statistical test of interconnect against stand alone, one alarm and no alarms by fire and non-fire household status was statistically significant.

Another feature that can improve the notification to occupants about a fire is when smoke alarms are connected to a home security system. Some systems have a smoke alarm that is loud enough to alert all residents, while other systems dial a central alarm company when activated. This is addressed in Table 5-7 below.

Table 5-7
Home Security Service Connection by Fire and Non-fire Households (Percent)

| Home Security Service Connection | All Households | Fire Households | Non-fire Households |
|---|---|---|---|
| No alarms | 3.3 | 7.6 | 3.3 |
| One alarm | 15.9 | 20.3 | 15.9 |
| Not connected | 67.0 | 64.0 | 67.0 |
| Connected | 13.8 | 8.0 | 13.8 |

Notes: Based on n = 2971 responses. The sample for this table excludes households that did not know if they had smoke alarms or did not know if the alarms were connected to a home security service. The survey did not ask if households with one alarm were connected to a home security service. Test of independence of household status and home security service connection in collapsed table included only *Not connected* and *Connected*, n = 2,219, $F = 8.8503$, $p = 0.0030$. The percent of households with *No alarms* in this table is different from other tables because of non-response to the question about home security service connections.

Like interconnected alarms, connections to home security services did not characterize the majority of homes. Among fire households, 8.0 percent were connected to a home security system, while for non-fire households, 13.8 percent had alarms connected to such systems. The difference in proportions for the collapsed table comparing connected and not connected by fire or non-fire household was statistically significant.

Alarms can be battery powered, powered by the house electrical system, or powered by a combination of battery and electrical, where usually the battery provides a backup in case of household power failure. The preferred type of alarm uses house current (also known as hard-wired alarms) with battery backup to provide power in the event that the house electricity fails.

Table 5-8 below displays the distribution of types of power used for smoke alarms. The unit of analysis in this table is the alarm, so that a household may contribute more than one observation.

Table 5-8
Power Sources for Smoke Alarms in Use by Fire and Non-fire Households (Percent)

| Power Source | All Households | Fire Households | Non-fire Households |
|---|---|---|---|
| Battery | 69.9 | 71.9 | 69.9 |
| House current | 13.0 | 9.6 | 13.0 |
| House current with battery backup | 17.1 | 18.4 | 17.1 |

Notes: Data from $n$ = 9,313 alarms where the respondent provided information about the source of power for the smoke alarm. $F$ = 1.3569, $p$ = 0.2575.

As shown in Table 5-8, 71.9 percent of fire households had battery powered alarms, 9.6 percent had house current powered alarms, and 18.4 percent had battery backup alarms. Non-fire households had slightly more house current powered alarms and slightly fewer battery powered alarms, but the difference by type of household was small and not statistically significant.

House current powered alarms with battery backup are the preferred types of alarms, followed by house current only, and then by battery only.[114] Using data from the National Fire Incident Reporting System (NFIRS) for fire department-attended fires between 2000 and 2004, it was shown that, when present, battery powered smoke alarms operated in 61 percent of the incidents, house current powered alarms operated in 70 percent of the incidents, and house current with battery backup alarms operated in 76 percent of the incidents.[115] Building codes have changed over time to require alarms powered by house current and, as a result, newer homes are more likely to have these types of smoke alarms.[116]

In the 1984 survey, 72 percent of the alarms in use by non-fire survey households were battery powered and 79.3 percent in fire households were battery powered. In that survey, only 2.3 percent of the alarms in fire households and 8.5 percent of the alarms in non-fire households used house current with battery backup as the power source.[117] Table 5-8 shows that the proportion of alarms using house current with battery backup has increased since 1984 and the proportion of battery powered alarms has decreased.

[114] NFPA 72 requires smoke alarms to be installed outside each sleeping area and on every level of the home. In new construction, smoke alarms are also required in all sleeping rooms. Alarms must be hard-wired with battery backup in new construction but may be battery powered in existing homes. For details see http://www.nfpa.org/faq.asp?categoryID=925#23013.
[115] Ahrens, M (2007b) *op cit.*, page 13. The data are for non-confined fires. This information is not collected in NFIRS for confined fires.
[116] Smith, CL (1994), "Smoke Alarm Operability Survey—Report on Findings." U.S. Consumer Product Safety Commission, Washington, DC.
[117] Audits and Surveys, *op cit.*, page 54.

Fire Extinguishers. In addition to smoke alarms, extinguishers have the potential to reduce fire losses. Table 5-9 shows the distribution of the number of fire extinguishers by fire and non-fire households

Table 5-9
Number of Household Fire Extinguishers
by Fire and Non-fire Households (Percent)

| Number of Extinguishers | All Households | Fire Households | Non-fire Households |
|---|---|---|---|
| No extinguishers | 23.6 | 28.1 | 23.5 |
| One extinguisher | 38.7 | 39.3 | 38.7 |
| Two extinguishers | 24.6 | 23.8 | 24.7 |
| Three extinguishers | 8.3 | 6.3 | 8.3 |
| Four or more extinguishers | 4.8 | 2.5 | 4.8 |

Notes: Based on n = 3003 respondents, $F = 2.5966$, $p < 0.0344$.

Table 5-9 shows that fire households were less likely to have fire extinguishers than non-fire households. The average number of extinguishers in fire households was 1.16 (95 percent confidence interval 1.08 – 1.25), while the average in non-fire households was 1.36 (95 percent confidence interval 1.28 – 1.43). The difference in the averages was statistically significant ($t = 3.27$, $p = 0.0011$).

*High Risk Households*

This section examines if there is a difference in household smoke alarm configurations in high risk populations. Two issues are considered as follows: (1) if there were smoke alarms on all floors and (2) if there were alarms in all bedrooms. This elaborates on the results shown in Table 5-4 and Table 5-5. As mentioned previously, having smoke alarms in every sleeping room and on each level of the house is recommended by fire safety experts.[118]

In this section, high risk households are defined as the households with characteristics that were shown to differ significantly between fire and non-fire households in Chapter 4. These characteristics included residential property ownership

[118] In addition to NFPA 72 above, see U. S. Consumer Product Safety Commission (2008), "Smoke Alarms – Why, Where and Which." CPSC Document #559. Available at http://www.cpsc.gov/CPSCPUB/PUBS/559.pdf.

(Table 4-3), household size (Table 4-5), occupant age distribution (Tables 4-6a, 4-6b, and 4-6c), and head of household educational levels (Table 4-9). In addition, while not identified as statistically significantly different between fire and non-fire households in Chapter 4, there is much evidence that smoking is a risk factor, so that is also considered in this section. Also, the urban and non-urban contrast is shown in the tables, although this did not appear to differ significantly between fire and non-fire households. This category is shown because other research has cited urban and non-urban location as a risk factor.

Tables 5-10 and 5-11 present the estimates from the survey.

Table 5-10
Risk Factors and Households with Smoke Alarms on All Floors

| Risk Factor | Percent with Smoke Alarms on All Floors | Sample Size | *F* | *P* |
|---|---|---|---|---|
| Renters | 80.8 | | | |
| Owners | 85.1 | 3003 | 2.3616 | 0.1245 |
| 1-4 household members | 84.3 | | | |
| 5 or more | 84.4 | 2998 | 0.0015 | 0.9691 |
| At least one person under 18 | 86.8 | | | |
| Nobody under 18 | 82.4 | 2967 | 4.1603 | 0.0415 |
| At least one person over 65 | 81.1 | | | |
| Nobody over 65 | 84.8 | 2967 | 1.5454 | 0.2139 |
| Not college graduate | 82.3 | | | |
| College graduate or higher | 85.4 | 2960 | 1.6728 | 0.1960 |
| At least one smoker | 83.9 | | | |
| No smokers | 84.0 | 3023 | 0.0033 | 0.9544 |
| Urban | 85.4 | | | |
| Non-urban | 78.0 | 3030 | 6.4363 | 0.0112 |

Notes: This table is presented differently from other tables in that it only shows the percent possessing the attribute. The percent without the attribute is omitted to save space in the table. For example, for *Renters*, 80.8 percent have smoke alarms on all floors (shown), while 19.2 percent do not have smoke alarms on all floors (not shown). The two statistics, *F* and *p,* in the last two columns are from tests of the independence of the household characteristic against whether there were smoke alarms on all floors. The statistical testing procedure is the same as that used for other tables in this chapter. The percent of households in the sample with smoke alarms on all floors was 84.0.

Table 5-10 compares the proportion of households with smoke alarms on all floors by various risk factors. Renters, for example, are compared with owners; and household size compares households with 5 members or more against those with fewer than 5 members.

Table 5-10 shows each of the seven risk factors with similar percentages of smoke alarms on all floors, that is, between 78.0 and 86.8 percent. Two groups have statistically

significant differences in the percent with smoke alarms on all floors. These are At Least One Person Under 18 and the Urban/Non-urban factor.

Table 5-11 shows results for the seven risk factors and the percentage of Smoke Alarms in All Bedrooms.

Table 5-11
Risk Factors and Households with Smoke Alarms in All Bedrooms

| Risk Factor | Percent with Smoke Alarms in All Bedrooms | Sample Size | *F* | *p* |
|---|---|---|---|---|
| Renters | 35.6 | | | |
| Owners | 28.9 | 2986 | 3.7097 | 0.0542 |
| 1-4 household members | 29.9 | | | |
| 5 or more | 33.6 | 2982 | 0.7629 | 0.3825 |
| At least one person under 18 | 35.2 | | | |
| Nobody under 18 | 27.4 | 2952 | 6.7874 | 0.0092 |
| At least one person over 65 | 20.9 | | | |
| Nobody over 65 | 32.7 | 2952 | 13.0564 | 0.0003 |
| Not college graduate | 27.2 | | | |
| College graduate or higher | 32.1 | 2945 | 2.8704 | 0.0903 |
| At least one smoker | 25.9 | | | |
| No smokers | 32.6 | 3003 | 5.1635 | 0.0231 |
| Urban | 32.3 | | | |
| Non-urban | 23.9 | 3008 | 7.9421 | 0.0049 |

Notes: See notes for Table 5-10. The percentage of households in the sample with smoke alarms in all bedrooms was 30.7.

For all households, 30.7 percent have smoke alarms in all bedrooms. In Table 5-11 four groups have significantly different percentages. In three of the groups, urban/non-urban, presence of a smoker, and household members over 65, the higher risk subsets (non-urban, smoker, and at least one person over 65) are less likely to have smoke alarms in all bedrooms than the lower risk group. In the other risk groups, people

under 18, households in the higher risk category of *At least one person under 18* are more likely to have smoke alarms in all bedrooms. [119]

## Conclusion

The largest single distinction between this survey and the 1984 survey was that almost all households (96.7 percent) in this survey have smoke alarms as compared with 62 percent in 1984. Two of the characteristics found to be significant discriminators of the presence or absence of smoke alarms in the 1984 survey, i.e., owners vs. renters and multiple family vs. single family dwellings, were not significant in the present survey. Region was significant in the current survey, with relatively more households with alarms in the Northeast and Midwest and fewer in the South and West. Also, households in urban communities were significantly more likely to have smoke alarms than households in non-urban areas.

In comparing between fire and non-fire households, fire households averaged 2.92 alarms while non-fire households averaged 3.54 alarms per household, a statistically significant difference. This may be somewhat explained by non-fire households having homes with more floors than fire households; and non-fire households had, on average, significantly more alarms per floor than fire households. The proportion of households with smoke alarms powered by the preferred choice of house current or house current with battery backup did not differ between fire and non-fire households.

In the 1984 survey, the difference in the average number of smoke alarms in fire and non-fire households was not statistically significant.

In the present survey, 8.0 percent of fire households and 13.8 percent of non-fire households had smoke alarms connected to a home security service, a statistically significant difference. The 1984 survey did not ask about connections to a service. The U. S. Consumer Product Safety Commission recommends smoke alarms on all floors and in all bedrooms. For fire households, 82.4 percent had alarms on all floors, while 84.0 percent of non-fire households had alarms on all floors. There was also a larger proportion of non-fire households than fire households with smoke alarms in all bedrooms (30.8 percent of non-fire households as compared with 21.7 percent of fire households).

For characteristics identified as high fire risk in Chapter 4, households with such characteristics had differences from other households with respect to the presence or absence of alarms on all floors or in all bedrooms. If there was a family member under 18 in the household, it was more likely that there were smoke alarms on all floors and in

[119] The cutpoint of 1-4 household members in Tables 5-10 and 5-11 was arbitrary. Other cutpoints were explored without changing the results. For example, using 1-3 household members and 4 or more in Table 5-10 showed 84.1 percent and 84.8 percent with smoke alarms on all floors ($F = 0.1007$, $p = 0.7510$). For Table 5-11, the results were 28.9 and 33.7 percent, respectively ($F = 2.3646$, $p = 0.1242$).

all bedrooms. On the other hand, a smaller proportion of households with smokers or at least one person over 65 had smoke alarms in all bedrooms.

In summary, while most households now have at least one smoke alarm, there is the potential to provide more protection with currently available smoke alarm technology. There could be more households with interconnected smoke alarms, more households with alarms powered by house current with battery backup instead of battery power alone, and more households could have alarms on all floors and in all bedrooms.

There are also steps that consumers can take to improve fire safety without changing the alarm technology. The survey did not ask if respondents routinely tested their smoke alarms, changed the batteries annually, or if the alarms were audible at every location in the home.[120] The literature on fire department-attended fires describes that smoke alarms were reported not to have operated in more than 75 percent of residential fires.[121] Presence of the alarms in the home is a first step, but residents need to do more to make sure they will be operational when needed. Moreover, residents need to know what to do when the alarm sounds and to practice a fire escape plan.

More than three-fourths of non-fire households and more than two-thirds of fire households had at least one portable fire extinguisher in the residence. While having a fire extinguisher may help in some fires, there have been questions raised about the usefulness of extinguishers. For example, extinguishers may cause splattering which can spread cooking fires.[122] The survey did not ask what type of extinguisher was in the household or if the respondent knew that different types of extinguishers were designed for different types of fires.[123] The survey also did not ask if the extinguisher had been tested or maintained or if the respondent knew how to operate the extinguisher.

Chapter 8 addresses how smoke alarms alerted fire households to fires and how extinguishers were used.

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[120] The survey asked if alarms had been tested only of fire households in the situation when the alarm did not sound during the fire. There is more information on this in Chapter 8.

[121] U.S. Fire Administration (2006), "Investigation of Fatal Residential Structure Fires with Operational Smoke Alarms." Topical Fire Research Series, U.S. Fire Administration, Emmitsburg, MD, page 4.

[122] Hall JR Jr. (2005), "Home Cooking Fire Patterns and Trends." National Fire Protection Association, Quincy, MA, page 6.

[123] For example, see Fire Protection Association Australia (2005), "Fire Safety Data Sheet: Fire Extinguishers." Victoria, Australia.

# Chapter 6
# Characteristics of Residential Fires

This chapter and the next two chapters return to the analysis of fires that was begun in Chapter 3. In that chapter, it was estimated that there were 7.43 million fires annually, of which 254,000 were attended by fire departments and 7.18 million were unattended. That was a ratio of 28.2 unattended fires for each fire department-attended fire, or, to put it another way, about 3.5 percent of all residential fires were attended by fire departments.

This chapter has two objectives, first, to begin to describe the characteristics of residential fires and, second, to contrast fire incidents that were attended by fire departments with those that were not. Chapter 7, which follows, analyzes only unattended fires, presenting a more detailed breakdown of the characteristics of those fires and the households that experienced them. Chapter 7 also compares fire incidence in the present survey with the 1984 survey, in part to provide a more detailed analysis of the factors associated with the decline in fires between 1984 and the present survey.[124] Chapter 8 focuses on the role played by smoke alarms and fire extinguishers in fires.

Following the description of the methods immediately below, the results are separated into four sections as follows:

- Comparison of demographic and other characteristics of households with attended and unattended fire incidents
- Comparison of fire characteristics of attended and unattended fire incidents
- Fire losses in attended and unattended incidents
- Presence or absence of smoke alarms and extinguishers in attended and unattended incidents

The last part of the chapter discusses and summarizes the characteristics that discriminate between attended and unattended fires. An appendix to the chapter presents estimates of the amount of the sampling error as related to the estimated number of fires.

## Methods

The analyses in Chapters 6, 7, and 8 are based on the 14-day recall period for low severity incidents and the 21-day recall period for high severity incidents, as introduced in Chapter 3. Non-fire households or households where the fire occurred outside the 14/21-day recall period are not considered in these chapters.[125] This makes the data different from Chapters 4 and 5, which defined fire and non-fire households on the basis of whether a fire occurred in the full 91-day period. Also, the unit of analysis in Chapters

[124] The 1984 survey is found in Audits and Surveys, Inc. (1985), *op cit.*

[125] In Chapter 7, comparisons between the present survey and the 1984 survey use all fires in the three-month period. See that chapter for details.

6, 7 and 8 is the fire, not the household, thus households with two fires in the period provide two separate records, and those with three fires provide three records.

The data in this chapter and the next two chapters were prepared in a similar way to the data used to estimate fire incident rates in Chapter 3. First, non-fire household records were removed, leaving a dataset with the 916 fire household records, describing 961 fire incidents. Each record contained up to three fire incidents and a description of the household characteristics. The dataset was then merged with the imputation dataset that contained 15 fire dates for each fire. Variables in the imputation dataset were the date of each fire incident reported by the household, the severity of each fire, the sampling weight (expansion weight from Chapter 2), the date of the telephone interview with the household, and the household stratum.[126] If the fire household had specified month and day of the fire, then the fire date on each of the 15 imputation records would have been identical. Otherwise, when day or month was missing, the dates were imputed 15 times using the probabilistic imputation process as described in Chapter 3. The reason for multiple imputations was to incorporate some additional variability in the dates of the fire, ultimately leading to additional variability in the household fire incidence rates.

The merged dataset contained (15 x 916=) 13,740 records, i.e., one record for each fire household. This was then expanded to the number of fires (15 x 961=14,415 fire records), with each record containing both household, and fire characteristics. Because each fire incident was replicated 15 times, the weights were then divided by 15 to bring them back to the correct sampling weights. This then allowed the sample to represent the 7.43 million annual fires in the U.S. that were estimated in Chapter 3.

The tables in this chapter were developed by partitioning the fire incidents into various categories associated with the fire, the household, or both. Examples include region of the country, age of residence, household income, fire department-attended or unattended. SAS® data step programs were written to extract the cases and assign the categories. Tabulation of the estimated number of fires in each category was done using Proc Freq or Proc SQL in the SAS system.

While all fire incidents (i.e., attended and unattended collectively) and unattended fire incidents (separately) are estimated reasonably precisely with coefficients of variation (CVs) of 8.5 and 8.8 percent, respectively, fire department-attended fires are estimated with much less precision, with a CV of 37.9 percent, because there are far fewer attended incidents in the survey.[127] Of the 961 fire incidents in the survey, between 260 and 271 incidents were in the 14/21-day recall period and were used to estimate the total number of fires. These are the only incidents used in this chapter and the next two chapters. Of these incidents, between 14 and 16 incidents were fire department-attended.

[126] There were 11 strata, as discussed in Chapter 2.
[127] The CV is the standard deviation divided by the mean and is expressed as a percent. The standard deviation includes the variability attributable to sampling and to imputation. For more details see Chapter 3.

The small number of fire department-attended incidents not only contributes to the amount of sampling variability in the estimated incident rate (measured by the size of the CV) but also restricts further analysis of attended fires. With between 14 and 16 fire department-attended fires, there can be at most 16 different areas where the fire started, 16 different heat sources, 16 different items first ignited, etc. As a result, some low probability categories in the tables are likely to have no estimated attended fires -- not because there were no attended fire incidents in the U.S. during the year, but because the survey did not have any of these incidents. These cases are indicated with a dash in the tables rather than a zero. The reader needs to be aware of this limitation of the data when looking at the attended fires and the ratio of unattended to attended fires in the tables in this chapter. This issue also extends to any breakdown of fire incidents, such as area of fire origin, heat source, etc. where the number of estimated fires is relatively low and therefore likely to have been based on a small number of actual responses.

Like the estimates for attended and unattended fires in Chapter 3, every estimated number of fires in this chapter and every ratio of unattended fires to attended fires have an associated standard error and confidence interval. To avoid cluttering the tables, these statistics are not presented in the tables. Instead, the reader can get a sense of the precision of the estimate from the coefficient of variation. As the estimated number of fires increases, the CV decreases. Tables relating the CV to the estimated number of fires and text describing how the tables were constructed are found in the appendix to this chapter. These tables can be used as a generalized variance (CV) function. For more information on the generalized variance function, see Wolter.[128]

The tables in this chapter show estimated fires (in thousands), broken down by unattended and attended, and the ratio of unattended to attended fires.

## Results

### *Household and Demographic Characteristics*

Table 6-1 shows the breakdown of attended and unattended fires by area of the country.

[128] Wolter KM (1985), *Introduction to Variance Estimation*. Springer-Verlag, NY, Chapter 5.

Table 6-1
Estimated Unattended and Attended Fires by Region
(Thousands of Fires)

| Region | All Fires | Unattended Fires | Attended Fires | Unattended Fires per Attended Fires |
|---|---|---|---|---|
| All | 7,430 | 7,176 | 254 | 28.2 |
| South | 2,822 | 2,717 | 105 | 25.9 |
| West | 2,271 | 2,175 | 97 | 22.5 |
| Northeast | 1,271 | 1,238 | 33 | 37.8 |
| Midwest | 1,066 | 1,046 | 20 | 52.4 |

Notes: Totals may not add due to rounding. The last column is Unattended Fires divided by Attended Fires. Ratios are computed in SAS® based on the unrounded estimated number of fires and may not agree exactly with the ratio of rounded fires. The first row, *All*, does not change in any of the tables and will not appear in any other tables in this chapter. The percentage of U.S. households by region is as follows: Northeast 18.7 percent, South 36.4 percent, Midwest 22.9 percent and West 22.0 percent. See Chapter 4, Table 4-1 for a listing of states in each region. Approximate CVs for estimated fires in thousands: 1,000, 27.2 percent; 2,000, 22.1 percent; 3,000, 17.9 percent. For details about how the CV is calculated, see the appendix to this chapter.

In Table 6-1, it appears that the largest estimated number of fires, both unattended and attended, was in the South, followed by the West, Northeast, and Midwest.[129] This is not surprising considering that the South (as defined in the survey) has the largest number of households; the West and Midwest have about the same number of households; and the Northeast has the fewest households. Correcting for the number of households, then, the number of fires (both unattended and attended) per 100 households was as follows: South 6.85, West 9.09, Northeast 6.00, and Midwest 4.11.[130] In addition to having the smallest per household fire rate, the Midwest also had proportionately fewer fire department-attended fires with 52.4 unattended fires per attended fire. This was followed by the Northeast at 37.8 unattended to attended fires, the South and the West at 25.9 and 22.5, respectively.

Of the 7.43 million fires, 5.98 million occurred in urban regions and 1.45 million in non-urban regions. In urban regions, 5.83 million were unattended and 154,000 were attended, while in non-urban regions, 1.35 million were unattended and 101,000 were

[129] Usually the term "estimated" will not appear with fires. The reader should understand that all statistics in this survey are estimated, not actual counts of events.
[130] Households by region from the U.S. Bureau of the Census obtained from http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH2-all.csv.

attended. The ratio of unattended to attended fires was 37.9 in urban regions and 13.4 in non-urban regions.

By dwelling type, 4.63 million fires occurred in single family residences and 2.64 million occurred in other types of residences.[131] Other types included apartments, mobile or manufactured homes, multifamily dwellings, townhouses, row houses and condos. Within single family residences, 115,000 fires were fire department-attended, for a ratio of 39.2 unattended fires per attended fire. Other home types had 124,000 fire department-attended fires, for a ratio of 20.3 unattended fires per attended fire.

In owner occupied housing, there were 4.86 million fires, of which 194,000 were fire department-attended. Among renters, there were 2.53 million fires, of which 45,000 were fire department-attended. Note that in the U.S. there are more than twice as many households that own rather than rent their residences.[132] Thus, the number of fires per 100 households was 6.19 for owner occupied housing and 7.58 for rental housing. Owners had 24.1 unattended fires for each attended fire, while renters had 55.1 unattended fires for each attended fire.[133]

Table 6-2 shows the relationship between the age of residence and fire department attendance.

[131] Respondents did not know the type of residence or refused to respond in cases covering 157,000 fires.
[132] Households by type of occupancy from the U.S. Bureau of the Census at http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH1-all.csv.
[133] Respondents accounting for 46,000 fires did not know or refused to answer if they rented or owned the residence.

Table 6-2
Attended and Unattended Fires by Age of Residence
(Thousands of Fires)

| Age of Residence (years) | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| 0-15 | 2,669 | 2,667 | 2 | 1,182.0 |
| 16-25 | 1,280 | 1,224 | 56 | 21.8 |
| 26-35 | 948 | 885 | 63 | 14.1 |
| 36-45 | 699 | 628 | 71 | 8.8 |
| 46 or older | 1,474 | 1,427 | 47 | 30.5 |

Notes: See notes for Table 6-1. Ratio is Unattended Fires divided by Attended Fires. Respondents reporting 360,000 fires did not know or refused to provide the age of the dwelling. All quantities are estimates. Approximate CVs for fires in thousands: 700, 37.2 percent; 1,000, 27.2 percent; 2,500, 19.9 percent.

In the survey data, as shown in Table 6-2, there were almost no fire department-attended fires in properties 15 years or newer. The ratio of unattended to attended fires appears to decline as properties age. This suggests that fires in older properties are more likely to involve fire departments than newer properties. For properties 46 years old or older, however, the ratio is higher with relatively fewer attended fires.

Table 6-3 shows the distribution of attended and unattended fires by household income.

Table 6-3
Attended and Unattended Fires by Household Income
(Thousands of Fires)

| Household Income | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| $0-$14,999 | 628 | 628 | - | - |
| $15,000-$34,999 | 1,894 | 1,781 | 113 | 15.8 |
| $35,000-$74,999 | 1,630 | 1,564 | 66 | 23.8 |
| $75,000 or more | 2,040 | 2,010 | 30 | 67.9 |

Notes: See notes for Tables 6-1 and 6-2. Also, the table does not include responses representing 1.24 million fires where the respondent either refused to provide or did not know the household income. No fire department-attended fires were reported for survey respondents with household incomes less than $15,000 per year. This is shown with a dash (-) in the table to symbolize that infrequent outcomes are unlikely to be reported in samples. It does not mean that there were no fire department-attended fires in the U.S. occurring in households with incomes less than $15,000 per year. Approximate CVs for fires in thousands: 600, 42.2 percent; 1,500, 24.5 percent; 2,000, 22.1 percent.

Table 6-3 shows that there were no fire department-attended fires in residences where households reported incomes of $15,000 or less. The relationship between household income and unattended fires shows that as incomes increase the ratio of unattended to attended fires increases, suggesting that relatively more attended fires occurred in lower income residences.

With respect to the household size, no clear pattern emerged relating the number of people in the household to the distribution of attended and unattended fires, as shown in Table 6-4 below.

Table 6-4
Attended and Unattended Fires by Household Size
(Thousands of Fires)

| Number of People in the Household | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| 1 | 951 | 941 | 11 | 89.2 |
| 2 | 1,788 | 1,737 | 51 | 34.1 |
| 3 | 1,522 | 1,442 | 80 | 18.0 |
| 4 | 1,637 | 1,614 | 23 | 69.0 |
| 5 or more | 1,427 | 1,353 | 74 | 18.3 |

Notes: See notes for Tables 6-1 and 6-2. The table omits responses representing 104,000 fires where the respondent refused to provide the household size. Approximate CVs for fires in thousands: 1,000, 27.2 percent; 1,500, 24.5 percent.

Taking the distribution of household size in the population into account, it appears that per household fire incidence increases with household size.[134] Households with a single member had 3.2 fires per 100 households, two member households had 4.8 fires, three member households had 8.3 fires, four member households had 10.0 fires, and larger households had 12.9 fires per 100 households. This pattern of increasing fire incidence was also consistent for unattended fires and attended fires separately. The ratio of unattended to attended fires was not consistently increasing or decreasing with household size, as shown above.

Households with at least one member under 18 years of age reported 3.78 million fire incidents, of which 3.65 million were unattended and 124,000 were attended. Households with no members under 18 had 3.56 million fires, of which 3.43 million were unattended and 131,000 were attended. The unattended to attended ratios were 29.5 for households with a member under 18 and 26.3 for households without any members under 18; both ratios are close to the overall ratio of 28.2 unattended fires per attended fire. Taking the number of households in the population into account showed 9.4 fires per 100 households in households with at least one member under 18 and 4.9 fires per 100 households when no household members were under 18.[135]

[134] In 2005, there were 30.1 million households with a single member, 37.4 million with two members, 18.3 million with three members, 16.4 million with four members, and 11.1 million with five or more members. Source: http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH1-all.csv.

[135] There were 40.1 million households with at least one member under 18 and 73.3 million households with no members under 18. Source: http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH1-all.csv.

Households with at least one member at least 65 years of age reported 344,000 fires, of which 312,000 were unattended and 32,000 were attended. Households with no members 65 years of age and older reported 6.99 million fires, 6.78 million unattended and 222,000 attended. Taking the household population into account, this was 8.1 fires per 100 households for those with all members 64 and younger and 1.3 fires per 100 households for all households with at least one member over 64.[136] The ratios were 30.5 unattended fires for each attended fire for households with members 64 and younger and 9.7 unattended fires to attended fires for households with at least one household member over 64.[137]

With respect to ethnicity, households identifying themselves as having a household head of Hispanic or Latino descent reported 777,000 fires, of which 684,000 were unattended and 93,000 were attended, for a ratio of 7.4 unattended fires to attended fires. On a population basis, there were 6.4 fires per 100 such households.[138]

By race, families with a White head of household reported 5.32 million fires, 5.15 million unattended and 173,000 attended fires for a ratio of 29.8 unattended fires to attended fires. This was 5.7 fires per 100 households.[139] Families with a Black household head reported 640,000 fires, of which 600,000 were unattended and 40,000 were attended, for a ratio of 15 unattended fires per attended fire. Correcting for population, there were an estimated 4.6 fires per 100 households.[140]

*Fire Characteristics*

This section focuses on the characteristics of residential fires.

Table 6-5 shows the distribution of unattended and attended fires by the location in the residence where the fire started.

[136] There were 86.8 million households with all members under 65 and 26.5 million with at least one member 65 or over. Source: http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH1-all.csv.
[137] Responses are not shown for both age group analyses representing 93,000 fires where the respondent did not know or refused to provide information about the household composition.
[138] Respondents refused to disclose the ethnicity of the head of household in cases representing an estimated 345,000 fires. There were 12.2 million households with a Hispanic head. Source: http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH1-hisp.csv. Note that Hispanic persons may be of any race and, as a result, may also be counted as Black or White household heads.
[139] Based on 92.9 million households. Source: http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH1-whitealone.csv.
[140] Based on 13.8 million households. Source: http://www.census.gov/population/socdemo/hh-fam/cps2005/tabH1-blackalone.csv.

Table 6-5
Attended and Unattended Fires by Area of Fire Origin
(Thousands of Fires)

| Area of Fire Origin | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| Kitchen | 5,080 | 4,987 | 93 | 53.4 |
| Living room | 569 | 530 | 39 | 13.7 |
| Bedroom | 505 | 505 | - | - |
| Bathroom | 438 | 438 | - | - |
| Other areas | 373 | 355 | 18 | 20.1 |
| Basement | 210 | 199 | 11 | 17.3 |
| Dining room | 160 | 140 | 20 | 7.0 |
| Attached garage | 95 | 22 | 73 | 0.3 |

Notes: See notes for Tables 6-1 and 6-2. *Other areas* include exterior of the house, siding, hall or entryway, porch or deck, inside enclosed wall space, laundry room, storage area, attic, or unspecified areas. The last category had more than half the incidents. Numbers may not add to totals due to rounding. Approximate CVs for fires in thousands: 150, 74.5 percent; 400, 54.3 percent; 5,000, 11.8 percent.

Table 6-5 shows that the largest number of fires at 5,080,000 began in the kitchen. Most were not attended by the fire service and the ratio is about twice the overall average at 53.4 unattended fires to attended fires. Also, fires beginning in bedrooms and bathrooms with 505,000 and 438,000 incidents, respectively, were also unlikely to be fire department-attended. On the other hand, fires starting in living rooms (569,000 incidents), dining rooms or dining areas (160,000 incidents), or basements (210,000 incidents) and garages (95,000 incidents) were more likely to be fire department-attended.

Table 6-6 shows the distribution of types of fire by heat source.

Table 6-6

Attended and Unattended Fires by Heat Source
(Thousands of Fires)

| Heat Source | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| Cooking appliances | 4,757 | 4,664 | 93 | 49.9 |
| Open flame | 783 | 744 | 39 | 19.1 |
| Other household appliances | 671 | 651 | 20 | 32.6 |
| Electrical lighting and wiring | 616 | 616 | - | - |
| Heating and cooling equipment | 326 | 281 | 46 | 6.2 |
| Cigarettes | 167 | 155 | 11 | 13.5 |
| A fire that spread to the house | 92 | 47 | 45 | 1.0 |
| Other (unspecified) | 17 | 17 | - | - |

Notes: See notes for Tables 6-1 and 6-2. *Open flame* includes candle, match, lighter, torch, spark from a fireplace, and fireworks. Approximate CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 600, 42.2 percent; 800, 32.8 percent; 4,500, 13.1 percent.

As expected from Table 6-5 where the majority of estimated fires began in the kitchen, cooking appliances dominate the heat sources shown in Table 6-6. A larger proportion of cooking appliance fires is likely to be unattended by the fire service, with a ratio of 49.9 unattended to attended fires. Other household appliances (non-cooking by definition), the third most frequent source of heat with 671,000 fires, were also less likely to be attended by fire departments, with a ratio of 32.6 unattended to attended fires. There were no attended fires recorded for electrical lighting and wiring fires, or other unspecified fires. On the other hand, fires originating in heating and cooling equipment (326,000 incidents) or a lit cigarette (167,000 incidents) were more likely to involve fire department attendance, with ratios of 6.2 and 13.5 unattended to attended fires, respectively. Fires involving open flame were also more likely to be fire department-attended, with 19.1 unattended fires per attended fire.

Table 6-7 displays the item first ignited in residential fires.

Table 6-7
Attended and Unattended Fires by Item First Ignited
(Thousands of Fires)

| Item First Ignited | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| Cooking materials | 4,009 | 3,915 | 93 | 41.9 |
| Appliance | 690 | 690 | - | - |
| Unspecified | 660 | 660 | - | - |
| Paper | 417 | 407 | 10 | 40.8 |
| Linen | 361 | 361 | - | - |
| Bedding | 253 | 253 | - | - |
| Electrical wire | 244 | 244 | 1 | 422.0 |
| Clothing | 130 | 130 | - | . |
| Cabinetry | 110 | 72 | 39 | 1.8 |
| Household utensils | 96 | 96 | - | - |
| Light vegetation | 95 | 95 | - | - |
| Decoration | 73 | 73 | - | - |
| Floor covering | 64 | 64 | - | - |
| Structural members | 55 | 10 | 45 | 0.2 |
| Other materials | 172 | 107 | 65 | 1.6 |

Notes: See notes for Tables 6-1 and 6-2. *Other materials* include rubbish, heavy vegetation, a person burned by a fire or flame, upholstered furniture, animal, pipe, mattress, or wood. Note that none of these categories was associated with more than 45,000 fire incidents. Approximate CVs for fires in thousands: 150, 74.5 percent; 200, 70.0 percent; 400, 54.3 percent; 700, 37.2 percent; 4,000, 14.6 percent.

As shown in Table 6-7, the most frequent item first ignited was cooking materials, accounting for 4.0 million incidents, with 41.9 unattended fire incidents for each attended incident.[141] The second most frequent item first ignited in fires was an appliance,

[141]Item First Ignited refers to the fuel load that was ignited by the heat source and at least for a short time had the capability to sustain the fire. This produced some confusion among many survey respondents who specified the container or the heat source instead. For example, frequently in cooking fires, respondents mentioned the pan or pot on the stove as the item first ignited. This is impossible because metal cookware cannot ignite except at very high temperatures. We changed this to "cooking materials," assuming that the respondent meant that the contents of the cookware had ignited. Other respondents specified the source of heat as the item first ignited, for example when they specified "appliance" as the item first ignited. Respondents may have believed that objects engulfed in flames were ignited. There is a more detailed discussion about the process for coding Item First Ignited in Chapter 7.

probably the cooking appliances in many cases. There were no fire department-attended fires for many categories including appliances, unspecified, linen, bedding, clothing, household utensils, and others. Of the Items First Ignited categories, only cabinetry, structural members (walls, floors, beams) and other materials were associated with a substantial proportion of attended fires relative to unattended fires.

Table 6-8
Attended and Unattended Fires by Time of Day
(Thousands of Fires)

| Time Of Day | All Fires | Unattended Fires | Attended Fires | Ratio | Fires per Hour |
|---|---|---|---|---|---|
| 6 am – noon | 1,287 | 1,226 | 61 | 20.0 | 214.5 |
| Noon – 5 pm | 1,923 | 1,864 | 60 | 31.2 | 384.6 |
| 5 – 9 pm | 2,827 | 2,766 | 61 | 45.0 | 706.8 |
| 9 pm – midnight | 898 | 887 | 11 | 77.4 | 299.3 |
| Midnight – 6 am | 494 | 433 | 61 | 7.2 | 82.3 |

Notes: See notes for Tables 6-1 and 6-2. Time of Day includes the left endpoint but does not include the right endpoint. Time of Day was determined from two variables. Respondents were first asked what time the fire occurred. If they reported that they did not know, they were then asked if the fire occurred in one of the following periods, the morning, afternoon, evening, at night, or overnight. If they asked for further clarification, the Time of Day categories shown in Table 6-8 were read to them. Approximate CVs for fires in thousands: 400, 54.3 percent; 900, 28.9 percent; 1,000, 27.2 percent; 2,000, 22.1 percent; 3,000, 17.9 percent.

Table 6-8 shows most fires occurred between 5 pm and 9 pm, which is consistent with most fires in the survey being cooking related. To compare the distribution of fires, it is best to compare fires per hour rather than total fires in Table 6-8 because some time categories have more hours than other time categories. On an hourly basis, 5 pm to 9 pm had the highest hourly fire incidence followed by noon to 5 pm and 9 pm to midnight. Fires occurring between midnight and noon were less frequent on an hourly basis.

In terms of the ratio of unattended to attended fires, fires between noon and midnight were more likely to be unattended than fires between midnight and noon. Many of the fires later in the day were cooking fires, which previous tables have shown to involve fire department attendance less frequently than fires involving other heat sources and different areas of origin.

*Fire Losses*

The next set of tables contrasts fire department-unattended and attended fires by the extent of fire losses. In general, the tables show that fire departments were likely to have attended fires with greater fire losses.

Table 6-9
Attended and Unattended Fires by Extent of Flame Damage
(Thousands of Fires)

| Flame Damage | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| None | 4,429 | 4,397 | 32 | 136.0 |
| Item first ignited only | 2,507 | 2,458 | 49 | 50.2 |
| Several items | 302 | 229 | 73 | 3.1 |
| Whole room | 81 | 36 | 45 | 0.8 |
| Beyond room | 39 | - | 39 | - |
| Whole house | 15 | - | 15 | - |
| Outside house only | 55 | 55 | 0 | 190.0 |

Notes: See notes for Tables 6-1 and 6-2. The table omits responses involving 1,000 fires where respondents did not know the extent of flame damage. Attended fires for *Outside house only* is greater than zero but rounded to zero. There were no reported unattended fires for *Beyond room* and *Whole house* categories. Approximate CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 2,500, 19.9 percent; 4,500, 13.1 percent.

Aside from the last row, Outside house only, Table 6-9 is arranged in order of increasing flame damage. Table 6-9 shows that as the extent of flame damage became larger, it was more likely that the incident was fire department-attended.

As shown in the table, most fires did not involve any flame damage or involved damage only to the item first ignited, and most were not attended by fire departments. When there was no flame damage, as was the case with 4.4 million fires, there were 136 unattended fires for each attended fire. When the damage was to the item first ignited only, which occurred in 2.5 million fires, there were 50.2 unattended fires to each attended fire. Damage to several items resulted in 3.1 unattended fires to every attended fire. When the damage involved the whole room, there were more attended fires than

unattended fires; and when the damage spread outside the room or to the whole house, all fires were attended by fire departments.

Table 6-10
Attended and Unattended Fires by Extent of Smoke Damage
(Thousands of Fires)

| Smoke Damage | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| None | 5,472 | 5,442 | 31 | 178.0 |
| A little smoke damage | 1,164 | 1,104 | 60 | 18.5 |
| Damage in most of the room | 338 | 314 | 23 | 13.5 |
| Damage to another room | 91 | 80 | 11 | 7.0 |
| Damage in whole house | 315 | 186 | 129 | 1.4 |
| Outside of house only | 48 | 47 | 0 | 164.0 |

Notes: See notes for Tables 6-1 and 6-2. Omits responses associated with 2,000 fires where respondents did not know or refused to provide information on the extent of smoke damage. *Outside of house only* attended fires was greater than zero but rounded to zero. Approximate CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 5,000, 11.8 percent.

Like Table 6-9, the extent of smoke damage is in ascending order in Table 6-10, with the exception of the last row. Table 6-10 shows that, like flame damage, most fires also involved no smoke damage or a small amount of smoke damage. Of the 7.4 million fires, almost 5.5 million had no smoke damage, and 1.2 million had what respondents reported to be "a little smoke damage." On the other hand, relatively few fires, under one-half million incidents, had smoke damage that spread to another room or the whole house.

Table 6-10 also shows that as smoke damage increased, the ratio of unattended fires to attended fires decreased, indicating more fire department presence was associated with fires with greater amounts of smoke damage. For example, when there was no smoke damage, there were 178 unattended fires for every attended fire. This decreased to 18.5 unattended fires for every attended fire (below the survey average of 28.2) for fires involving a little smoke damage, 13.5 when most of the room was damaged by smoke, and to 7.0 when another room was involved.

Table 6-11
Attended and Unattended Fires by Cost of Property Damage
(Thousands of Fires)

| Property Loss | All Fires | Unattended Fires | Attended Fires | Ratio |
|---|---|---|---|---|
| None | 3,819 | 3,810 | 9 | 407.0 |
| $1-$99 | 2,212 | 2,182 | 30 | 72.4 |
| $100-$999 | 844 | 834 | 10 | 83.6 |
| Over $1000 | 303 | 109 | 194 | 0.6 |

Note: See notes for Tables 6-1 and 6-2. Also, respondents were asked to specify an estimate for property damage that would include the cost of repair or replacement of the home and contents. They were asked to include costs even if the costs were covered by insurance. The table omits responses associated with 251,000 fire incidents where the respondents did not know or refused to provide an estimate of the property damage. Approximate CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 800, 32.8 percent; 2,000, 22.1 percent; 4,000, 14.6 percent.

Table 6-11 shows that most residential fires had no reported property damage, and for these fires, almost all were not attended by the fire service. This pattern of almost no fire department attendance generally held true until the fire damage exceeded $1000, where there were more attended fires than unattended fires.

In 65,000 fire incidents, the conditions after the fire required families to stay out of the residence for one night or more. Of these, 9,600 fires were unattended and 55,000 were attended for a ratio of 0.2 unattended fires to attended fires; i.e., almost all such fires were attended by fire departments. In the remaining 7.4 million fires (7.2 million unattended and 199,000 attended), where the respondents could return immediately after the fire, the ratio was 35.9.

The last measure of fire losses is whether people were hurt or injured in the incident. There were an estimated 130,000 people who got sick or were injured in fires.[142] All the incidents where these fire losses occurred were reported to have been unattended by fire departments.

[142] Survey respondents reported in question 72 that somebody was hurt, got sick, or died in the fire in an estimated 180,000 fire incidents. When question 72 was answered positively, then the respondents were asked questions 74 and 76 about the number of deaths and injuries, respectively. There were no reported deaths in the answer to question 74, and there were an estimated 130,000 people reported to have been injured or sickened in the fire. It is likely that respondents may have changed their minds about several injuries or illnesses. Survey interviewers did not probe about the discrepancy. In any case, the relative standard error (or CV) is so large for an estimated 130,000 or 180,000 illnesses or injuries that the difference between 130,000 or 180,000 incidents is not statistically meaningful.

*Smoke Alarms and Extinguishers*

As noted in Chapter 4, most fire and non-fire households had smoke alarms. There were 6.5 million fires (6.3 million unattended and 239,000 attended) where there were smoke alarms present and 749,000 fires (734,000 unattended and 15,000 attended) in residences where there were no smoke alarms. The ratios were 26.4 unattended fires for each attended fire in residences with smoke alarms and 47.4 unattended fires for each attended fire where there were no smoke alarms present. In residences where smoke alarm were present, it was more likely that fires were attended rather than unattended, but such an effect may be due to other housing, demographic, or fire characteristics.

With respect to fire extinguishers, there were 4.7 million fires in residences with extinguishers, of which 4.6 million were unattended fires and 150,000 were attended fires. Households without extinguishers had 2.7 million incidents of which 2.6 million were unattended and 105,000 were attended. Households with extinguishers had 30.7 unattended fires per attended fire, while those households without extinguishers had 24.6 unattended fires per attended fire. This indicates the presence of extinguishers had at best a small effect in reducing the number of fire department-attended fires.

## Conclusion

This chapter presented descriptions of the characteristics of the estimated 7.4 million fire department-attended and unattended fires from the Residential Fire Survey. Like Chapter 3, the analysis was based on the 14- and 21-day recall periods, scaled to estimate annual and per household fire incidence. Estimates in this chapter have more sampling variability than total fire estimates from Chapter 3, because they are based on partitions of the data, which result in smaller samples. As shown in the appendix to the chapter, the sampling variability, expressed as a percent of the estimate, decreases with increasing estimates. Estimates of less than one million fires have a coefficient of variation of at least 27 percent; estimates less than one-half million, 50 percent; and estimates of less than 250,000, about 66 percent.

In the chapter, it was shown that the largest number of fires was in the South, followed by the West, Northeast, and Midwest. Given how the regions were defined, the South had the largest population of households, and the Northeast and West had the lowest. On a per household basis, the West had the largest fire incidence at 9.09 fires per 100 households, followed by the South and Northeast, with the Midwest as the lowest. About twice as many fires occurred in owner occupied housing as renter occupied housing. This was expected because there was about twice as much owner occupied housing as renter occupied housing in the U.S. Correcting for the type of occupancy showed that there were 6.19 fires per 100 households for owner occupied housing and 7.58 fires per 100 households for renter occupied housing.

In terms of the ratio of unattended to attended fires, the pattern was the same as the per household basis by region. The West had the lowest ratio of unattended to attended fires (i.e., a larger proportion of fires were fire department-attended than in other regions), followed by the South and Northeast, with the Midwest as the highest. Although owner occupied housing had a smaller per capita fire incidence, there was a higher ratio of unattended to attended fires among renters than owners.

In urban regions, fires were three times more likely to be unattended than in non-urban regions. About twice as many fires occurred in single family residences than other types of residences. This was to be expected because more people live in single family homes than other types of residences. In single family home fires, there were 39.9 unattended fires per attended fire, while in non-single family housing there were 20.7 unattended fires per attended fire. As housing of all types aged, the ratio of unattended to attended fires decreased, indicating that there were relatively more attended fires in older housing. This ratio increased with income, indicating that lower income households had relatively more attended fires.

The per household fire incidence rate also was shown to increase with increasing household size. Households with one member had 3.2 fires per 100 households, two members 4.8 fires, and five and larger households 12.9 fires per 100 households. Households with a family member under 18 had 9.4 fires per 100 households in contrast to those without anyone under 18 at 4.9 fires per 100 households. Households with a family member 65 or older had 1.3 fires per 100 households in contrast to those without anybody 65 or older at 8.1 fires per 100 households.

There was no consistent pattern between the ratio of unattended to attended fires and household size, or whether the household had a family member under 18. However, households with at least one member 65 or older had 9.5 attended fires for every unattended fire in contrast to other households with 30.5 when all the household members were under the age of 65. Thus, there were fewer fires in households with older members, but when fires occurred, they were more likely to be fire department-attended.

By race and ethnicity characteristics, the fire rate was 4.6 fires per 100 households for households with a Black household head, 5.7 fires per 100 households for households with a White household head and 6.4 fires per 100 households for households with a Hispanic or Latino head of household. Also, households headed by Hispanic and Black persons had fewer unattended fires per attended fire than households headed by White persons.

Most fires (5.1 million -- both attended and unattended) began in the kitchen, and most fires (4.8 million) were cooking-related. These fires were less likely to be fire department-attended than other fires as there were 49.9 unattended cooking appliance fires per fire department-attended fire. Almost all cooking fires began in the kitchen. Fires starting in the living room and dining room, although much less frequent, were more likely to involve the fire department, as were fires involving cigarettes and other open flame heat sources. Heating and cooling equipment fires also were more likely to

involve the fire department, as were fires starting in the basement, as well as fires involving cabinetry or structural materials.

By time of day, the most likely time for fires was between 5 pm and 9 pm, followed by noon to 5 pm. The period 5 pm to 9 pm also had the second highest ratio of unattended to attended fires, consistent with this time being the time that the evening meal is cooked. On the other hand, fires occurring between midnight and noon, while occurring less frequently on a per hour basis than other times of the day, had the lowest ratio of unattended to attended fires. Thus fires occurring between midnight and noon were relatively more likely to involve fire departments.

Most fires involved no loss or very small losses (although with so many fires, the total losses were not insignificant). According to respondents, most fires had no flame damage and no smoke damage. In these cases, with no reported damage or property loss, the ratio of fire department-unattended to attended incidents was quite high. For example, the ratio was 136.0 unattended to attended fires when there was no flame damage, 178.0 when there was no smoke damage, and 407.0 when there was no property loss. In contrast, when there was flame damage to several items or the whole room; smoke damage to most of the room, another room or the whole house; and property damage over $1000, the proportion of unattended to attended fires was much lower.

Most residences, as described in Chapter 4, had smoke alarms. Households with smoke alarms were more likely to have fire department-attended incidents than households without smoke alarms. For households with smoke alarms, there were 26.4 unattended fires per attended fire, while those without smoke alarms had 47.4 unattended fires per attended fire. This difference in the ratio of unattended to attended fires may be related to other household characteristics that differ in smoke alarm and non-smoke alarm households.

Households with fire extinguishers had 30.7 unattended fires to attended fires while, non-extinguisher households had 24.6 unattended fires to attended fires. Everything else being constant, extinguishers may be associated with a small reduction in the proportion of fire department-attended fires.

The findings of this chapter should be considered as associations between fires and other factors rather than causal relationships, because examining one factor at a time only can provide an overall characterization of incidents. The next chapter continues this examination in a more detailed way. In that chapter, fire incidents are analyzed by source of heat, i.e., appliance and non-appliance fires. Within the categories of appliance fires, cooking fires, electrical lighting and electrical wiring fires, heating and cooling appliance fires, and other household appliance fires are analyzed separately. Non-appliance fires include cigarette fires and small open flame fires. The next chapter also compares the number of various types of non-fire department-attended fires with the estimates from the 1984 survey.

## Appendix to Chapter 6

### Generalized Coefficient of Variation[143]

As mentioned in the text for this chapter, it is undesirable to put confidence intervals or coefficients of variations (CV) with each estimate in the text. However, reporting statistics without a measure of sampling error does not provide the reader with any sense of precision of the estimate. An approach to this is to provide a generalized coefficient of variation that can guide the reader about the approximate precision of any given estimate.

The CV is the standard error (standard deviation of the estimate) divided by the parameter estimate. When normal distribution theory holds, the 95 percent confidence interval for parameters such as means or proportions can be expressed as the

$$\text{Parameter Estimate} * (1 \pm 1.96 * \text{CV}/100) \qquad (1)$$

where the CV is a percent. Equation (1) shows that the variability around the parameter estimate is about twice the CV.

All other things being equal, the CV should decrease with increasing parameter estimates.

To estimate the relationship between the estimated number of fires and the CV, we randomly generated samples from the dataset of different sizes, ranging from 1.5 percent of the fire incidents to 85 percent of the incidents.[144] Only incidents in the 14/21-day recall period were used. Graphical analysis showed that the relationship was exponential, which could be linearized by using the log of the CV instead of the CV.

After transforming to the log of CV, the graphical analysis shows that from an estimated 1,000,000 fires to 6,500,000 fires, the graph was linear and very smooth ($R^2$ *adjusted*=0.9443). The equation for the CV estimated by the regression relationship was

$$\text{CV} = 33.4567 * \exp(-0.0002081119 * \text{Fires}/1000) \qquad (2)$$

Selected values of the CV computed with equation (2) are shown in Table A3-1 below.

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[143] For more information on the generalized variance function see Wolter (1985), *op cit.,* Chapter 5.

[144] Sampling of cases and computation of estimated standard errors used the SAS® System (Proc Surveymeans and Proc MIAnalyze); similar to the approach as that used in Chapter 3. Graphical analysis and regression computations were made in the *R* language.

Table A3-1
Generalized Coefficients of Variation
(1,000,000-6,000,000 Fires)

| Estimated Number of Fires (thousands) | Coefficient of Variation (percent) |
|---|---|
| 1,000 | 27.2 |
| 1,500 | 24.5 |
| 2,000 | 22.1 |
| 2,500 | 19.9 |
| 3,000 | 17.9 |
| 3,500 | 16.1 |
| 4,000 | 14.6 |
| 4,500 | 13.1 |
| 5,000 | 11.8 |
| 5,500 | 10.7 |
| 6,000 | 9.6 |

For example, if the estimated number of fires was 3,000,000 (shown as 3,000 in Table A3-1), then the CV is 17.9 percent and the 95 percent confidence interval would be 1,946,000 - 4,054,000. To put it another way, the confidence interval would be plus or minus approximately 35.8 percent of the parameter estimate.

The equation fits best in the middle of the range. The values in Table A3-1 are most accurate in the middle of the table and less accurate at the lower or upper end.

A separate regression model was fitted to values from 200,000 to 1,000,000 fires. The fitted equation was

$$CV = 90.0531 * exp(-0.001262848 * Fires/1000) \qquad (3)$$

The fit was also good, with an $R^2$ *adjusted* value of 0.8896. Tabled values of equation (3) are below in Table A3-2.

Table A3-2
Generalized Coefficients of Variation
(150,000-950,000 Fires)

| Estimated Number of Fires (thousands) | Coefficient of Variation (percent) |
|---|---|
| 150 | 74.5 |
| 200 | 70.0 |
| 250 | 65.7 |
| 300 | 61.7 |
| 350 | 57.9 |
| 400 | 54.3 |
| 450 | 51.0 |
| 500 | 47.9 |
| 550 | 45.0 |
| 600 | 42.2 |
| 650 | 39.6 |
| 700 | 37.2 |
| 750 | 34.9 |
| 800 | 32.8 |
| 850 | 30.8 |
| 900 | 28.9 |
| 950 | 27.1 |

The variance and CV of parameter estimates from survey data depends on the number of cases, the weights associated with the cases, and the distribution of the values of the estimates within and between the strata. Two estimates that resulted in the same estimated number of fires could have different CVs because the number of fires between or within strata was different. However, the generalized CVs should provide the reader with an approximate value of the sampling variability of estimates of various sizes.

## Chapter 7
## Consumer Products Involved in Unattended Residential Fires

In Chapter 3, it was estimated that there were 7.43 million residential fires in the U.S., of which 7.18 million were not attended by the fire service. The estimated number of unattended fires was about one-third of the 22.9 million unattended residential structure fires estimated to have occurred in 1984 by the last residential fire survey. One question raised by the current survey estimates in Chapter 3 is why there has been such a steep decline in the number of residential fires, and in particular, unattended fires. To understand this decline, it is necessary to examine the nature of residential fires more closely. This examination was begun in Chapter 6, and continues in this chapter where the focus is on where in the residence the fire began and the consumer products that were involved in the fire.

A major objective of this chapter is to compare fires by type between the 1984 survey and the current survey. Some methodological issues with this comparison are discussed in the next section.

The analysis in this chapter, like in Chapters 3, 6, and 8, is based on fires rather than households. The source data for the fire estimates in this chapter are the low severity fire incidents that occurred during the 14-day recall period and the high severity incidents that occurred during the 21-day recall period. To facilitate comparison with the 1984 survey, only fire incidents reported not to have been attended by fire departments are used in this chapter. If all fire incidents had been used instead of only unattended incidents, the results would differ very slightly because of the small number of attended fires. Separate analyses for only attended fires are not recommended because the estimates from attended fires have large relative variances because of the small number of such incidents.

Following the methods section, the chapter begins with an overview of the origin and causes of residential fires as reported in the survey, including the room of origin, time of origin, types of equipment or appliances, item first ignited in the fire, and other characteristics. Then the chapter focuses on the major categories of equipment (or appliances) involved in residential fires, namely fires associated with cooking equipment, electrical wiring, and heating and cooling equipment. Fires not involving appliances, such as those associated with candle, match, lighter, and cigarette heat sources are then analyzed. The last section is a discussion and summary of the results. An appendix to this chapter provides more detail on the methods used in making comparisons between estimates from the current survey and the 1984 survey.

## Methods

One objective of this chapter is to compare the fire estimates from the current survey with the estimates from the 1984 survey. By breaking down the estimates by fire origin, heat source, cause, and other factors, it is possible to develop some insight as to how the composition of unreported residential fires has changed in the 20 years between the surveys. However, this raises a problem because there is a major difference between the two surveys in the way that the data are analyzed. In the 1984 survey, even though a one-month recall period was used for estimating total attended and unattended fire incidence, data from the full three months were used for more detailed analyses. These included analyses of where fires started in the residence, the item first ignited, and other such breakdowns. The three-month estimates were then scaled to the totals from the one-month period, so that the total number of fires agreed with the one-month estimates.[145]

This then presents two options for the analysis of the current survey as follows:

- Option 1. Estimate consumer product-related fire incidence in the current survey using the 14/21-day recall period.
- Option 2. Estimate consumer product-related fire incidence in the current survey using the three-month period.

The estimates will be different in a predictable way. As shown in Chapter 3, incidents of greater severity are likely to be remembered for a longer time; consequently, estimates based on a three-month period are likely to contain more severe incidents than estimates based on a one-month period. The question then is how to make estimates with the current survey that most accurately represent 2004-2005 fire incidence and, at the same time, are comparable to the 1984 survey.

It turns out that no single estimate can be made that accomplishes both objectives. While using a 14/21-day recall period produces the best estimate of fires for the 2004 survey in Option 1, the distribution of types of incidents in the 14/21-day period is likely to be less severe than incidents in the full three-month period. The comparison then is likely to show a decline in severity from 1984 to 2004, which would only be an artifact of the analysis, not necessarily a real change over the 20 years. On the other hand, Option 2 avoids the problem with comparisons between surveys, but the fire estimates based on the three-month period are not accurate because they are too heavily weighted toward the higher severity incidents.

This chapter takes a middle position by presenting the estimates based on the 14/21-day recall period, but making between-survey comparisons with estimates based

[145] Audits and Surveys (1985), *op cit.*, page 35. Although the incidents were reweighted in that survey to the annual totals estimated from the one-month recall period, the distribution of the types of fires is not affected by the reweighting. The authors do not explain the reason for their shift to the full three-month period, but it is likely that they were considering the larger sample size available from the three-month period that would reduce the variance of the estimates.

on the full three-month period scaled to the calendar year.[146] To avoid having two fire estimates for every category, when comparing with the 1984 survey, the difference is shown only in percentage terms, usually as a percentage decrease from the comparable 1984 fire estimate. There is more detail about this in the appendix in this chapter.

The tables in this chapter were developed by partitioning the non-fire department-attended fire incidents into various categories associated with the fire incident. Examples are area of fire origin, item first ignited, source of heat, etc. Tables include the estimated number of fires, the percentage distribution, and, when data were available from the 1984 survey, the percentage change in 2004 from 1984. SAS® data step programs were written to extract the cases and assign the categories. Tabulation of the estimated number of fires in each category was done using Proc Freq or Proc SQL in the SAS system.

Like the estimates for attended and unattended fires in Chapter 3, every estimated number of fires in this chapter and every ratio of unattended fires to attended fires have an associated standard error and confidence interval. To avoid cluttering the tables, these statistics are not presented in the tables. Instead the reader can get a sense of the precision of the estimate from the coefficient of variation (CV). As the estimated number of fires increases, the CV decreases. Tables relating the CV to the estimated number of fires and a description of how the tables were constructed are found in the appendix to Chapter 6.

## Results

### *Overview*

Table 7-1 shows the household locations where the unattended residential fires occurred.

[146] The annual estimate that was based on the full three-month recall period was 5.379 million fires. The weights were scaled by multiplying by 7.430/5.379 to reweight to the total number of fires estimated in Chapter 3, using the 14/21-day recall periods.

Table 7-1
Area of Fire Origin of Unattended Residential Fires
(Thousands of Fires)

| Area of Fire Origin | Number of Fires | Percent | Percentage Decrease from 1984 Survey |
|---|---|---|---|
| All locations | 7,176 | 100.0 | 69.3 |
| Kitchen | 4,987 | 69.5 | 72.1 |
| Living room | 530 | 7.4 | 75.6 |
| Bedroom | 505 | 7.0 | 51.6 |
| Bathroom | 438 | 6.1 | 66.8 |
| Other locations | 716 | 10.0 | 33.8 |

Notes: Estimated number of fires and percents based on 14/21-day recall period projected to one year and to national estimates. Percentage decrease from 1984 survey is based on three-month recall period in both 2004 and 1984 surveys. See the Methods section and the appendix to this chapter for details. Totals may not add due to rounding. Other locations include basement (199,000 fires), dining room/dining area (140,000 fires), and the following categories with less than 100,000 estimated fire incidents: exterior of the house, siding, hall, garage or carport, porch or deck, inside the wall, laundry room, storage area, and roof. Estimated coefficients of variation (CV) for fires in thousands: 500, 47.9 percent; 700, 37.2 percent. See the appendix to Chapter 6 for details about the computations of the estimated CV.

Table 7-1 shows that almost 70 percent of the unattended fires began in the kitchen. The living room, bedroom, and bathroom areas accounted for 7.4, 7.0, and 6.1 percent respectively. Finally, the other locations accounted for 10.0 percent of the incidents.

Most, but not all, fires that started in the kitchen (4.5 million or 91 percent of the 4.987 million fires in Table 7-1) were cooking related.[147] Electrical lighting or wiring accounted for 31 percent of living room fires and 44 percent of bedroom fires. A lit cigarette was associated with 11 percent of living room fires and 6 percent of bedroom fires.

The table shows an overall 69.3 percent decrease in residential fires not attended by the fire service from the 1984 survey. The largest category of fires, kitchen fires, showed a decrease of 72.1 percent. By itself, this decrease accounts for a large proportion of the decrease in the total number of fires between the two surveys. Fires originating in the living room decreased the most by 75.6 percent. Smaller decreases were observed in fires originating in the bathroom, bedroom, and other locations.

[147] Most cooking-related fires began in the kitchen, and most kitchen fires involved cooking. A small number of cooking fires began outside the kitchen, and a small number of non-cooking fires began in the kitchen.

The 1984 survey did not report on the number of fires that were associated with smoking materials, but there were occasional references to smoking materials in that survey; for example, 25.6 percent of the bedroom fires (estimated 308,500 fires) were smoking related.[148] The comparable estimate from the present survey shows a 70.2 percent decrease in smoking-related bedroom fires.

Table 7-2 presents an overall description of the fires by source of heat. The percentage decrease from the 1984 survey for fires involving heat sources other than appliances, such as cigarettes and open flame incidents, is not shown in this table because the numbers of those types of fires were not presented in the 1984 report.

[148] In the 1984 survey, smoking-material related fires were estimated from the response to the question "What provided the heat that started the fire?" The response indicating smoking materials was "Smoking Materials—Cigarettes, Cigars, Pipe Tobacco." See Audits and Surveys (1985), *op cit.,* pages 35-36.

Table 7-2
Source of Heat for Unattended Residential Fires
(Thousands of Fires)

| Source of Heat | Number of Fires | Percent | Percentage Decrease from 1984 Survey |
|---|---|---|---|
| All heat sources | 7,176 | 100.0 | 69.3 |
| Cooking appliances | 4,664 | 65.0 | 63.3 |
| Open flame | 744 | 10.4 | |
| Other household appliances | 651 | 9.1 | 84.4 |
| Electrical lighting and wiring | 616 | 8.6 | 51.7 |
| Heating and cooling equipment | 281 | 3.9 | 69.5 |
| Cigarettes | 155 | 2.2 | |
| Other heat sources | 64 | 0.9 | |

Notes: See notes for Table 7-1. Cooking appliances include stoves, toasters, coffee makers, and parts such as wiring and plugs. Open flame includes matches, lighters, torches and candles. Other household appliances include TVs, washer-dryers, irons, hair dryers, power tools, and refrigerators. Electrical lighting and wiring includes lamp cords, extension cords, fuses, light bulbs, and fixtures. Heating and cooling equipment includes furnaces, fireplaces, central and room air conditioners, space heaters, and water heaters. Something else includes fires started by lightning. Other heat sources include fires starting elsewhere and spreading to the house and fires started by lightning. Estimates from the 1984 survey were used for the percentage decrease from 1984. Comparable fire estimates from the 1984 survey were available only for Cooking appliances, Other household appliances, Electrical lighting and wiring, and Heating and cooling equipment. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 600, 42.2 percent; 5,000, 11.8 percent. See the appendix to Chapter 6 for details.

Table 7-2 shows that 4.66 million fires involved cooking appliances. This was almost two-thirds of all estimated unattended fire incidents. The second largest category was open flame (candles, matches, lighters, torches) at 744,000 incidents, followed by other household appliances at 651,000, and electrical lighting and wiring at 616,000 incidents.

In comparing the number of appliance fires with the 1984 survey, there was a smaller decline in cooking appliance-related fires than all fires. Electrical lighting and wiring-related fires also decreased less than the overall fire percentage, and other household appliances-related fires decreased by a greater amount.

Table 7-3 shows the item first ignited. Item first ignited was derived from two questions in the survey that were answered as free text. Question 17a was, “Now please think of the items that caught on fire. Which item caught fire first?” Question 17 was

"What other items caught fire?" An attempt was made to reconstruct the NFIRS definition of item first ignited which is defined as "… the first object ignited by the heat source that had sufficient volume or heat intensity to extend to uncontrolled or self-perpetuating fire."[149] Responses in the two free text fields were analyzed and edited, when necessary, to come as close as possible to this definition.

One problem involved separating item first ignited from the appliance or the heat source. For example, when "stove" was reported as both the heat source and item first ignited, the more likely item first ignited was "cooking materials." Also "cooking materials" was substituted for "pot," when pot was reported as the item first ignited. Again, although many people would think that the pot or the stove caught fire, it was more likely to be the contents of the pot.

Another problem involved appliances. When an appliance was named by respondents both as the source of heat and item first ignited, but a component part could have caught fire, "appliance casing or housing" was coded. Examples include the hood over a stove, wiring inside or connecting an appliance to electrical power, the burner on a stove, the inside liner of the microwave oven, the electrical elements in a coffee maker, the inside of a water heater, wiring in a vacuum cleaner, etc.

In some cases, the coding was more straightforward. Paper was coded when the data indicated bags, match boxes, napkins, newspaper, etc. Linen included towels and potholders. Bedding was sheets, pillow cases, and blankets. Electrical wire included circuit boards, sockets, plugs, and wires (not attached to an appliance). Clothing was selected to identify wearing apparel either on or not on a person. Light vegetation included grass, plants, and leaves. Household utensils were bowls, containers, plates, and pots in the rare cases when pots were the item first ignited, but the pots were not used for cooking at the time. Cabinetry included furniture such as tables, desks, drawers, bookcases, but excluded chairs and appliances. Floor coverings included carpets. Heavy vegetation included trees. Decorations were ornaments or accessories such as pictures. Human and animal indicated where the heat source made contact with a person or an animal before other items. Structural members included framing, walls, roofs, siding, and trim.

Finally, none or unspecified was coded when not enough information was provided to determine if the fire had spread from the original heat source to some other object. Responses so coded included "ceiling fan caused smoke," "the wire in the lamp," and "washer just smoking."

[149] United States Fire Administration (2003), "NFIRS 5.0 Complete Reference Guide." Emmitsburg, MD, pages 4-18.

Table 7-3
Item First Ignited in Unattended Residential Fires
(Thousands of Fires)

| Item First Ignited | Number of Fires | Percent |
|---|---|---|
| All fires | 7,176 | 100.0 |
| Cooking materials | 3,915 | 54.6 |
| Appliance casing or housing | 690 | 9.6 |
| None or unspecified | 660 | 9.2 |
| Paper | 407 | 5.7 |
| Linen | 361 | 5.0 |
| Bedding | 253 | 3.5 |
| Electrical wire | 244 | 3.4 |
| Clothing | 130 | 1.8 |
| Household utensils | 96 | 1.3 |
| Light vegetation | 95 | 1.3 |
| Other items | 325 | 4.5 |

Notes: See notes for Table 7-1. *Other items* include the following in descending order of frequency: cabinetry, floor covering, heavy vegetation, person or animal, rubbish, and structural members. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 400, 54.3 percent; 700, 37.2 percent; 4,000, 14.6 percent. Items with estimated numbers of fires under 90,000 are included in *Other items* and are not presented on separate lines. Because of the difficulties in interpreting the survey responses to the questions associated with Items First Ignited, as discussed in the text, some responses may not be reliable.

In Table 7-3, the largest category was cooking materials at 3.9 million fires or 54.6 percent of the total. This result is consistent with cooking fires as the most frequent type of fire incident. Some other items listed in the table such as appliance casing or housing, linen, and clothing can be ignited by cooking equipment. Appliance casing or housing, none or unspecified (no item mentioned), paper, linen, bedding, electrical wire, and clothing were the remaining categories with appreciable estimated numbers of incidents.

An estimated 130,000 people were injured or got sick in these incidents; approximately one injury or illness for every 56 fires. Of these, 102,000 illnesses or injuries were associated with cooking fires and 27,000 were associated with open flame fires.[150] About half the illnesses or injuries in cooking fires involved cooking materials (food, cooking oil, or grease). When asked what type of medical attention was required, the largest response category was no medical attention (97,000 illnesses/injuries), and the

[150] The respondent(s) did not specify the type of open flame. It was not a candle, match, lighter, torch or spark from fireplace.

second largest was first aid received at the scene (32,000 illnesses/injuries). The most frequent type of injury was burns (101,000 illnesses/injuries), followed by other, unspecified (28,000).[151]

Respondents were asked if they had to stay somewhere other than their residence for a night or more because of the fire. There were an estimated 9,600 fires where this occurred. In these incidents, the residents returned within a week. All of these were cooking-related fires.

Table 7-4 below shows the average and total dollar value of property loss by heat source. These fires involved an estimated total damage to buildings and contents of $612 million.

[151] The injury and illness estimates above are based on very small sample sizes and, as a result, have CVs that are at least 75 percent. Also, in the introduction to Chapter 6, it was pointed out that low probability events are unlikely to be captured when there are small sample sizes. This does not mean that low probability events such as serious injuries and hospitalization do not occur in fires, just that they were not captured in the data.

Table 7-4
Average and Total Dollar Value of Property Loss
by Heat Source for Unattended Residential Fires
(Thousands of Fires)

| Heat Source | Number of Fires | Average Loss Per Fire ($) | Total Loss (Million $) |
|---|---|---|---|
| All heat sources | 7,176 | 85.32 | 612.2 |
| Cooking appliances | 4,664 | 70.30 | 327.9 |
| Open flame | 744 | 25.79 | 19.2 |
| Other household appliances | 651 | 242.58 | 157.9 |
| Electrical lighting and wiring | 616 | 70.30 | 43.3 |
| Heating and cooling equipment | 281 | 180.94 | 50.8 |
| Cigarettes | 155 | 16.95 | 2.6 |
| Other heat sources | 64 | 48.83 | 3.1 |

Notes: See notes for Table 7-1. Definitions of heat sources are found in the notes for Table 7-2. Dollar loss is direct loss per fire, as reported in the survey, including expenses for repairing the residence and replacement of the contents of damaged areas. Property loss was not reported for an estimated 240,000 fires. Average damage is based on records reporting property loss; total loss is computed from the number of fires and the average loss per fire. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 600, 42.2 percent; 4,500, 13.1 percent.

The largest category of total dollar loss involved cooking appliances, at $327.9 million, with an average loss of $70.30 per incident. The loss attributed to cooking fires represented more than half the total estimated loss from all unattended fires.

By individual incident, the costliest types of incidents involved other household appliances with an average cost per fire of $242.58 (total loss $157.9 million), heating and cooling equipment at $180.94 per fire (total of $50.8 million), and something else at $179.99 per fire ($3.1 million).[152] Fires involving appliances tended to be more costly on average than other types of fires because the cost may have included repair or replacement of the appliance. Note that cigarette and open flame incidents had the lowest reported property damage per incident at $16.95 and $25.79 per incident, collectively accounting for almost $22 million or 4 percent of estimated total fire losses.

*Household Appliance/Equipment Fires -- An Overview*

[152] There is more detail on other household appliances in Table 7-16 and Table 7-17.

As shown in Table 7-2, the source of heat for most fires was cooking appliances. In the analysis of fire data, fire incidents are often separated into those involving appliances or equipment and those where the heat source was not an appliance.[153] In Table 7-5, appliances included the following categories: cooking appliances, electrical lighting or wiring, another household appliance, and heating or cooling equipment. Non-appliances included various open flame sources (as described in Table 7-2) and lit cigarettes, lightning, and unspecified.

Collectively, appliances were involved in 6.2 million fire incidents, accounting for 86.6 percent of all unattended residential fires. By type of area, 84.7 percent of fires in urban areas (4.9 million fires) involved appliances, while in non-urban areas 94.7 percent (1.3 million fires) involved appliances. In detached single family homes, 81.8 percent of the fires (3.8 million fires) involved appliances, while in other types of residences, 95.0 percent of the fires (2.4 million fires) involved appliances.

Between 1984 and 2004, the estimated number of appliance fires not attended by the fire service decreased by 65.3 percent, and non-appliance fires decreased by 84.0 percent.[154] As the largest component of non-appliance fires were those started by cigarettes and small open flames, this decline in non-appliance fires probably reflects the decrease in smoking-related incidents.

Table 7-5 records the estimated number of unattended residential appliance fires and non-appliance fires by time of day when they occurred.

[153] Appliance and Equipment are used in this text as synonyms. The National Fire Incident Reporting System (NFIRS) uses the term equipment and does not use the term appliance, but in keeping with the 1984 survey and more widespread usage, the term appliance is usually used in this report.

[154] Appliance and non-appliance fires are from the 1984 report in Audits and Surveys (1985), Table 6-2. Tabulations of non-appliance fires were not further broken down into smoking materials, open flame, etc. in the 1984 survey, so those comparisons cannot be made with the present survey.

Table 7-5
Time of Fire Occurrence of Unattended Residential Fires
By Appliance and Non-appliance Fires
(Thousands of Fires)

| Time of Day[155] | Number of Fires | | |
|---|---|---|---|
| | All | Appliance | Non-appliance |
| All times | 7,176 | 6,212 | 964 |
| 6 am – noon | 1,226 | 1,147 | 79 |
| Noon – 5 pm | 1,864 | 1,544 | 320 |
| 5 – 9 pm | 2,766 | 2,408 | 358 |
| 9 pm – midnight | 887 | 696 | 190 |
| Midnight – 6 am | 433 | 417 | 17 |

Note: Notes: See notes for Table 7-1. Also, Time of Day includes the left but not the right endpoint, e.g., fires occurring at noon are in the *Noon – 5 pm* time period. The table excludes equipment classified as other (0.2 percent of incidents). Appliance fires include cooking appliances, heating and air-conditioning equipment, electrical lighting or wiring, and other household appliances. Non-appliance fires include all other categories. Estimated CVs for fires in thousands: 200, 70.0 percent; 400, 54.3 percent; 700, 37.2 percent; 1,000, 27.2 percent; 1,500, 24.5 percent; 2,500, 19.9 percent; 3,000, 17.9 percent.

Table 7-5 shows that most appliance fires (38.1 percent) and most non-appliance fires (37.1 percent) occurred between 5 and 9 pm. The highest hourly fire incidence rate was also in that period, at 1,648 appliance fires per hour and 24 non-appliance fires per hour.[156] The next highest hourly rate was 845 appliance fires per hour between noon and 5 pm.

Table 7-6 shows item first ignited by appliance and non-appliance fires.

[155] The time categories shown in the table were selected because the survey offered respondents a choice of specifying the actual time of the incident, or if they were unable to recall the time, the time periods in the table.

[156] Note that each part of the day in the table may contain a different number of hours. For example, the periods *6 am – Noon* and *Midnight – 6 am* each include 6 hours, *Noon – 5 pm* has 5 hours, etc. To compare rates with different numbers of hours, hourly rates were calculated by dividing the number of fires by the product of the number of hours in the period and the number of days in the year (365.25). The time categories were taken from the survey instrument. For more details, see Table 6-8, in Chapter 6 and the text following that table.

Table 7-6
Item First Ignited in Unattended Residential Fires
by Appliance and Non-appliance Fires
(Thousands of Fires)

| Item | Appliance Fires | | Non-appliance Fires | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| All | 6,212 | 100.0 | 964 | 100.0 |
| Cooking materials | 3,879 | 62.5 | - | - |
| Appliance case | 649 | 10.4 | - | - |
| None | 483 | 7.8 | 177 | 18.4 |
| Linen | 318 | 5.1 | - | - |
| Electrical wire | 244 | 3.9 | - | - |
| Paper | 219 | 3.5 | 188 | 19.5 |
| Bedding | 179 | 2.9 | - | - |
| Household utensils | 92 | 1.5 | - | - |
| Light vegetation | - | 0.0 | 92 | 9.6 |
| Other | 149 | 2.4 | 503 | 52.2 |

Notes: See notes for Table 7-1. Items first ignited with estimated numbers of fires fewer than 90,000 are shown collectively in the *Other* category.[157] Dashes in the table indicate estimated number of fires under 90,000. Items first ignited for Appliance-*Other* fires include clothing and floor coverings. Items first ignited for Non-appliance-*Other* Fires include bedding, decorations, cabinetry, heavy vegetation, clothing, and other items. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 600, 42.2 percent; 4,000, 14.6 percent.

The distribution of items first ignited by appliance and non-appliance fires are very different. As cooking fires were the largest category of appliance fires, it is not surprising that cooking materials represented the largest category of item first ignited with 3.9 million fires (62.5 percent) where an appliance was the heat source. These are followed by appliance case (housing and casing) at 649,000 fires (10.4 percent) which were also probably largely cooking related. No item first ignited reported (483,000 fires or 7.8 percent), linen (mostly kitchen towels, pot holders, etc. at 318,000 or 5.1 percent), paper (219,000 fires or 3.5 percent), electrical wiring (244,000 fires or 3.9 percent), and bedding (179,000 fires or 2.9 percent) constitute almost all the remaining items. For fires that had non-appliance heat sources, paper was the largest category of item first ignited at 188,000 fires or 19.5 percent, followed by no item reported (177,000 fires or 18.4 percent), and light vegetation (92,000 fires or 9.6 percent).

[157] Excluding detailed estimates with fewer than 90,000 fires will not be consistently used in this chapter, but is being used with item first ignited, because it appears that the question may not have been answered reliably by many respondents. See the discussion following Table 7-3.

The next sections contain analyses on the four main categories of fires with appliances as heat sources as follows: cooking fires, electrical wiring fires, heating and cooling equipment fires, and other household appliance fires.

*Cooking Fires*

Table 7-7 shows the types of cooking appliances involved in residential fires.

Table 7-7
Cooking Appliances Involved in Unattended Residential Fires
(Thousands of Fires)

| Source of Heat | Number of Fires | Percent | Percentage Decrease from 1984 Survey |
|---|---|---|---|
| All cooking appliances | 4,664 | 100.0 | 63.3 |
| Stove/Range (all power types) | 3,789 | 81.2 | 61.4 |
| Electric | 2,596 | 55.7 | |
| Gas | 1,131 | 24.2 | |
| Other | 62 | 1.3 | |
| Microwave oven | 332 | 7.1 | |
| Toaster oven, toaster | 208 | 4.5 | 69.0 |
| Outdoor grill | 124 | 2.7 | |
| Coffeemaker, teapot | 68 | 1.5 | 85.3 |
| Countertop oven | 48 | 1.0 | |
| Other cooking appliance | 42 | 0.9 | |
| Unspecified | 52 | 1.1 | |

Note: See notes for Table 7-1. Also, *Unspecified* includes fires where the respondent identified the heat source as "other appliance" and "don't know" and those who indicated that the fire involved a cooking appliance but did not answer the question to specify the appliance. The category *Stove/Range* includes electric, gas and other powered stoves. *Gas* includes the responses "gas, type unknown," "natural gas," and "propane." *Other* power sources for *Stove/Range* include wood, charcoal, and fuel oil, and the response "other." Percentage decreases are only presented for the categories reported in the 1984 survey. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 1,000, 27.2 percent; 2,500, 19.9 percent; 4,000, 14.6 percent.

Table 7-7 shows that stoves (including both the top burners and the oven unit), accounted for the largest amount of fire department-unattended cooking appliance-related fires at 3.8 million fires (81.2 percent). Electric stoves were involved in 55.7 percent of the incidents and gas stoves were involved in 24.2 percent of the cooking appliance fires.

According to the American Housing Survey in 2005, 61 percent of households used electricity as their cooking fuel and 39 percent used gas.[158] This would indicate about 3.8 stove fires per 100 households with electric stoves per year and 2.6 stove fires per 100 households with gas stoves per year. This is about a 47 percent higher unattended fire risk factor for electric stoves. The risk factor for attended fires computed from official statistics also shows a 47 percent increased risk factor for electric stoves as compared with gas. Interestingly, the official statistics show that the risk of civilian injury due to electric stoves was 118 percent higher and property damage was 133 percent higher. However, the risk of fire deaths for gas stoves was 15 percent higher.[159]

Cooking appliance-related unattended fires decreased 63.3 percent between 1984 and 2004, a slightly smaller decrease than all fires.[160] There was a similar decrease in stove-related fires and toaster oven-related fires. Coffee and teapot fires decreased the most by 85.3 percent. The 1984 survey reported the number of fires associated with some other cooking appliances, such as deep fryers and frying pans. For 2004 there were too few fires involving these cooking appliances to show in Table 7-7; however, the estimated number of fires decreased by 92.0 and 95.5 percent, respectively.

In the 2004 survey, 71.5 percent of cooking appliance fires involved electric appliances and 23.1 percent involved gas (natural gas, propane, butane, or type of gas unspecified). In comparison with the 1984 survey, there was a 57.6 percent decrease in electrically powered cooking appliance fires since 1984 and a 68.6 percent decrease in gas appliance-related fires.[161]

Table 7-8 shows that most of the cooking-related fires involved food, cooking oil, or grease catching on fire. This type of incident accounted for 83.2 percent of the cooking-related fires or 3.9 million fires. Also, 289,000 fires involved linens (6.2 percent), mostly dish towels, pot holders, and tablecloths. The remaining items first ignited that accounted for more than 90,000 fires were no item first reported (126,000 fires and 2.7 percent), and paper (95,000 fires and 2 percent). Items with small estimated numbers of fires are shown in the Other line. These included household utensils such as plastic spoons and containers, clothing, appliance housings or casings, bedding, and light vegetation. Collectively they accounted for 275,000 fires and about 5.9 percent of the total.

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[158] U.S. Census Bureau (2006b), Current Housing Reports, Series H150/05, *American Housing Survey for the United States: 2005.* U.S. Government Printing Office, Washington, DC, 20401, Table 1A-5, page 6.
[159] Hall JR Jr. (2005), *op cit.*,, page 8, and Table 8, page 27. Also, Smith L, Monticone R, and Gillum B (1999), "Range Fires: Characteristics Reported in National Fire Data and a CPSC Special Study." U.S. Consumer Product Safety Commission, Washington, DC.
[160] Cooking fires in 1984 from Audits and Surveys (1985), *op cit*. All cooking fires from Table 6-4, page 38. Appliance detail from Table 6-5, page 39.
[161] In 1984, 66.6 percent of cooking appliance fires used electric power and 28.9 percent used gas. See Audits and Surveys (1985), *op cit.*, page 41.

Table 7-8
Item First Ignited in Unattended Residential Cooking Fires
(Thousands of Fires)

| Item First Ignited | Number of Fires | Percent |
|---|---|---|
| All | 4,664 | 100.0 |
| Cooking materials | 3,879 | 83.2 |
| Linen | 289 | 6.2 |
| No item reported | 126 | 2.7 |
| Paper | 95 | 2.0 |
| Other | 275 | 5.9 |

Notes: See notes for Table 7-1. *Other* includes clothing, household utensils, appliance housing or casing, bedding, and light vegetation. Estimated CVs for fires in thousands: 150, 74.5; 300, 61.7; 4,000, 4.6.

When asked if the cooking appliance was working properly before the fire, in 98.7 percent of the incidents, respondents said that the appliance was working properly. The only appliances with substantially lower percentages of incidents where the appliance was said to be working properly before the fire were coffeemakers and teapots, which were said to have worked properly in 65.3 percent of the incidents where they were the heat source. No comparable statistics were reported for the 1984 survey, either for all cooking fires or coffeemaker/teapot fires. [162] In the 1984 survey, equipment failure was associated with the fire in 59.2 percent of the toaster fire incidents and 47.2 percent of the toaster oven fires. In contrast, in the 2004 survey, there were no reported toaster or toaster oven incidents where the appliances were reported as not working properly before the fire.

The next three tables display the consequences of fire department-unattended cooking fires. Tables 7-9 and 7-10 show the number of fires by flame and smoke damage categories. Table 7-11 presents an estimate of the amount of property damage by type of cooking fire. All of these tables depart from the usual format of comparing with the 1984 survey because damage and injury estimates were not presented in that survey.

[162] Audits and Surveys (1985), *op cit.,* page 41. As the structure of the questions in the two surveys was not identical, comparisons may be difficult. Question 19 in the 1984 survey asked, "In your opinion what caused the fire? Was it … 1. Equipment or product failure, 2. Human carelessness, 3. Children playing with fire, 4. Something else (specify):" The 2004 survey asked, "Did the source of heat that started the fire seem to be working properly just before the fire?" There were no questions in the 2004 survey asking if human carelessness caused the fire.

Table 7-9
Extent of Flame Damage Associated with
Unattended Residential Cooking Appliance Fires
(Thousands of Fires)

| Source of Heat | All Incidents | No Flame Damage | Confined to One Item | Several Items |
|---|---|---|---|---|
| All cooking appliances | 4,664 | 2,867 | 1,630 | 166 |
| Stove/Range | 3,788 | 2,398 | 1,275 | 115 |
| Electric | 2,596 | 1,734 | 825 | 37 |
| Gas | 1,131 | 602 | 451 | 78 |
| Other | 62 | 62 | 0 | 0 |
| Microwave oven | 332 | 190 | 136 | 6 |
| Toaster oven, toaster | 208 | 137 | 71 | 0 |
| Coffeemaker, teapot | 68 | 0 | 24 | 45 |
| Countertop oven | 48 | 33 | 15 | 0 |
| Outdoor grill | 124 | 37 | 87 | 0 |
| Other appliance | 42 | 42 | 0 | 0 |
| Unspecified | 52 | 30 | 22 | 0 |

Notes: See notes for Table 7-1. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 450, 51.0 percent; 600, 42.2 percent; 1,000, 27.2 percent; 2,500, 19.9 percent; 4,000 14.6 percent.

Table 7-9 shows that for fire department-unattended cooking fires, in general, the amount of flame damage was small. For example, an estimated 166,000 fire incidents (3.6 percent) resulted in flame damage beyond the original item where the fire started; the other items had either no flame damage or damage to a single item, typically the appliance itself. For all stoves and ranges, 97.0 percent of the incidents had no flame damage or damage was confined to a single item, while 115,000 incidents had damage that spread beyond a single item. Only coffeemakers and teapots showed a sizeable proportion of incidents involving flame damage beyond the original item (45,000 of 68,000 incidents or 65.3 percent).

Table 7-10 shows the extent of smoke damage associated with fire department-unattended cooking fires.

Table 7-10
Extent of Smoke Damage Associated with
Unattended Residential Cooking Appliance Fires
(Thousands of Fires)

| Source of Heat | All Incidents | No Smoke Damage | Little Damage or Only Room of Origin | Smoke Damage to Other Rooms or Whole House |
|---|---|---|---|---|
| All cooking appliances | 4,664 | 3,564 | 907 | 191 |
| Stove/Range | 3,788 | 2,880 | 721 | 188 |
| Electric | 2,596 | 1,920 | 487 | 188 |
| Gas | 1,131 | 897 | 233 | 0 |
| Other | 62 | 62 | 0 | 0 |
| Microwave oven | 332 | 303 | 24 | 3 |
| Toaster oven, toaster | 208 | 176 | 32 | 0 |
| Coffeemaker, teapot | 68 | 23 | 45 | 0 |
| Countertop oven | 48 | 48 | 0 | 0 |
| Outdoor grill | 124 | 124 | 0 | 0 |
| Other appliances | 42 | 9 | 34 | 0 |
| Unspecified | 52 | 1 | 52 | 0 |

Notes: See notes for Table 7-1. Also, for *Microwave oven*, the column All Incidents includes an estimated 2,400 fires where the smoke damage was not specified. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent; 500, 47.9 percent; 700, 37.2 percent; 1,000, 27.2 percent; 2,000, 22.1 percent; 3,000, 17.9 percent; 4,000, 14.6 percent.

Like flame damage, the amount of smoke damage per fire tended to be low. An estimated 191,000 cooking fires (4.1 percent) involved smoke damage beyond the room where the fire started. There was almost no smoke damage beyond the room of origin for fires involving appliances other than stoves.

Table 7-11
Estimated Property Damage Associated with
Unattended Residential Cooking Appliance Fires
(Thousands of Fires)

| Source of Heat | All | None | $1-$9 | $10-$99 | Over $100 |
|---|---|---|---|---|---|
| All cooking appliances | 4,664 | 2,810 | 408 | 954 | 352 |
| Stove/Range | 3,788 | 2,414 | 359 | 679 | 202 |
| Electric | 2,596 | 1,723 | 259 | 386 | 119 |
| Gas | 1,131 | 633 | 95 | 293 | 84 |
| Other | 62 | 57 | 5 | 0 | 0 |
| Microwave oven | 332 | 100 | 49 | 59 | 125 |
| Toaster oven, toaster | 208 | 138 | 0 | 69 | 0 |
| Coffeemaker, teapot | 68 | 0 | 0 | 68 | 0 |
| Countertop oven | 48 | 48 | 0 | 0 | 0 |
| Outdoor grill | 124 | 68 | 0 | 57 | 0 |
| Other appliance | 42 | 13 | 0 | 0 | 24 |
| Unspecified | 52 | 30 | 0 | 22 | 1 |

Note: See notes for Table 7-1. Also, the All category and subtotals include some estimated fires where the respondent did not know or refused to state the amount of property damage. These estimates do not appear in other columns These were as follows: *Electric stoves*, 119,000 fires; *Gas stoves*, 25,000 fires; *Other appliances* 6,000 fires; and *Toaster oven, toaster* < 1000 fires. Estimated CVs for fires in thousands: 150, 74.5; 300, 61.7; 600, 42.2; 1,000, 27.2; 1,500 24.5; 2,500 19.9; 4,000, 14.6.

Table 7-11 shows that an estimated 2.8 million cooking fires (60.2 percent) had no reported financial loss from property damage and most cooking fires had little loss. For ranges and stoves, for example, there were an estimated 881,000 fires (23.3 percent) with property damage of $10 or more, while 63.7 percent had no reported property damage. An estimated 202,000 range or stove fires had estimated property damage of $100 or more. Also, of note in this table is the high proportion of microwave oven fires with property damage over $100. Respondents were not asked to detail the types of property damage leading to the estimate, but for microwave ovens, some of the cost probably involved replacement or repair of the appliance.

The 1984 survey also presented property loss estimates for selected kitchen appliances. For fires associated with ranges and ovens, 70.7 percent had no property

damage.[163] However, it is difficult to compare non-zero dollar losses between the two periods without correcting for inflation.

Few cooking-related fires were serious enough to require people to leave the residence. There were an estimated 9,600 fires, comprised of 5,700 range or oven fires and 3,300 microwave oven fires and 600 toaster oven fires, in which respondents reported leaving the residence. All respondents who were forced to leave reported that they were able to return home in less than a week.

Also, relatively few cooking-related fires involved injuries. There were an estimated 102,000 people injured in these incidents. Seventy-two percent of the injured victims had burns and the remaining 28 percent reported their injuries as "other" (i.e., not a burn, smoke inhalation, a laceration, bruise, or fracture.) Twenty-eight percent of victims required medical treatment, and that treatment was described as having received first aid at the scene. No victims were hospitalized.

*Electrical Lighting and Wiring Fires*

At 616,000 estimated fires, electrical lighting and wiring fires ranked fourth in the number of unattended fire incidents. Table 7-12 shows the distribution of the estimated unattended fires by type of lighting and wiring appliance.

[163] Audits and Surveys (1985), *op cit.,* page 42.

Table 7-12
Electrical Lighting and Wiring Equipment Involved
in Unattended Residential Fires
(Thousands of Fires)

| Source of Heat | Number of Fires | Percent | Percentage Decrease from 1984 Survey |
|---|---|---|---|
| All lighting and wiring | 616 | 100.0 | 51.7 |
| Light fixture | 140 | 22.7 | 45.4 |
| Lamp and light bulb | 68 | 11.1 | |
| Fuse, circuit breaker panel | 62 | 10.0 | 83.2 |
| Cord (unspecified) | 57 | 9.3 | |
| Other installed wiring | 48 | 7.8 | 36.3 |
| Other lighting and wiring | 43 | 7.0 | |
| Lamp cord | 36 | 5.8 | |
| Extension cord | 5 | 0.8 | 90.6 |
| Unspecified | 157 | 25.5 | |

Notes: See notes for Table 7-1. Estimated CVs for fires in thousands: 150, 74.5 percent; 600, 42.2 percent.

Aside from the Unspecified category, Table 7-12 shows that the largest number of electrical lighting and wiring fires was associated with light fixtures, at 140,000 fires or 22.7 percent of the total. Lamp and light bulb related incidents accounted for 68,000 fires and 11.1 percent of the total. Wiring accounted for about 146,000 fires. Wiring fires included 57,000 fires associated with cords (unspecified), 48,000 fires from other installed wiring, 36,000 incidents that were lamp cord fires, and 5,000 fires involving extension cords. Some of the fires reported in the category of other lighting and wiring may have also involved wiring.

Also, Table 7-12 shows that electrical lighting and wiring fires decreased by 51.7 percent from the 1984 survey, where there were an estimated 864,000 incidents.[164] The largest percentage drop occurred in fuse and circuit breaker panel fires at 83.2 percent and extension cord fires at 90.6 percent. Light fixture-related fires with a decrease of 45.4 percent and other installed wiring-related fires at 36.3 percent did not decrease as much as all fires.

[164] Audits and Surveys (1985), *op cit.*, page 45. The percentage decreases are based on the comparable estimate of 438,000 fires. See the appendix to this chapter for the description of the methodology used in comparing between the surveys.

Table 7-13 presents the distribution of items first ignited in fire department-unattended electrical fires.

Table 7-13
Item First Ignited in Unattended Residential Electrical Fires
(Thousands of Fires)

| Item | Number of Fires | Percent |
|---|---|---|
| All lighting and wiring fires | 616 | 100.0 |
| Bedding | 149 | 24.1 |
| No item reported | 137 | 22.3 |
| Electrical wiring | 130 | 21.1 |
| Other | 200 | 32.5 |

Notes: See notes for Table 7-1. The *Other* category includes appliance housings and casings, paper, and linens. Estimated CVs for fires in thousands: 150, 74.5 percent; 600, 42.2 percent.

An estimated 24.1 percent of the items first ignited were bedding (sheets, pillows, bedclothes), accounting for about 149,000 fires. Respondents did not specify the item first ignited in 22.3 percent of incidents, or 137,000 fires, possibly indicating that nothing was ignited except the heat source itself. Electrical wiring and the Other category (appliance casings, paper, and linens), accounted for the rest of the items first ignited in electrical fires.

Respondents said that the electrical lighting and wiring equipment was working properly before the fire in an estimated 553,000 fires or 89.7 percent of the incidents. The equipment most frequently mentioned as not working properly before the fire was Cord (unspecified), accounting for an estimated 57,000 fire incidents.

Of the 616,000 electrical lighting and wiring fires, respondents reported no flame damage occurred in 488,000 fires (79.2 percent). Of the remaining 127,000 fires, flame damage was confined to the first item ignited. In an estimated 458,000 fires (74.5 percent), respondents reported no smoke damage at all. In the remaining 158,000 incidents, respondents were unable to describe how much smoke damage had occurred, if any.

In 270,000 incidents (43.8 percent), respondents indicated that property damage resulting from the fire was $10 or less. In 97,000 fires (16 percent), damage was between $10 and $99, and in 237,000 fires (38.5 percent), the damage exceeded $100. The last category, for damage over $100, included an estimated 85,000 light fixtures fires; 72,000 fires where the respondent did not know the specific wiring or lighting source of the

incident; 43,000 incidents involving other wiring or lighting; and 37,000 incidents involving fuses, circuit breakers, and panel boards.

There were no injuries reported to have resulted from electrical lighting and wiring fire incidents.

*Heating and Cooling Appliance Fires*

Heating and cooling appliances were involved in an estimated 281,000 fires, about 4 percent of all fire department-unattended incidents, ranking immediately after electrical lighting and wiring fires in the total number of appliance fire incidents. Table 7-14 shows the distribution of the number of fires by the type of equipment.

Table 7-14
Heating and Cooling Appliances Involved in Unattended Residential Fires
(Thousands of Fires)

| Source of Heat | Number of Fires | Percent | Percentage Decrease from 1984 Survey |
|---|---|---|---|
| All heating and cooling | 281 | 100.0 | 69.5 |
| Central and fixed heating | 85 | 30.1 | 73.0 |
| Fixed local heating equipment | 84 | 30.1 | |
| Central heating furnace | - | - | |
| Portable heater | 97 | 34.5 | 71.7 |
| Heating stove | 10 | 3.6 | |
| Unspecified | 89 | 31.8 | |
| Water heater | - | - | 69.4 |
| Fireplace | - | - | 99.4 |

Notes: See notes for Table 7-1. The *Unspecified* category includes the responses "don't know," "refused," and "other heating and cooling appliances." The 1984 survey estimates for totals were from Audits and Surveys, Inc., *op cit.,* (1985, Table 6-3, page 37) except for air conditioning which was in Table 6-13, page 49. Some of the detailed estimates from the 1984 survey were in Table 6-12, page 48. The 1984 survey separates heating from cooling equipment, which is no longer possible because of equipment such as heat pumps that provide both residential heating and cooling. There were an estimated 200 fires involving central heating furnaces (shown as "-", otherwise it would need to be shown as 0.2). There were no fires involving water heaters or fireplaces during the 14/21-day recall period, but there were fires during the three-month period, which were used to compute the percentage decrease. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent.

Of the estimated 281,000 unattended heating and cooling fires, the largest category was associated with portable heaters at 97,000 fires, accounting for 34.5 percent of the total incidents. Central and fixed heating equipment-related incidents collectively represented 85,000 incidents (30.1 percent), of which less than 1,000 incidents were associated with central heating. There were no incidents involving air conditioners, fireplaces, or installed water heaters. Respondents did not specify the type of heating equipment in an estimated 89,000 incidents.

In comparing with the 1984 survey, overall heating and cooling equipment-related incidents decreased 69.5 percent from the estimated 675,000 incidents in 1984.[165] This was about the same decrease observed for all equipment types. In both the present survey and the 1984 survey, portable heaters accounted for the largest number of heating and cooling equipment-related fires.[166]

In the incidents involving equipment attached to a chimney or vent, all the incidents involved the equipment itself, not the chimney or vent. All the portable heaters were powered by electricity. Respondents indicated that most of the fixed local heater incidents involved either "other" fuel or "gas (type unknown)."[167] Respondents said that the equipment was the main source of heat in their homes for less than 1,000 of the 281,000 fire incidents. All equipment was said to be working properly before the fire.

Item first ignited in unattended heating and cooling equipment-related fires is shown in table 7-15.

[165] See notes for Table 7-14.
[166] Audits and Surveys (1985), *op cit.,* page 47, Table 6-12.
[167] The survey question was, "What kind of fuel/source of power did it use?" The individual's response was then recorded verbatim, without presenting the individual with a list of likely fuel/power types.

Table 7-15
Item First Ignited in Unattended Residential
Heating and Cooling Equipment Fires
(Thousands of Fires)

| Item | Number of Fires | Percent |
|---|---|---|
| All heating and cooling | 281 | 100.0 |
| Electrical wire | 114 | 40.5 |
| Appliance | 80 | 28.6 |
| Other | 87 | 30.9 |

Notes: See notes for Table 7-1. *Other* includes paper, no item first ignited reported, household utensils, and linens. Estimated CVs for fires in thousands: 150, 74.5 percent; 300, 61.7 percent.

Heating and cooling equipment fires ignited electrical wire, possibly attached to the appliance itself, in 114,000 fires (40.5 percent) and other parts of the appliance itself in 80,000 fires (28.6 percent). The remaining items first ignited were paper, household utensils, and linens. All fires where the items first ignited were appliances and household utensils involved fixed heating and cooling equipment such as central and fixed heating, water heaters, fireplaces, and stoves. When the item first ignited was specified, portable heater fires involved only electrical wire as the item first ignited.

Flame damage was reported as "none" in an estimated 194,000 incidents (69 percent). Only fires associated with portable heaters were reported to have had flame damage spreading to several items (30,000 estimated incidents). An estimated 57,000 incidents involved flame damage confined to the first item ignited. In 219,000 incidents (78 percent), there was no smoke damage reported. Of the remaining 61,000 incidents, there was little smoke damage or the smoke damage was confined to the room of origin. No property damage was reported in 193,000 incidents (69 percent). Damage was reported as between $10 and $100 in 30,000 incidents (11 percent) and over $100 in 57,000 incidents (20 percent).

There were less than 200 injuries estimated to have occurred in heating and cooling equipment-related fire incidents.

*Other Household Appliances*

Table 7-16 shows the estimated number of fires associated with other household appliances. This category ranked third as the heat source in unattended fires, behind cooking appliances and open flames, with an estimated 651,000 fires or 9 percent of the total unattended fires. This was an 84.4 percent decrease from the 1984 survey where an estimated 2.03 million fires involved other household appliances.[168]

Table 7-16
Sources of Heat for Other Household Appliances Involved
in Unattended Residential Fires
(Thousands of Fires)

| Source of Heat | Number of Fires | Percent | Percentage Decrease from 1984 Survey |
|---|---|---|---|
| All other household appliances | 651 | 100.0 | 84.4 |
| Personal grooming equipment | 234 | 35.9 | |
| Home office equipment | 90 | 13.8 | 33.4 |
| Clothes washer | 75 | 11.5 | 89.6 |
| Humidifier | 70 | 10.8 | |
| Iron | 60 | 9.2 | 89.4 |
| Refrigerator or freezer | 37 | 5.7 | 77.9 |
| Home entertainment | 23 | 3.6 | 95.2 |
| Unspecified | 62 | 9.5 | |

Notes: See notes for Table 7-1. Also, *Unspecified* includes the responses "don't know" and "other household appliances." Estimated CVs for fires in thousands: 150, 74.5 percent; 250, 65.7 percent; 650, 42.2 percent.

The largest number of fires involved personal grooming appliances such as hair dryers, curling irons, etc. These appliances were associated with an estimated 234,000 fires, more than one-third of the other household appliance-related incidents. There were 90,000 fires involving home office equipment (personal computers, printers, faxes, etc.), accounting for 13.8 percent of incidents; clothes washers involved 75,000 fires (11.5 percent), and humidifiers involved 70,000 fires (10.8 percent).

[168] Audits and Surveys (1985), *op cit.*, page 37, Table 6-3. In the 1984 survey, other appliances (TVs, radios, dryers, washers, and tools) accounted for 1,891,000 fires and air conditioning and refrigeration accounted for 143,000 fires.

Fire incidents involving other household appliances declined 84.4 percent between the two surveys, a larger decline than the 69.3 percent decline for unattended fires in general. The decrease in the number of fires in home entertainment equipment, clothes washers, irons, refrigerator/freezers, clothes dryers, vacuum cleaners, and power tools contributed to the decline. The single category not following this trend was home office equipment where the reduction was about one-third. The lower decline might have been a result of the proliferation of personal computers and other office equipment in residences.

Table 7-17 shows the distribution of items first ignited in the other appliance fires.

Table 7-17
Item First Ignited in Unattended
Residential Fires Involving Other Appliances
(Thousands of Fires)

| Item | Number of Fires | Percent |
|---|---|---|
| All | 651 | 100.0 |
| Appliance casing | 406 | 62.4 |
| No item reported | 185 | 28.4 |
| Floor covering | 60 | 9.2 |

Notes: See notes for Table 7-1. Estimated CVs for fires in thousands: 150, 74.5 percent; 400, 54.3 percent; 650, 42.2 percent.

Table 7-17 shows that in most of the incidents, the item first ignited was the appliance itself. Floor coverings, primarily rugs, were the items first ignited in 9.2 percent of the incidents, representing 60,000 fires.

All appliances described in Table 7-17 were powered by electricity. In all the incidents, the survey respondents reported that the appliances had been working properly before the fire.

In 484,000 incidents (74 percent), there was no flame damage, while in the remaining 167,000 incidents; the flame damage was confined to the item that was ignited first or the appliance itself. The incidents with flame damage were approximately equally divided among fires involving personal grooming equipment, irons, and the “don’t know” category.

Smoke damage estimates were similar. In 506,000 incidents (78 percent), there was no smoke damage; in 70,000 incidents (11 percent), the smoke damage was confined to the room of origin; and in 74,000 incidents (11 percent), the smoke damage spread to another room or area. Only fires involving clothes washers and humidifiers produced smoke damage to the room of origin or to another room.

In 561,000 incidents (86 percent), there was some property damage. No property damage was reported for 90,000 incidents (14 percent). Property damage was between $1 and $100 in 365,000 incidents (56 percent). Property damage over $100 was reported for 196,000 incidents (30 percent). Fires involving home entertainment systems, refrigerators or freezers, and clothes washers had property damage of $100.

There were no injuries reported in any of these incidents.

### *Cigarette and Small Open Flame Fires*[169]

Table 7-18 shows the distribution of heat sources for cigarette and small open flame fires. The table does not show the percentage decrease from the 1984 survey because that survey did not report on the number of fires associated with cigarette and small open flame heat sources.

[169] This is the first and only detailed section on non-appliance fires in this chapter. In addition to the cigarette and small open flame heat sources, there were an estimated 47,000 fires that began outside the house and spread to the house and 17,000 fires where the heat source was not specified. Neither of these categories had a sufficient estimated number of fires to warrant more detailed breakdowns in the chapter.

Table 7-18
Unattended Residential Cigarette
and Small Open Flame Fires
(Thousands of Fires)

| Source of Heat | Number of Fires | Percent |
|---|---|---|
| All small open flame and cigarettes | 900 | 100.0 |
| Candle | 465 | 51.6 |
| Cigarette | 155 | 17.2 |
| Lighter | 140 | 15.6 |
| Match | 84 | 9.4 |
| Other open flame | 55 | 6.1 |

Notes: See notes for Table 7-1. Also, *Other open flame* includes torch, spark from fireplace, and other unspecified open flame sources. Estimated CVs for fires in thousands: 150, 74.5 percent; 450, 51.0 percent; 900, 28.9 percent.

Table 7-18 shows that the largest proportion of incidents, slightly more than half at 465,000, involved candles. Lighters and cigarettes accounted collectively for almost 300,000 fires, while matches were the source of heat in 84,000 incidents.

Children under 10 started an estimated 35,000 small open flame and cigarette fires (3.8 percent). No incidents were started by children under 5. An estimated 30,000 fires involved lighters and the remainder involved other open flames including torches, matches, and unspecified heat sources.

Table 7-19 shows the distribution of item first ignited in unattended cigarette and small open flame-related fires.

Table 7-19
Item First Ignited in Unattended Residential
Cigarette and Small Open Flame Fires
(Thousands of Fires)

| Item | Number of Fires | Percent |
|---|---|---|
| All cigarettes | 155 | 100.0 |
| Bedding | 74 | 47.7 |
| Other | 81 | 52.3 |
| All open flame | 744 | 100.0 |
| Paper | 169 | 22.7 |
| No item reported | 161 | 21.7 |
| Decoration | 73 | 9.8 |
| Cabinetry | 72 | 9.6 |
| Other | 270 | 36.3 |

Notes: See notes for Table 7-1. The category *Other*, under *All cigarettes*, includes heavy vegetation, paper, rubbish, and floor coverings. The category *Other*, under *All open flame*, includes light vegetation, clothing, linens, appliance casings, cooking materials, and other items. Estimated CVs for fires in thousands: 150, 74.5 percent; 400, 54.3 percent; 700, 37.2 percent.

Table 7-19 shows cigarette fires and small open flame fires separately because the patterns of items first ignited are different for the different types of heat sources.

For fires involving cigarettes as the heat source, the largest single category of item first ignited was bedding at 74,000 incidents (47.7 percent). In incidents where the heat sources involved open flame, the largest single category of item first ignited was paper, at 169,000 incidents, accounting for 22.7 percent of the open flame incidents, followed by no item reported at an estimated 161,000 incidents.

In the 465,000 estimated candle fires, there was no reported flame damage in 156,000 fires, the flame damage was confined to the first item ignited in 240,000 fires, the flame damage involved several items in 33,000 fires, and the whole room in 36,000 fires. There was no smoke damage in 356,000 candle fires, a little smoke damage in 72,000 candle fires, and smoke damage in the room of origin in 36,000 candle fires. In 246,000 candle fires, there was no reported dollar amount of property damage. In 67,000 incidents, damage was $100 or more, damage was between $10 and $99 in 52,000 incidents, and between $1 and $9 in 69,000 incidents.

With respect to fires associated with lighters, for an estimated 127,000 fires, survey respondents reported that there was no flame damage. In the remaining incidents, 13,000 fires, the flame damage involved only the item first ignited. None of the lighter fires produced any smoke damage. Also, most fire incidents, 127,000, did not result in any property damage, although 3,000 fires had estimated losses between $1 and $9 and 10,000 fires had losses between $10 and $99.

Cigarette-related fires had no flame damage in one-third of the incidents (52,000 fires), flame damage to only the item first ignited in 100,000 fires, and flame damage to several items in 3,000 fires. Smoke damage was split almost 50-50 between none (80,000 incidents) and to the room of origin (75,000 incidents). More than two-thirds of the incidents, 106,000 fires, had no reported dollar loss from the fire, while for 17,000 incidents, reported dollar losses were greater than $100, 17,000 reported losses between $10 and $99, and 15,000 incidents involved losses under $10.

Incidents involving matches resulted in flame damage to the first item ignited and no smoke damage in all 84,000 incidents. No property damage was reported in 29,000 incidents (34 percent), and respondents did not know the amount of damage in the remaining incidents. For incidents involving other open flame heat sources, no flame damage was reported in 29,000 of the 55,000 incidents, damage to the first item in 23,000 incidents, and to the outside of the house in 3,000 incidents (fires starting outside the house). There was no smoke damage in 31,000 incidents, a little smoke damage in 23,000 incidents, and damage to the outside of the house in 1,000 incidents. Property damage was reported as none for an estimated 9,000 fires, $1-9 for 3,000 fires, and $10-99 for 42,000 fires.

Three percent of the incidents (27,000) involved injuries. In 24,000 of these incidents, no medical attention was required, while in 3,000 incidents, first aid at the scene was required. All the injuries were burns. In these injury incidents, 24,000 fires were started with matches, while in the remaining 3,000 incidents, a lighter was the heat source.

## Conclusion

The analysis in this chapter used the same methodology as that used in Chapters 3 and 6, by using low severity incidents in the 14-day recall period and high severity incidents in the 21-day recall period and then scaling to a calendar year.

The only departure from this methodology was when comparing the estimated number of fires with the estimates in the 1984 survey. Similar to the 1984 survey, the comparison statistics used the entire three-month recall period, scaled to the total number of fires from the 14/21-day recall period. As pointed out earlier in this chapter and as fully developed in Chapter 3, there is evidence that survey respondents tend to remember incidents of greater severity longer than incidents with less severity. As a result, the data

from the three-month recall period in either survey is weighted toward more serious incidents than would be found in a general sample of fires.

Because the three-month recall period is weighted toward more serious incidents, neither survey used the three-month recall period for making estimates of annual fire incidence. However, the 1984 survey used the three-month period for analysis of the types of fires. The reasoning for that choice of period was not stated in their report, but it was probably motivated by the need to obtain an adequate sample size for the more detailed analyses. In order to compare the results from the two surveys, it is necessary to use data from the current survey covering the same period. Otherwise, everything else being equal, comparing a 14/21-day survey to a three-month survey, the 14/21-day survey would show, on average, less severe fires and lower fire losses. In order to avoid that apparent artifactual decline in severity, it was necessary to develop a second set of estimates in the current survey based on the three-month period but scaled to the calendar year. This was essentially the same procedure used for the 1984 survey, and the estimates should then be comparable. These three-month estimates are used only for computing the percentage change in fire incidents. The estimated number of fires based on the three-month recall period using the current survey does not appear anywhere in the chapter.

Using these comparable three-month estimates in this chapter, it was estimated that there was a 69.3 percent decrease in the number of fire department-unattended fires between 1984 and 2004. The decrease in the number of cooking appliance-related fires was slightly less, at 63.3 percent. However, as cooking fires represent about two-thirds of the incidents, the decline in cooking fires explains a large part of the decrease in total incidents.

Other household appliance fires declined 84.4 percent, and heating and cooling equipment fires declined 69.0 percent. Electrical lighting and wiring fires did not decline as much, at 51.7 percent of the 1984 incidents. Because the 1984 survey did not present estimates of fires associated with smoking materials and open flames, it is not possible to calculate the decrease in the number of fires; but it seems likely that the decrease was at least as large as the overall decrease of 69.3 percent, and perhaps considerably more. One clue is that the 1984 survey presented estimates for the number of non-appliance fires, a category that included smoking and small open flame fires. Using that estimate, it was possible to show that there was an 84.0 percent decrease in non-appliance fires. Some of that decrease was undoubtedly due to decreases in smoking and small open flame fires, which in turn were likely to be related to decreases in smoking in the population.

Similar to the 1984 survey, most of the 7.2 million fires that were not attended by fire departments occurred in kitchens and most involved cooking appliances. Unattended fires resulted in an estimated 130,000 injuries, most frequently burns. Most injuries did not require medical attention; for those that did, first aid at the scene was the most frequently reported treatment. In 9,600 incidents, residents had to leave the home for a night or more because of the fire but in all cases were able to return within a week. The

7.2 million incidents resulted in an estimated $612 million in property damage and loss from the fire.

About 81 percent of the 4.7 million cooking appliance-related fires involved ranges or stoves, with about twice as many electric range fires as gas range fires. As there are more electric stoves in use in the population, such a result was not unexpected. Correcting for the number of stoves by fuel type, the fire risk factors were estimated at 3.8 electric stove fires per 100 households and 2.6 gas stove fires per 100 households. It is worth noting that the increased fire risk associated with electric stoves is consistent with official statistics on fire department-attended fires. Official statistics also show that electric stove fires have a higher risk of injury and property loss but a lower risk of death.

After range fires, microwave ovens accounted for 7.1 percent of the cooking appliance fires; and toaster oven fires accounted for 4.5 percent of these incidents. The most frequently mentioned item first ignited was cooking materials (foodstuffs, grease, etc.) at 83.2 percent of the incidents, with linens (dish towels, pot holders, table cloths) second at 6.2 percent. The estimated total dollar loss from cooking fires was $328 million.

After cooking appliances, open flame and cigarette fires were the next largest category, accounting for an estimated 900,000 incidents. With open flame fires, paper was the most frequently mentioned item first ignited, while cigarette fires most frequently ignited bedding. Cigarette fires involved $2.6 million in property loss, while open flame incidents involved $19 million. The average loss in these incidents was the lowest of all the heat source categories.

There were 651,000 household appliance fires, involving $158 million in property damage. Appliances such as dishwashers, clothes washers and dryers, TVs, home entertainment equipment, computers, and home office equipment averaged $243 per incident in losses, the largest average loss per fire. Household appliance fires decreased 84.4 percent from the 1984 survey, the largest percentage decrease among the different types of equipment involved in fires. This finding is noteworthy because there are many more of household appliances in the home now than there were in 1984.

Electrical lighting and wiring fires accounted for 616,000 incidents and $43 million in fire losses. There was a 51.7 percent decrease in the number of incidents between the two surveys, the smallest percentage decrease observed among different categories of equipment. Heating and cooling equipment fires involved 281,000 incidents and $51 million in losses. There was a 69.5 percent decrease in the number of incidents from the 1984 survey, just about the same percentage as all incidents.

To conclude, numerically, the largest drop in fire department-unattended fires between the two surveys was in fires associated with cooking equipment. There were over 12,000,000 fire department-unattended cooking equipment related-fires in 1984, which was more than the total number of fire department-unattended fires in the 2004 survey. In percentage terms, non-appliance fires decreased almost 84 percent from 2004,

almost 20 percentage points more than appliance fires. The 1984 survey did not present estimates for the number of cigarette fires, but there is a strong possibility that much of that decline in these types of fires was associated with decreases in the number of cigarette fires, which in turn was probably associated with decreases in the number of smokers over the last 20 years.

## Appendix to Chapter 7

### Calculation of the Percentage Change Between the 2004 Survey and the 1984 Survey

Several tables in this chapter show the percentage changes in the estimated number of unattended fires between the current survey and the 1984 survey. As mentioned in the text, estimates of the number of equipment specific fires in the 1984 survey used a different procedure than the estimate for total fires. The purpose of this appendix is to describe the methodology and the similar methodology used in the 2004 survey that was used to compare estimates.

The key difference from the 1984 survey was that the estimate of total fires in that survey was based on a one-month recall period, but the estimate of equipment specific fires was based on a three-month recall period. To take into account that respondents may have forgotten incidents occurring earlier in the recall period, the authors of the 1984 survey scaled the incidents to the total estimated from the one-month period. This corrects for some forgotten incidents but it does not take into account the problem that incidents of lesser severity are less likely to be recalled. As a result, the mixture of types of fires over a three-month period is likely to have fires of greater severity than those in the one-month period.

As a result, comparing equipment specific fires in the 1984 survey with those in the 2004 survey based on the 14/21-day recall period would be likely to show a decrease in incident severity. That decrease would be an artifact of two different recall periods, not necessarily a true decrease in severity.

The solution used in this chapter was to compare estimates calculated in the same way. The comparable estimates from the 2004 survey were calculated by using the full three-month period, but scaling to the total based on the 14/21 day recall period. However, this creates two estimates for every category, one estimate based on the 14/21-day recall period, believed to be the most accurate, and the other based on the three-month period, the most comparable. To avoid confusing the reader with two different sets of fire estimates, the comparable estimate is used only to compute the percentage change between the 1984 and 2004 survey. The comparable estimates are not shown in this chapter.

The percentage change between the two surveys is computed as follows:

Pct Change = 100 * (1 – 2004 survey estimate/1984 survey estimate)

where the 2004 survey estimate is computed on the basis of the full three-month period, scaled to the 2004 annual estimates from the 14/21-day recall period analysis.

The example below shows how some of the percentage changes were computed in Table 7-2 in the chapter.

Table 7A-1
Changes in Selected Appliance Categories

| Equipment | 2004 Best Estimate | 2004 Comparable Estimate | 1984 Survey Estimate | Percent Change from 1984 Survey |
|---|---|---|---|---|
| All fires | 7,176 | 6,854 | 22,322 | 69.3 |
| Cooking appliances | 4,664 | 4,533 | 12,344 | 63.3 |
| Other household appliances | 651 | 316 | 2,034 | 84.4 |
| Electrical lighting and wiring | 616 | 430 | 890 | 51.7 |
| Heating and cooling | 281 | 233 | 763 | 69.5 |

Column 2 in Table 7A-1 (2004 Best Estimate) shows the estimated number of fires appearing in Table 7-2 in the text. These were computed using the 14/21-day recall period scaled to the calendar year. The next column (2004 Comparable Estimate) shows the 2004 estimates that were comparable to the 1984 survey. The 2004 Comparable Estimate does not appear anywhere in the chapter, to avoid confusing the reader with estimates that are believed to be less accurate. It is used only to calculate the Percent Change that appears in chapter tables.

## Chapter 8
## Operation and Effectiveness of Smoke Alarms and Fire Extinguishers

Having characterized fire households and residential fires in previous chapters, this chapter investigates how residents became aware of fires and how these fires were extinguished. This involves examining the role of smoke alarms and fire extinguishers in residential fires.

As shown in Chapter 5, smoke alarms have become almost universal in homes, with an estimated 96.7 percent of U.S. households having at least one smoke alarm.[170] This is a substantial increase from the mid-1970s where alarm prevalence was about 20 percent, 62 percent of households in 1984, and 84 percent in the mid-1990s.[171] As many have noted, smoke alarms are an inexpensive method of providing early warning in residential fires. This can translate into saving lives and preventing injuries. According to the NFPA, the death rate in fire department-attended home structure fires was twice as high in homes fires where no smoke alarm was present as compared with home fires where an alarm was present.[172]

This chapter explores two issues about smoke alarms. After looking at how residents became aware of a fire, including because of an alarm sounding, the chapter then characterizes how alarms operated in various fire scenarios. The benefits from smoke alarm operation follow in increasing order:

- The smoke alarm sounds
- The smoke alarm alerts household members to the fire
- When the alarm sounds, it provides the only alert of the fire

If the alarm alerted people at the same time as some other event, such as a household member smelling smoke, the alarm may have provided a benefit by confirming the existence of the fire. If the alarm provided the only alert of the fire, then the alarm is of even greater benefit by providing an earlier warning of the fire. This can allow household members to put their escape plans into action earlier or apply some other strategy.

The second issue about alarms concerns the reasons why alarms did not operate during residential fires. This first requires determining if enough smoke reached the alarm so that it should have operated. After establishing that the alarm should have operated, according to the survey respondent, the remaining focus is on the condition of

[170] This was 96.8 percent of non-fire households and 92.7 percent of fire households.
[171] Ahrens M (2007b), *op cit.* Ballesteros M, Kresnow MJ, (2007), "Prevalence of Residential Smoke Alarms and Fire Escape Plans in the U.S: Results from the Second Injury Control and Risk Survey (ICARIS-2)," *Public Health Reports*, Vol. 122, pp. 224-231. Audits and Surveys (1985), *op cit.,* page 53. Market Facts (1993), "Smoke Detector Operability Study Final Report," Washington, DC, page 7. Smith CL (1994), "Smoke Detector Operability Survey, Report on Findings," U.S. Consumer Product Safety Commission, Bethesda, MD.
[172] Ahrens (2007b), *op cit.,* page 18.

the alarm, including the respondent's perception of whether the alarm was in working order and when it was last tested.

The chapter then addresses how the fire was put out and the usage of fire extinguishers, especially focusing on whether the extinguishers operated when residents tried to use them. Different from smoke alarms, the use of fire extinguishers to fight fires is controversial because such actions might cause occupants to delay leaving the residence.[173]

Following a brief description of the methods, the chapter then begins with an overview of how residents were alerted to the fire (smoke alarms), and how the fire was put out (fire extinguishers). Specific types of fires are then considered in subsequent sections. The chapter concludes with a discussion section.

## Methods

Like the previous two chapters and Chapter 3, the unit of analysis in this chapter is fires using the annual fire incidence rates based on the 14- and 21-day recall periods. From the analysis in Chapter 3, this involves an estimated 7.43 million fires, of which 254,000 were attended by fire services and 7.18 million were unattended.

For the most part, the analyses in the chapter use the percentage of total incidents, rather than percentages conditional on some other factor. For example, when considering if a smoke alarm alerted people to a fire, the percent of such cases is computed as the estimated number of incidents where the alarm alerted people divided by the estimated total fire incidents. In order for an alarm to have alerted people, a number of events must have occurred as follows: someone was home, there was an installed smoke alarm, the alarm was in working order, enough smoke must have reached the alarm, the alarm sounded, and someone heard it. Thus, the percent of such cases is an estimate for the joint probability that all these events occurred. Another type of computation is the conditional probability of an alarm alerting someone given that someone was home and the alarm sounded. This would be computed from the estimated number of fire incidents where the alarm alerted people divided by the estimated number of fire incidents where people were home, an alarm was present, and the alarm sounded.

This report presents the first computation, because that represents the overall benefit of the alarm. Readers who prefer the second computation will find enough information in the tables to estimate those probabilities.

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[173] According to the NFPA, "… A portable fire extinguisher can save lives and property by putting out a small fire or containing it until the fire department arrives; but portable extinguishers have limitations. Because fire grows and spreads so rapidly, the number one priority for residents is to get out safely…" From the fact sheet on fire extinguishers: http://www.nfpa.org/itemDetail.asp?categoryID=277&itemID=18264&URL=Research%20&%20Reports/Fact%20sheets/Fire%20protection%20equipment/Fire%20extinguishers

The tables in this chapter look different from the other tables in this report because, for the most part, they contain only percentages. This is to facilitate comparisons of smoke alarm and extinguisher operation for different types of fires, (e.g., attended or unattended fires, kitchen or living room fires, etc.). Every table presents the estimated total number of fires, allowing the reader to reconstruct the estimated number of fires in any particular table cell, if desired.

Different from the last two chapters, the tables in this chapter do not contain coefficients of variation (CV). As shown in the appendix to Chapter 6, the CV is inversely proportional to the estimated number of fires. Estimates of appropriate CVs are available from the tables in the appendix to Chapter 6 after the percentages are converted to the estimated number of fires.

The survey questionnaire requested information on the respondents' fire losses, some of which were presented in earlier chapters. These include information on injuries, time away from home, lost time from work, flame damage, smoke damage, and dollar value of property damage. It is tempting to try to relate the fire losses to how the smoke alarm or fire extinguisher operated during the incident. Everything else being constant, one would think that incidents in which the alarm operated would have fewer fire losses than in those fires where the alarm did not operate. However, everything cannot be held constant. In particular, smoke alarm operation and use of an extinguisher may indicate a more serious fire than when the alarm did not operate and when the extinguisher was not needed. Because of this, Chapter 8 does not relate alarm operation or extinguisher operation to fire losses, and such an analysis is discouraged.[174]

Each section in this chapter presents estimates in a series of five tables. The first three tables contain information on smoke alarms. These are as follows:

Method of Discovery of the Fire
Smoke Alarm Operation
Reasons for Non-operating Smoke Alarms

The remaining two tables address extinguishers. These are as follows:

How the Fire Was Extinguished
Location and Use of the Fire Extinguisher

These sets of tables are presented for a number of different scenarios. The first set of tables includes all fire incidents, contrasting between fire department-attended and unattended incidents. All the remaining tables in the chapter are for unattended fires only. The next set of tables is by the area of fire origin (where the fire began), followed

[174] It is also problematical to relate the presence of smoke alarms to fire losses. First, most of the residences in the survey had smoke alarms, resulting in a small sample size and imprecise estimates for fires in residences without smoke alarms. Second, residences that do not have smoke alarms may be different from those that do in ways that are related to the type of fire and fire damage. Thus, the presence of smoke alarms and fire extinguishers may be a proxy for some other variable associated with fires.

by heat source (appliance fires first and non-appliance fires second), then finally by the different smoke alarm configurations in residences.

As in previous chapters, all computations were made using the SAS® software system. Unless otherwise noted, the data are based on the 14- and 21-day recall periods developed in Chapter 3. Missing dates are imputed using the multiple imputation procedure from Chapter 3. All the cases are weighted by the appropriate sampling weights to provide national level annual estimates. When it is desirable in this chapter to compare results with the 1984 survey, estimates are made based on the full three-month recall period scaled to the annual estimates based on the 14/21-day totals in the same way as was done in Chapter 6. The text notes when estimates are based on the three-month period.

## Results

### *Overview: All Incidents*

This section considers all fire incidents, examining smoke alarm and extinguisher performance in fire department-attended and unattended incidents. As shown in Chapter 6, more than two-thirds of fire incidents began in the kitchen. As a result, the estimates in summary tables are dominated by cooking fires. Later tables in the chapter contrast smoke alarm and extinguisher use in cooking and non-cooking fire incidents.

Table 8-1 presents the method of discovery for all fires, unattended fires, and attended fires.

Table 8-1
Method of Discovery by Attended and Unattended Fires
(Percent of Fires)

| Method of Discovery | All Fires | Unattended Fires | Attended Fires |
|---|---|---|---|
| Nobody home | 4.0 | 2.8 | 38.9 |
| Person present at fire origin | 22.7 | 23.2 | 8.9 |
| Other evidence of fire | | | |
| Smelled smoke | 18.2 | 18.9 | - |
| Saw flames | 16.0 | 16.6 | - |
| Saw smoke | 14.3 | 14.0 | 23.7 |
| Heard fire | 3.1 | 3.2 | - |
| Felt heat | 1.7 | 1.8 | - |
| Smoke alarm alerted people | 11.8 | 11.8 | 12.5 |
| Someone else provided an alert | 3.6 | 3.8 | - |
| Something else provided an alert | 1.3 | 0.8 | 15.7 |
| *Estimated number of fires (thousands)* | *7,430* | *7,176* | *254* |

Notes: Multiple responses were permitted to the survey questions about how residents discovered a fire. The table omits responses associated with a small number of incidents where the respondent said they did not know or refused to answer how the fire was discovered; in general, the "refused" and "don't know" responses are not included in tables. When respondents reported nobody was at home, no further questions were posed to them about the fire incident. Detail lines may not sum to 100 percent due to rounding, multiple responses, or omission of "refused" and "don't know" responses. Estimated percentages are based on the total number of fires shown in the last row of the table, i.e., 7.43 million, 7.176 million unattended fires and 254,000 attended fires. Dashes (-) indicate estimates of 0 (zero) percent from the data, but the dashes indicate that the population percent may be greater than zero.

Table 8-1 describes how people discovered that there was a fire. In that table, for the estimated 7.4 million residential fires, nobody was home in 4.0 percent of incidents; thus, someone was at home in the other 96.0 percent of incidents. When nobody was home, it would have been impossible for respondents to answer the remaining questions about whether the alarm sounded, what alerted them to the fire, etc. Consequently, when the survey respondent indicated that nobody was home when the fire started, questions about the alarm sounding and notifying residents were skipped. Thus, it is possible that fires where nobody was home had sounding alarms, or even alarms that alerted neighbors or bystanders.

In Table 8-1, the responses about method of discovery of the fire were very different for fire department-attended and unattended fires. Nobody was home in 38.9 percent of fire department-attended fires in contrast to nobody home in 2.8 percent of unattended fires. Fires that started when nobody was home were qualitatively different from fires started with a resident at home. For example, when someone was home at the time of the fire, 66.5 percent of the fire incidents involved a cooking appliance, 8.6 percent involved electrical lighting or electrical wiring, 8.6 percent involved another household appliance, 5.6 percent involved a candle and 3.2 percent involved heating or cooling equipment. In contrast, when nobody was home when the fire started, 32.7 percent involved heating or cooling equipment, 22.7 percent involved a candle, 20.3 percent involved another household appliance, and 5.7 percent involved cooking appliances. Similar differences might also be expected in the room of fire origin and the item first ignited.

As shown Table 8-1, in 22.7 percent of incidents, someone was present at the fire when it started. Respondents indicated that they smelled smoke in 18.2 percent of fires, saw flames in 16.0 percent, saw smoke in 14.3 percent, and heard or felt the fire in 4.8 percent of incidents. Respondents indicated that in 11.8 percent of fires, the smoke alarm alerted them to the fire. Other means of alerting people to the fire included another household member telling the respondent about the fire, or something else (unspecified) provided the alert of the fire.

For those incidents when people were home at the time of the fire, people were alerted to the fire by the smoke alarm (possibly in combination with other evidence of fire) in 11.8 percent of the fires. Conditional on someone being home, people were alerted by the alarm in 12.1 percent of unattended fires and in 20.5 percent of attended fires.[175]

Table 8-2 describes further how the smoke alarm operated during the fire.

[175] Calculated from the estimated number of fires. Similar calculations can be made from Table 8-1. First note that for unattended fires, someone was home in (100 - 2.8 =) 97.2 percent of incidents and for attended fires someone was at home in (100 - 38.9 =) 61.1 percent. Then the smoke alarm alerted people conditional on someone home in (11.8 / 97.2 =) 12.1 percent for unattended fires and (12.5 / 61.1 =) 20.5 percent for attended fires.

Table 8-2
Smoke Alarm Operation by Attended and Unattended Fires
(Percent of Fires)

| Smoke Alarm Operation | All Fires | Unattended Fires | Attended Fires |
|---|---|---|---|
| When the fire started | | | |
| Someone was at home | 96.0 | 97.2 | 61.1 |
| Nobody was home | 4.0 | 2.8 | 38.9 |
| If someone was home | | | |
| There was a smoke alarm | 85.6 | 86.4 | 61.1 |
| There was no smoke alarm | 9.7 | 10.1 | 0.0 |
| If there was a smoke alarm and someone home | | | |
| The alarm sounded | 30.3 | 30.0 | 40.0 |
| The alarm did not sound | 55.2 | 56.5 | 20.7 |
| If people were home and the alarm sounded | | | |
| It alerted people to the fire | 11.8 | 11.8 | 12.5 |
| Something else alerted people | 18.5 | 18.2 | 27.5 |
| If the smoke alarm alerted people | | | |
| It provided the only alert | 9.8 | 9.7 | 12.5 |
| Something else also alerted people | 2.0 | 2.1 | 0.0 |
| *All Fires* | *7,430* | *7,176* | *254* |

Notes: See Table 8-1.

Table 8-2 shows that in 85.6 percent of fires (86.4 percent for unattended and 61.1 percent for attended), someone was home and there was at least one smoke alarm in the residence. When considering the presence of alarms alone, regardless of whether someone was home, the survey responses indicated that 88.6 percent of fires occurred in households that had alarms (88.4 percent for unattended fires and 93.9 percent for attended fires).[176] Thus the main distinction between attended and unattended fires is not so much the presence of alarms, but whether someone was at home during the fire.

[176] In Chapter 5, it was shown that 92.7 percent of fire households had at least one smoke alarm. There are two reasons for the difference between this number and the estimate that 88.6 percent of fires occurred in households that had alarms. First, the data in this chapter are based on fires, not households, so that households with more than one fire are counted more than once. Second, the analysis in Chapter 5 was based on all fire households, i.e. those with fires in the full 91-day period, while the statistics in this chapter are from households with fires in the 14- and 21-day recall periods. From this comparison it seems likely that households with higher fire household incidence rates are slightly less likely to have smoke alarms.

Table 8-2 also shows that someone was home and the smoke alarm sounded in 30.3 percent of incidents (30.0 percent unattended and 40.0 percent attended). Using calculations that are comparable to the 1984 survey, the alarms in the present survey sounded in 24 percent more unattended incidents and in 21 percent more attended incidents than as reported in the 1984 survey.[177]

As shown in both Table 8-1 and Table 8-2, the alarm alerted people to the fire in 11.8 percent of incidents. In 18.5 percent of incidents, something else also alerted people to the fire. In 9.8 percent of incidents, the sounding alarm was the only alert of the fire.

One measure of the benefit of smoke alarms may be seen in those 9.8 percent of incidents where the alarm provided the only alert. If the household did not have an alarm, it is not necessarily true that they would have been unaware of the fire, because the other alerting events shown in Table 8-1 might have occurred. However, the sounding alarm in those 9.8 percent of incidents may have provided the respondents with additional time to extinguish or contain the fire or to put escape plans into action.

Table 8-3 addresses the estimated 55.2 percent of fires (56.5 percent unattended and 20.7 percent attended) where the smoke alarm did not sound.

[177] The 1984 Residential Fire Survey (Audits and Surveys, 1985, *op cit.,* page 57) reported that the smoke alarm sounded in 30.2 percent of unreported residential fires when people were at home, and in 43.2 percent of reported fires when people were at home. These statistics cannot be compared with Table 8-2, because the 1984 survey statistics used the full three-month recall period, while Table 8-2 (like other tables in this chapter) uses the 14/21-day recall period. Comparable statistics from the present survey, using the full 91-day recall period, and conditioning on someone home, would be 38.4 percent of fires where the alarm sounded for all incidents, 37.5 percent of unattended fires, and 52.2 percent of fire department-attended fires. The percentage change for unattended incidents was computed as 100 * (0.375 / 0.302 – 1) = 24.1 percent. The comparable statistics from the current survey are presented to demonstrate the calculation. The best estimate of the proportion of alarms that sounded is based on the 14/21-day recall period and is shown above in the text. The methodology for computing the comparable statistics is explained in more depth in the Appendix to Chapter 7.

Table 8-3
Reasons for Non-operating Smoke Alarm by Attended and Unattended Fires
(Percent of Fires)

| Reasons for Non-operating | All Fires | Unattended Fires | Attended Fires |
|---|---|---|---|
| Someone was home, there was a smoke alarm, and the alarm did not sound | 55.2 | 56.5 | 20.7 |
| If alarm did not sound | | | |
| Enough smoke reached the alarm | 6.0 | 5.9 | 9.5 |
| Not enough smoke | 49.0 | 50.3 | 11.2 |
| If enough smoke reached the alarm | | | |
| Alarm was in working order | 5.4 | 5.2 | 9.5 |
| Alarm was not in working order | 0.6 | 0.7 | - |
| Alarm tested last | | | |
| Less than a month before the fire | 11.5 | 11.6 | 11.2 |
| 1-6 months before | 28.3 | 28.9 | 8.9 |
| 7-12 months before | 6.5 | 6.8 | 0.6 |
| One year or more before | 5.7 | 5.9 | - |
| Alarm has not been tested | 2.0 | 2.1 | - |
| *Estimated number of fires (thousands)* | *7,430* | *7,176* | *254* |

Notes: See Table 8-1. Note that all questions in this table were skipped if respondents reported that the smoke alarm alerted people to the fire. Missing responses are omitted from the table.

In more than half the unattended fires, as shown in Table 8-3, the alarm did not sound, probably in keeping with the small nature of the fire, when discovered. For most unattended fires where the alarm did not sound, the survey respondents believed that not enough smoke reached the alarm. This is in keeping with most such fires being small. For attended fires, in slightly less than half the fires, respondents believed that enough smoke reached the alarm, which is in keeping with the more serious nature of attended fire incidents. If enough smoke reached the alarm, respondents usually indicated that they believed that, before the fire, the alarm was in working order. Only a small fraction of respondents believed the alarm was not in working order.

Respondents who reported that the alarms did not operate were also asked when the alarms were tested last. Most indicated that they had tested the alarms during the last year.

Table 8-4 describes how fires were extinguished.

Table 8-4
How the Fire Was Extinguished by Attended and Unattended Fires
(Percent of Fires)

| Extinguishment Method | All Fires | Unattended Fires | Attended Fires |
|---|---|---|---|
| Nobody home | 4.0 | 2.8 | 38.9 |
| What was done to put out fire | | | |
| Put water on the fire | 18.7 | 19.2 | 4.1 |
| Turned off power to appliance | 18.0 | 18.3 | 9.8 |
| Smothered | 15.8 | 16.1 | 9.2 |
| Separated fuel from heat source, moved outside | 11.5 | 11.9 | - |
| Used baking soda, salt, flour, etc. | 6.6 | 6.8 | - |
| Blew out the fire | 6.2 | 6.4 | - |
| Used an extinguisher | 5.0 | 4.5 | 17.7 |
| Other | 2.2 | 2.2 | 2.5 |
| How was fire ultimately extinguished | | | |
| Fire department | 2.2 | - | 64.4 |
| Someone in the household | 77.7 | 79.7 | 23.5 |
| Went out by itself | 17.6 | 17.8 | 12.0 |
| Somebody else put it out | 1.9 | 2.0 | - |
| *Estimated number of fires (thousands)* | *7,430* | *7,176* | *254* |

Notes: Multiple responses were permitted for the questions, "What was done to put out the fire?" and "How was the fire ultimately extinguished?" Totals may not add to 100 percent because of multiple responses and omission of missing responses. Also see the notes following Table 8-1.

Table 8-4 shows that fire extinguishers were used in 5.0 percent of fire incidents (4.5 percent of unattended fires and 17.7 percent of attended fires). Fire extinguishers were much more likely to be used in attended fires than in unattended fires and, in particular, were the most frequent method used by residents to extinguish the fire in attended fires.[178]

In keeping with the observation that most fires started in the kitchen, putting water on a fire was the most frequent way that unattended fires were extinguished.

[178] In such cases the fire department may have arrived after the fire was extinguished. Fire departments typically will respond to such alarms even when the fire is reported as having been put out, to remove hazardous or hot materials, or to provide first aid and emergency transportation.

Removing power, separating from the heat source (including removing the pan from the stove), and smothering were also frequent methods.

Ultimately someone in the household extinguished the fire in 77.7 percent of fire incidents, it went out by itself in 17.6 percent of incidents, the fire department extinguished the fire in 2.2 percent of incidents, and someone else put it out in 1.9 percent of incidents.

Table 8-5
Location and Use of Fire Extinguisher by Attended and Unattended Fires
(Percent of Fires)

| Extinguisher Location and Use | All Fires | Unattended Fires | Attended Fires |
|---|---|---|---|
| Nobody home | 4.0 | 2.8 | 38.9 |
| Someone home and fire extinguisher available | | | |
| In same room where fire started | 32.1 | 32.8 | 12.5 |
| In a different room | 28.4 | 28.5 | 26.5 |
| No extinguisher present | 35.5 | 35.9 | 22.1 |
| Someone tried to use an extinguisher | | | |
| Extinguisher was in room where fire started | 3.2 | 3.4 | - |
| Extinguisher was in a different room | 1.7 | 1.2 | 17.7 |
| Results from using the extinguisher | | | |
| Put out the fire completely | 2.5 | 2.5 | 2.5 |
| Minimized but did not put out fire | 1.1 | 1.1 | - |
| Had little or no effect | 1.0 | 0.6 | 11.2 |
| *Estimated number of fires (thousands)* | *7,430* | *7,176* | *254* |

Note: Detail lines may not add to 100 percent because of omission of "missing" and "don't know" responses.

As shown in Table 8-5, in more than 60 percent of unattended fire incidents, residents were home and had fire extinguishers available. In slightly less than one-third of these incidents, the extinguishers were located in the same room as the fire. For attended fires where someone was home, in 12.5 percent of incidents the extinguisher was in the same room as the fire and 26.5 percent it was in a different room. The smaller percent of attended fires where there were extinguishers present (in either the same or different rooms) also results from a smaller percentage of people at home at the time of the fire for attended fires.

Table 8-5 also suggests that when the extinguisher was located in the same room where the fire started, it was more likely to be used than when it was located in a different room. When used in unattended fire incidents, the extinguisher was likely to put out the fire or minimize the fire in more than half the incidents. For the most part, fire extinguishers had little or no effect for fires that were ultimately attended by fire departments.

In the 1984 Residential Fire Survey, a home fire extinguisher was used in 4.7 percent of incidents. Fire extinguisher usage in the present survey represents a 51 percent increase over the previous survey. [179]

The remainder of this chapter considers only fires that were not attended by fire departments.

*Area of Fire Origin*

This section examines the issues of fire discovery and fire extinguishment for fires not attended by fire departments by the area where the fire began. Six areas were chosen for the tables in this section as follows: kitchen, living room, bedroom, bathroom, basement, and other areas. The other areas include the attic, dining room, laundry room, porch or deck, roof, siding, storage room, utility room, hallway, and every other place in the residence not otherwise classified. The reason for combining these areas was because no single area accounted for many incidents.

To some extent, the area where a fire began often suggested what the heat source and item first ignited were, although not always. For example, 91 percent of fires that started in the kitchen were cooking fires, i.e., involved the stove or some other cooking appliance as the heat source.[180] The area of fire origin also had some relationship to the proximity of the smoke alarm. For example, as shown in Chapter 5, smoke alarms are often in bedrooms. Smoke alarms are not often found in kitchens because steam and smoke can set off nuisance alarms.[181]

Table 8-6 shows how fires were discovered by the area of fire origin.

[179] Audits and Surveys (1985), *op cit.*, page 32. The comparable statistic based on the three-month recall period in the present survey is 7.1 percent for all fires (6.1 percent for fire department unattended and 18.6 percent for attended).
[180] Also 97 percent of cooking fires started in the kitchen.
[181] Smith CL (1994), *op cit.*

Table 8-6
Method of Discovery by Area Where Fire Began
(Percent of Unattended Fires)

| Method of Discovery | Kitchen | Living Room | Bed-room | Bath-room | Other Areas | Base-ment |
|---|---|---|---|---|---|---|
| Nobody home | 0.3 | - | 11.9 | 0.1 | 14.9 | 23.5 |
| Person present at fire origin | 24.2 | 45.4 | 3.8 | 42.2 | 3.0 | - |
| Other evidence of fire | | | | | | |
| Smelled smoke | 17.4 | 28.2 | 48.0 | 16.2 | 4.8 | - |
| Saw flames | 19.0 | 7.8 | 0.1 | - | 38.7 | - |
| Saw smoke | 15.6 | 24.1 | 3.0 | 10.7 | 7.0 | - |
| Heard fire | 1.9 | - | - | 30.8 | 0.1 | - |
| Felt heat | 1.7 | - | 8.7 | - | 0.2 | - |
| Smoke alarm alerted people | 14.9 | 0.3 | 11.6 | 0.8 | 2.1 | 12.4 |
| Someone else provided an alert | 4.0 | 10.3 | 3.7 | - | 0.2 | - |
| Something else provided an alert | 0.4 | - | 3.8 | - | - | 7.8 |
| *Estimated number of unattended fires (thousands)* | *4,987* | *530* | *505* | *438* | *517* | *199* |

Notes: See Table 8-1.

This table shows several different patterns in the methods of discovery of the fire. Almost half the living room and bathroom fires were discovered by a person present when the fire began. The person may have discovered the fire by smelling or seeing smoke or, with bathroom fires, hearing the fire. The smoke alarm rarely alerted residents to the fire incident, probably because neither room was likely to have an alarm installed.

In nearly one-quarter of the kitchen fires, someone was present at the fire origin. Like the living room and bathroom fires, in many cases residents were probably near enough to the kitchen to be aware of smoke, heat, or flames; but in other cases, they were not present at the origin of the fire. According to the literature, the leading factor resulting in fire department-attended cooking fires is unattended cooking.[182] In 14.9 percent of the kitchen fire incidents, residents reported that the smoke alarm alerted them to the fire.

[182] Ahrens M, Hall JR Jr., Comoletti J, Gamache S and LeBeau A (2007), "Behavioral Mitigation of Cooking Fires through Strategies Based on Statistical Analysis," FEMA, Washington, DC, page 2.

In fires originating in bedrooms, other areas, and the basement, residents were less likely to be home when the fire began. When residents were home, bedroom and other area fires provided other evidence such as the smell of smoke or seeing smoke or seeing flames. In contrast, residents were unlikely to become aware of basement fires from the presence of smoke, flames, or heat. Residents were more likely to be aware of basement fires from hearing the smoke alarm. Smoke alarms alerted people in 11.6 percent of bedroom fires and 12.4 percent of basement fires. This finding is likely to reflect where smoke alarms were located in residences.

Table 8-7 provides more detail on the operation of the smoke alarm during these fire incidents.

Table 8-7
Smoke Alarm Operation by Area Where Fire Began
(Percent of Unattended Fires)

| Smoke Alarm Operation | Kitchen | Living Room | Bed-room | Bath-room | Other Areas | Base-ment |
|---|---|---|---|---|---|---|
| When the fire started | | | | | | |
| Someone was at home | 99.7 | 100.0 | 88.1 | 99.9 | 85.1 | 76.5 |
| Nobody was home | 0.3 | - | 11.9 | 0.1 | 14.7 | 23.5 |
| If somebody was home | | | | | | |
| There was a smoke alarm | 89.5 | 99.1 | 76.8 | 99.9 | 67.8 | 20.3 |
| There was no smoke alarm | 9.6 | 0.9 | 11.3 | - | 13.5 | 56.2 |
| If there was a smoke alarm and someone home | | | | | | |
| The alarm sounded | 36.9 | 25.0 | 16.7 | 0.8 | 12.1 | 12.4 |
| The alarm did not sound | 52.5 | 74.1 | 60.1 | 99.1 | 55.7 | 7.8 |
| If people were home and the alarm sounded | | | | | | |
| It alerted people to the fire | 14.9 | 0.3 | 11.6 | 0.8 | 2.1 | 12.4 |
| It did not alert people to the fire | 22.0 | 24.7 | 5.1 | 0.0 | 10.0 | - |
| If the smoke alarm alerted people | | | | | | |
| It provided the only alert | 12.0 | 0.3 | 11.6 | 0.1 | 2.1 | 12.4 |
| Something else also alerted people | 2.9 | - | - | 0.8 | - | - |
| *Estimated number of unattended fires (thousands)* | *4,987* | *530* | *505* | *438* | *517* | *199* |

Notes: See Table 8-2.

In kitchen fires, as shown in Table 8-6, an alarm alerted people to a fire in 14.9 percent of incidents (also repeated in Table 8-7 above). Table 8-7 shows that people were at home and that there was a smoke alarm in 89.5 percent of residences where there was a kitchen fire, and the alarm sounded in 36.9 percent of these incidents. The alarm provided the only alert in 12 percent of the incidents. Thus, in slightly less than one-third of the kitchen fires where the alarm sounded, the alarm provided the only alert.

With respect to living room and bathroom fires, in neither case did the alarm typically alert people to the fire, but for different reasons. In living room fires, people were at home and the alarm sounded in 25 percent of the incidents; but aside from 0.3 percent of incidents, something else usually alerted residents. In bathroom fires, the alarm sounded in less than 1 percent of incidents.

In bedroom fires, the alarm sounded in 16.7 percent of incidents, alerting residents in 11.6 percent of incidents, more than two-thirds of the incidents where the alarm sounded. When residents were alerted by smoke alarms, it was the only alert of the fire.

In basement fires, someone was home and there was a smoke alarm in the residence in 20.3 percent of incidents. The alarm sounded in 12.4 percent of incidents, providing the only alert of the incident in every case where it sounded. In fires beginning in other areas, the alarm sounded in 12.1 percent of incidents, alerting people and providing the only alert in 2.1 percent of incidents.

Tables 8-6 and 8-7 provide some evidence of the importance of having alarms on all floors and in all bedrooms. In fires starting in the basement, smoke alarms were shown to have provided the only information of the existence of the fire. In fires starting in bedrooms, in 11.6 percent of incidents, smoke alarms alerted residents and in such cases, those were the only alerts. Further discussion about alarm location is included in the section on alarm configurations later in this chapter.

Tables 8-6 and 8-7 also provide some information about the relationship between where people were at the time of the fire, the location of the alarm, and whether the alarm alerted household members. Alarms were typically located in hallways, in basements, and in bedrooms. Alarms were rarely located in kitchens or bathrooms. When fires began in the basement, residents were rarely in that area; thus, other evidence of fire such as the smell of smoke or seeing or hearing the fire did not alert them to the fire. When the alarm sounded, it was the only alert. In contrast, in living room and bathroom fires, residents were present when the fire began in about half the incidents.

Table 8-8 describes the incidents where someone was home, there was an alarm present in the residence, but the alarm did not sound during the fire. As shown in Table 8-7, this occurred in about half of the kitchen fire incidents, half of the incidents in other areas, and half of the bedroom incidents. For living room fires, in almost three-quarters of the incidents the alarm did not sound, and it did not sound in almost all the fires starting in the bathroom.

Table 8-8
Reasons for Non-operating Smoke Alarm by Area Where Fire Began
(Percent of Unattended Fires)

| Reasons for Non-operating | Kitchen | Living Room | Bed-room | Bath-room | Other Areas | Base-ment |
|---|---|---|---|---|---|---|
| Someone was home and there was a smoke alarm in the residence | 52.5 | 74.1 | 60.1 | 99.1 | 55.7 | 7.8 |
| If alarm did not sound | | | | | | |
| Enough smoke reached the alarm | 8.3 | 1.1 | - | - | 0.2 | - |
| Not enough smoke | 43.8 | 73.0 | 60.1 | 99.1 | 55.5 | 7.8 |
| Don't know/refused | 0.4 | - | - | - | - | - |
| If enough smoke reached the alarm | | | | | | |
| Alarm was in working order | 7.4 | 1.1 | - | - | 0.2 | - |
| Alarm was not in working order | 0.9 | - | - | - | - | - |
| Alarm tested last | | | | | | |
| Less than a month before the fire | 8.7 | 14.0 | 15.8 | 28.6 | 22.3 | - |
| 1-6 months before | 27.9 | 24.7 | 26.5 | 70.5 | 18.2 | 7.8 |
| 7-12 months before | 5.4 | 10.2 | 16.9 | - | 15.0 | - |
| One year or more before | 6.6 | 17.1 | 0.9 | - | - | - |
| Alarm has not been tested | 2.1 | 8.0 | - | - | - | - |
| Don't know/refused | 1.7 | - | - | - | 0.1 | - |
| *Estimated number of unattended fires (thousands)* | *4,987* | *530* | *505* | *438* | *517* | *199* |

Notes: See Table 8-3.

Table 8-8 indicates that the most frequent reason why alarms did not sound was because insufficient smoke reached the alarms. The only situation where residents believed that sufficient smoke reached non-sounding alarms was in kitchen fires. As shown in previous tables, most residents believed that their alarms were in working order and most reported having tested their alarms during the previous year.

Tables 8-9 and 8-10 describe how fires were extinguished.

Table 8-9
How the Fire Was Extinguished by Area Where Fire Began
(Percent of Unattended Fires)

| Extinguishment Method | Kitchen | Living Room | Bed-room | Bath-room | Other Areas | Base-ment |
|---|---|---|---|---|---|---|
| Nobody home | 0.3 | - | 11.9 | 0.1 | 14.9 | 23.5 |
| What was done to put out fire | | | | | | |
| Put water on the fire | 20.8 | 31.7 | 3.8 | 0.6 | 29.2 | - |
| Turned off power to appliance | 17.0 | 30.1 | - | 52.2 | 7.9 | 20.3 |
| Smothered | 19.3 | 7.6 | 13.3 | 1.4 | 15.2 | - |
| Separated from heat source, moved outside | 12.6 | 0.8 | 28.2 | 16.0 | 1.0 | - |
| Used baking soda, salt, flour, etc. | 9.8 | - | - | - | 0.3 | - |
| Blew out the fire | 7.0 | - | 5.9 | - | 16.5 | - |
| Used an extinguisher | 5.2 | 0.5 | 8.6 | 0.1 | 4.0 | - |
| Other | 3.1 | - | - | 0.1 | - | 0.1 |
| How was fire ultimately extinguished | | | | | | |
| Someone in the household | 83.3 | 69.5 | 49.5 | 99.9 | 80.7 | 44.0 |
| Went out by itself | 14.4 | 28.4 | 50.5 | - | 16.0 | 37.3 |
| Somebody else put it out | 2.3 | 2.1 | - | 0.1 | 3.2 | - |
| *Estimated number of unattended fires (thousands)* | *4,987* | *530* | *505* | *438* | *517* | *199* |

Notes: See Table 8-4.

Table 8-9 shows that putting water on the fire, removing power, and smothering were the most frequent methods for extinguishing kitchen fires, followed by separating from a heat source, moving the object outside, using baking soda, etc. In fires starting outside the kitchen, the strategy was most likely to depend on the nature of the item ignited and the availability of water. Living room fires and fires in other areas often were extinguished with water. In basement and bathroom fires, the most frequent approach was to turn off the power to the equipment that was the source of heat for the fire. In bedroom fires, almost one-third were extinguished by separating from the heat source or moving the hot object outside.

Extinguishers were used in 5.2 percent of kitchen fire incidents, 8.6 percent of fires originating in bedrooms, and 4 percent of fires in other areas. Extinguishers were used in less than 1 percent of living room, bathroom, and basement fires.

Table 8-10
Location and Use of Fire Extinguisher by Area Where Fire Began
(Percent of Unattended Fires)

| Extinguisher Location and Use | Kitchen | Living Room | Bed-room | Bath-room | Other Areas | Base-ment |
|---|---|---|---|---|---|---|
| Nobody home | 0.3 | - | 11.9 | 0.1 | 14.9 | 23.5 |
| Someone home and extinguisher available | | | | | | |
| In same room where fire started | 45.0 | 10.1 | 7.5 | - | - | 7.8 |
| In different room | 16.0 | 60.2 | 68.5 | 85.0 | 36.1 | 12.6 |
| No extinguisher present | 38.7 | 29.8 | 12.1 | 14.9 | 49.0 | 56.0 |
| Someone tried to use an extinguisher | | | | | | |
| Extinguisher was in room of fire origin | 4.8 | - | - | - | - | - |
| Extinguisher was in a different room | 0.4 | 0.5 | 8.6 | 0.1 | 4.0 | - |
| Results from using the extinguisher | | | | | | |
| Put out the fire completely | 3.1 | 0.5 | - | 0.1 | 4.0 | - |
| Minimized but did not put out fire | 1.6 | - | - | - | - | - |
| Had little or no effect | - | - | 8.6 | - | - | - |
| *Estimated number of unattended fires (thousands)* | *4,987* | *530* | *505* | *438* | *517* | *199* |

Notes: See Table 8-5.

Table 8-10 shows that accessibility of a fire extinguisher is of some importance in extinguisher usage. For example, when the extinguisher was kept in the kitchen, there was a 10.7 percent chance that the extinguisher was used in a kitchen fire (= 4.8 percent / 45.0 percent), in contrast to a 2.5 percent chance that the extinguisher was used in a kitchen fire if it was in a different room. The table also suggests that the kitchen and basement are places where extinguishers are likely to be kept.

When used, the extinguisher put out the fire completely in kitchen fires about two-thirds of the time. In bedroom fires, the extinguisher appeared to have little or no effect; while in fires originating in other areas, the extinguisher put out the fire completely.

*Appliance Fires*

Table 8-11 presents data on how appliance fires were discovered by type of appliance involved.

Table 8-11
Method of Discovery for Appliance Fires
(Percent of Unattended Fires)

| Method of Discovery | Stove Range | Other Cooking Appliance | Other Appliance | Lighting Wiring | Heating Cooling |
|---|---|---|---|---|---|
| Nobody home | - | - | 9.4 | - | 20.9 |
| Person present at fire origin | 21.3 | 19.1 | 41.8 | 28.1 | 35.7 |
| Other evidence of fire | | | | | |
| Smelled smoke | 15.6 | 14.5 | 16.7 | 48.8 | 27.4 |
| Saw flames | 20.7 | 29.5 | - | 0.8 | 13.8 |
| Saw smoke | 14.5 | 24.1 | 10.8 | 8.2 | - |
| Heard fire | 2.2 | 0.2 | 10.0 | - | 3.6 |
| Felt heat | 2.2 | 0.2 | - | 0.1 | - |
| Smoke alarm alerted people | 15.7 | 16.0 | - | 5.2 | 4.1 |
| Someone else provided an alert | 5.1 | - | - | 8.8 | 0.1 |
| Something else provided an alert | 0.5 | 0.4 | - | - | - |
| *Estimated number of unattended fires (thousands)* | *3,789* | *876* | *651* | *616* | *281* |

Notes: See Table 8-1. Other Cooking Appliance includes microwave ovens, toaster ovens and toasters, coffeemakers, teapots, counter top ovens, outdoor grills, and other devices. Other Appliance includes personal grooming equipment (hair dryers, curlers, etc.), home office equipment, washing machines, humidifiers, irons, etc.

As most stove and range fires occurred in the kitchen and most kitchen fires involved stoves or ranges, the stove and range and the other cooking columns in Table 8-11 are similar to the kitchen fire results in the previous set of tables in this chapter. The only notable difference between stove and range fires and other cooking appliance fires was that residents were more likely to see flames or smoke as evidence of fire for those involving cooking appliances than for fires involving stoves or ranges. The smoke alarm alerted people in 15.7 percent of stove or range fires and 16 percent of cooking fires, a slightly higher percentage than in all fires. Note that cooking appliance fires (both stove

or range and other) had about one person in five present at the fire origin, implying that four of five fires involved some degree of unattended cooking.

In other appliance fires, almost half the incidents involved someone present at the time when the incident began. Smelling smoke, seeing smoke, or hearing the fire provided the most frequent evidence of fire. No incidents involved people reporting that they were alerted to the fire by the smoke alarm. In lighting and wiring incidents and heating and cooling incidents, the smoke alarm alerted people in 5.2 and 4.1 percent of incidents, respectively.[183] Smelling or seeing smoke or seeing flames provided the most frequent alert of these types of fires.

[183] Heating and cooling equipment fires were presented in Table 7-14. About one-third of the incidents involved central heating and cooling equipment, one-third portable heaters, and one-third were unspecified. Lighting and wiring incidents were presented in Table 7-12. Almost one-quarter of incidents involved light fixtures; the remainder involved light bulbs and lamps, fuses or circuit breaker panels, electrical cords, and other such equipment.

Table 8-12
Smoke Alarm Operation for Appliance Fires
(Percent of Unattended Fires)

| Smoke Alarm Operation | Stove Range | Other Cooking Appliance | Other Appliance | Lighting Wiring | Heating Cooling |
|---|---|---|---|---|---|
| When the fire started | | | | | |
| Someone was at home | 100.0 | 100.0 | 90.6 | 100.0 | 79.1 |
| Nobody was home | - | -- | 9.2 | - | 20.9 |
| If somebody was home | | | | | |
| There was a smoke alarm | 87.1 | 97.2 | 79.2 | 83.8 | 77.4 |
| There was no smoke alarm | 12.1 | 2.3 | 11.4 | 15.3 | 1.6 |
| If there was a smoke alarm and someone home | | | | | |
| The alarm sounded | 40.9 | 30.4 | 3.7 | 6.4 | 17.9 |
| The alarm did not sound | 46.1 | 66.8 | 75.5 | 77.4 | 59.5 |
| If people were home and the alarm sounded | | | | | |
| It alerted people to the fire | 15.7 | 16.0 | - | 5.2 | 4.1 |
| Something else alerted people | 25.2 | 14.4 | 3.7 | 1.2 | 13.8 |
| If the smoke alarm alerted people | | | | | |
| It provided the only alert | 13.4 | 10.7 | - | 5.2 | 0.6 |
| Something else also alerted | 2.3 | 5.3 | - | - | 3.6 |
| *Estimated number of unattended fires (thousands)* | *3,789* | *876* | *651* | *616* | *281* |

Notes: See Table 8-2.

Table 8-12 shows that smoke alarms sounded in 40.9 percent of stove and range fires, alerted people to the fire in 15.7 percent of the incidents, and provided the only alert in 13.4 percent of incidents. Thus, when alarms alerted people to stove and range fires, they usually provided the only alert. Other cooking fires had similar statistics, sounding in 30.4 percent of incidents, alerting people in 16 percent of incidents, and providing the only alert in 10.7 percent of incidents. For heating and cooling fire incidents, the alarm sounded less frequently at 17.9 percent, alerting residents in 4.1 percent of incidents (about one-quarter of the incidents where the alarm sounded), and providing the only alert in 0.6 percent of incidents.

Also, as shown in Table 8-12, in lighting and wiring incidents, alarms sounded in 6.4 percent of incidents, alerted people in 5.2 percent of incidents, and when the alarms alerted people, they were the only alert. Alarms sounded in 3.7 percent of other appliance incidents and did not alert people to any of those fire incidents.

Table 8-13
Reasons for Non-operating Smoke Alarms for Appliance Fires
(Percent of Unattended Fires)

| Reasons for Non-operating | Stove Range | Other Cooking Appliance | Other Appliance | Lighting Wiring | Heating Cooling |
|---|---|---|---|---|---|
| If alarm did not sound | | | | | |
| Enough smoke reached the alarm | 8.6 | 4.5 | - | 0.8 | - |
| Not enough smoke | 37.6 | 60.2 | 75.5 | 76.7 | 59.5 |
| Don't know/refused | - | 2.0 | - | - | - |
| If enough smoke reached the alarm | | | | | |
| Alarm was in working order | 7.3 | 4.5 | - | 0.8 | - |
| Alarm was not in working order | 1.3 | - | - | - | - |
| Alarm tested last | | | | | |
| Less than a month before the fire | 9.2 | 12.6 | 30.0 | 11.4 | - |
| 1-6 months before | 24.2 | 29.8 | 26.0 | 42.6 | 59.5 |
| 7-12 months before | 3.5 | 12.0 | 5.7 | 22.7 | - |
| One year or more before | 8.4 | 0.8 | 13.8 | 0.8 | - |
| Alarm has not been tested | 0.1 | 11.5 | - | - | - |
| Don't know/refused | 0.8 | - | - | - | - |
| *Estimated number of unattended fires (thousands)* | *3,789* | *876* | *651* | *616* | *281* |

Notes: See Table 8-3.

As shown in Table 8-13, the most frequent explanation for alarms not sounding was that insufficient smoke reached the alarms. This was the case in more than one-third of stove and range fires, slightly less than two-thirds of other cooking and heating/cooling equipment fires, and three-quarters of other appliance and lighting and wiring fires. Respondents indicated that, when enough smoke reached the alarm, it was usually in working order. Most respondents also reported that the alarm was tested during the previous year.

Table 8-14
How the Fire Was Extinguished for Appliance Fires
(Percent of Unattended Fires)

| Extinguishment Method | Stove Range | Other Cooking Appliance | Other Appliance | Lighting Wiring | Heating Cooling |
|---|---|---|---|---|---|
| Nobody home | - | - | 9.4 | - | 20.9 |
| What was done to put out fire | | | | | |
| Put water on the fire | 22.6 | 13.6 | - | 13.8 | 3.6 |
| Turned off power to appliance | 13.5 | 39.1 | 49.0 | 16.1 | 10.7 |
| Smothered | 23.1 | 1.1 | - | - | 42.6 |
| Separated from heat source, moved outside | 12.8 | 16.7 | - | 23.1 | 1.4 |
| Used baking soda, salt, flour, etc. | 11.4 | 6.8 | - | - | - |
| Blew out the fire | 7.4 | 3.9 | - | - | - |
| Used an extinguisher | 4.1 | 9.9 | - | - | - |
| Other | 3.6 | 2.5 | - | - | - |
| How was fire ultimately extinguished | | | | | |
| Someone in the household | 87.3 | 67.4 | 48.8 | 73.4 | 98.6 |
| Went out by itself | 12.4 | 24.1 | 50.9 | 20.6 | 1.4 |
| Somebody else put it out | 0.3 | 8.5 | 0.2 | - | - |
| *Estimated number of unattended fires (thousands)* | *3,789* | *876* | *651* | *616* | *281* |

Notes: See Table 8-4.

In Table 8-14 it was reported that stove and range fires were extinguished most frequently by smothering, next most frequently by putting water on the fire, then by removing power, and then by separation of the burning items from the heat source. Turning off the power was the most frequent method of extinguishment for other cooking fires, and was the only type of extinguishment for other appliance fires. In lighting and wiring fires, separation from the heat source, removing power, and using water were the most frequent methods.[184] Heating and cooling fires were extinguished by smothering in almost half the cases, and by removal of power, separation from the heat source, and applying water to the fire in the remaining fire incidents.

Fire extinguishers were used in almost 10 percent of other cooking incidents, 4.1 percent of stove and range incidents, but not for any of the other appliance, lighting and wiring, and heating and cooling fire incidents.

[184] If the electricity is turned off, then putting water on the burning materials is safe. Otherwise, there is a risk of electric shock and of spreading the fire when applying water to an electrical fire.

Table 8-15
Location and Use of Fire Extinguisher for Appliance Fires
(Percent of Unattended Fires)

| Extinguisher Location and Use | Stove Range | Other Cooking Appliance | Other Appliance | Lighting Wiring | Heating Cooling |
|---|---|---|---|---|---|
| Nobody home | - | - | 9.4 | - | 20.9 |
| Someone home and extinguisher available | | | | | |
| In same room where fire started | 45.8 | 28.2 | 9.3 | 13.8 | 35.7 |
| In different room | 15.6 | 22.9 | 46.0 | 65.4 | 39.6 |
| No extinguisher present | 38.7 | 48.9 | 35.3 | 20.7 | 3.8 |
| Someone tried to use an extinguisher | | | | | |
| Extinguisher was in room of fire origin | 3.5 | 9.9 | - | - | - |
| Extinguisher was in a different room | 0.5 | - | - | - | - |
| Results from using the extinguisher | | | | | |
| Put out the fire completely | 2.5 | 7.1 | - | - | - |
| Minimized but did not put out fire | 1.6 | - | - | - | - |
| Had little or no effect | - | - | - | - | - |
| *Estimated number of unattended fires (thousands)* | *3,789* | *876* | *651* | *616* | *281* |

Notes: See Table 8-5.

Table 8-15 shows that for cooking fires, extinguishers were more likely to be used if they were kept in the room where the fire started. This is especially noticeable with other cooking fires where, in 9.9 percent of incidents, the extinguisher was in the same room as the fire and was used to put out the fire; if the extinguisher was in a different room, there were no incidents when it was used. For stove and range fires, the extinguisher was more likely to be in the same room (presumably the kitchen) and, if so, was more than twice as likely to be used than if in a different room. Note that despite lack of usage, in 9.3 percent of other appliance incidents, 13.8 percent of lighting and wiring incidents, and 35.7 percent of heating and cooling fire incidents, the extinguisher was in the room where the fire began.

When used in stove and range fires, the extinguisher put out the fire completely in 2.5 percent of incidents and minimized the fire in the remaining 1.6 percent. In other cooking equipment incidents, the extinguisher put out the fire in 7.1 percent of the 9.9 percent of fires when it was used.

*Non-appliance Fires*

Tables 8-16 to 8-20 display smoke alarm and extinguisher information for unattended non-appliance fires. These include candle fires, lighter, cigarette and match fires, and other fires.

Table 8-16
Method of Discovery for Non-appliance Fires
(Percent of Unattended Fires)

| Method of Discovery | Candle | Lighter, Cigarette, Match | Other |
|---|---|---|---|
| Nobody home | 14.3 | 2.6 | - |
| Person present at fire origin | 11.4 | 24.3 | 3.3 |
| Other evidence of fire | | | |
| Smelled smoke | 14.2 | 22.0 | 1.2 |
| Saw flames | 12.6 | 12.5 | - |
| Saw smoke | 20.8 | - | 20.6 |
| Heard fire | 15.2 | - | - |
| Felt heat | 9.3 | - | - |
| Smoke alarm alerted | 6.9 | 7.9 | 2.7 |
| Someone else provided an alert | - | 5.9 | 0.7 |
| Something else provided an alert | 4.1 | - | 13.2 |
| *Estimated number of unattended fires (thousands)* | *465* | *380* | *119* |

Notes: See Table 8-1. Other includes the following heat sources: torch, spark from a fireplace, fireworks, other open flame, a fire that started somewhere else and spread to the home, lightning, and the response of "something else," "don't know," or "refused."

Table 8-16 shows that residents were less likely to be home in candle fires (not home in 14.3 percent of incidents) than in unattended fires in general (not home in 2.8 percent of incidents, as shown in Table 8-1). Among the different heat sources, this was only exceeded by heating and cooling fire incidents (20.9 percent, Table 8-12). For candle fires, people reported seeing smoke as evidence of the fire most often (at 20.8 percent of the incidents), and hearing the fire second most often (at 15.2 percent of

incidents). Smelling smoke was the most frequent evidence of fire for lighter, cigarette, and match fires, while seeing smoke was most frequent for other fires. The smoke alarm alerted people to the fire in 6.9 percent of candle fires, 7.9 percent of lighter, cigarette and match fires, and in 2.7 of the other non-appliance fires.

Table 8-17
Smoke Alarm Operation for Non-appliance Fires
(Percent of Unattended Fires)

| Smoke Alarm Operation | Candle | Lighter, Cigarette, Match | Other |
|---|---|---|---|
| When the fire started | | | |
| Someone was at home | 85.7 | 97.4 | 100.0 |
| Nobody was home | 14.3 | 2.6 | - |
| If somebody was home | | | |
| There was a smoke alarm | 85.7 | 93.4 | 41.9 |
| There was no smoke alarm | - | 0.1 | 58.1 |
| If there was a smoke alarm and someone home | | | |
| The alarm sounded | 19.5 | 27.7 | 19.4 |
| The alarm did not sound | 66.2 | 65.7 | 22.4 |
| If people were home and the alarm sounded | | | |
| It alerted people to the fire | 6.9 | 7.9 | 2.7 |
| Something else alerted people | 12.6 | 19.8 | 16.7 |
| If the smoke alarm alerted people | | | |
| It provided the only alert | 6.2 | 7.9 | 2.7 |
| Something else also alerted people | 0.7 | - | - |
| *Estimated number of unattended fires (thousands)* | *465* | *380* | *119* |

Notes: See Table 8-2.

In Table 8-17, the estimates indicate that people were home and the smoke alarm sounded in 19.5 percent of candle fires; 27.7 percent of lighter, cigarette and match fires; and 19.4 percent of other fires. The sounding alarm alerted people in 6.9 percent of candle fire incidents; 7.9 percent of lighter, cigarette, and match fires; and 2.7 percent of other fires. In all three types of non-appliance fires, if the alarm alerted people, in almost every case, it provided the only alert.

Table 8-18
Reasons for Non-operating Smoke Alarm for Non-appliance Fires
(Percent of Unattended Fires)

| Reason for Non-operating | Candle | Lighter, Cigarette, Match | Other |
|---|---|---|---|
| If alarm did not sound | | | |
| Enough smoke reached the alarm | 6.3 | 6.2 | 0.7 |
| Not enough smoke | 59.8 | 59.5 | 21.7 |
| Don't know/refused | - | - | - |
| If enough smoke reached the alarm | | | |
| Alarm was in working order | 6.3 | 6.2 | 0.7 |
| Alarm was not in working order | - | - | - |
| Alarm tested last | | | |
| Less than a month before the fire | 0.2 | 27.4 | 0.5 |
| 1-6 months before | 47.9 | 15.0 | 17.8 |
| 7-12 months before | 8.7 | 7.0 | 3.9 |
| One year or more before | 0.2 | 1.2 | - |
| Alarm has not been tested | 9.2 | - | 0.2 |
| Don't know/refused | - | 15.1 | - |
| *Estimated number of unattended fires (thousands)* | 465 | 380 | 119 |

Notes: See Table 8-3.

As shown in Table 8-18, when people were home and the alarm did not sound, respondents reported that there was not enough smoke to trigger the alarm in all three categories of non-appliance fires. This is similar to responses shown earlier for other heat sources. Respondents believed, in all cases, that when enough smoke reached the alarm and it did not sound, that it was in working order. Most reported having tested their alarms during the previous year.

Table 8-19
How the Fire Was Extinguished for Non-appliance Fires
(Percent of Unattended Fires)

| Extinguishment Method | Candle | Lighter, Cigarette, Match | Other |
|---|---|---|---|
| Nobody home | 14.3 | 2.6 | - |
| What was done to put out fire | | | |
| Put water on the fire | 43.6 | 27.2 | 1.9 |
| Turned off power to appliance | - | - | 13.0 |
| Smothered | 11.6 | 6.0 | 62.1 |
| Separated from heat source, moved outside | 15.2 | - | 3.9 |
| Used baking soda, salt, flour, etc. | - | - | - |
| Blew out the fire | 6.1 | 31.2 | - |
| Used an extinguisher | 9.5 | 4.6 | 19.4 |
| Other | - | - | 0.5 |
| How was fire ultimately extinguished | | | |
| Someone in the household | 74.3 | 93.4 | 60.7 |
| Went out by itself | 17.0 | 3.1 | 39.1 |
| Somebody else put it out | 8.7 | 3.5 | 0.2 |
| *Estimated number of unattended fires (thousands)* | *465* | *380* | *119* |

Notes: See Table 8-4.

Table 8-19 shows that water was used to put out candle fires more frequently than with any other heat source (43.6 percent of incidents). It is likely that the fires started with lighters, cigarettes, and matches probably were of smaller sizes than most fires, because residents indicated that they were able to blow out these fires in almost one-third of incidents. Water was also used frequently with such fires (27.2 percent of incidents). For the other non-appliance incidents, smothering the fire was the most frequent method of extinguishment, followed by the use of a fire extinguisher. Of particular note, while extinguishers were used in 4.6 percent of all unattended fires, extinguishers were used twice and four times as frequently in candle fires and other fires at 9.5 and 19.4 percent, respectively.

Table 8-20
Location and Use of Fire Extinguisher for Non-appliance Fires
(Percent of Unattended Fires)

| Extinguisher Location and Use | Candle | Lighter, Cigarette, Match | Other |
|---|---|---|---|
| Nobody home | 14.3 | 2.6 | - |
| Someone home and extinguisher available | | | |
| In same room where fire started | 12.6 | 8.6 | 29.7 |
| In different room | 70.4 | 21.9 | 26.6 |
| No extinguisher present | 2.8 | 66.8 | 43.6 |
| Someone tried to use an extinguisher | | | |
| Extinguisher was in room of fire origin | - | - | 16.7 |
| Extinguisher was in a different room | 9.5 | 4.6 | 2.7 |
| Results from using the extinguisher | | | |
| Put out the fire completely | 0.2 | 4.6 | 2.7 |
| Minimized but did not put out fire | - | - | 16.7 |
| Had little or no effect | 9.3 | - | - |
| *Estimated number of unattended fires (thousands)* | *465* | *380* | *119* |

Notes: See Table 8-5.

For candle fires and lighter, match, or cigarette fires, accessibility of the extinguishers did not appear to play an important role as related to their usage, as shown in Table 8-20. For these types of fires in which extinguishers were used, the extinguishers were located in different rooms from where the fire started. In the other non-appliance incidents, extinguishers that were used were much more likely to be in the room where the fire started.

Table 8-20 shows that extinguishers were not very effective in putting out candle fires but, in contrast, they were completely effective in putting out lighter, match, and cigarette fires. Extinguishers were moderately effective by minimizing but not extinguishing completely most other non-appliance fires.

### *Alarm Configurations*

Tables 8-21 through 8-25 show the operation of smoke alarms as related to how the alarms were configured in the residence. The responses provide insight into whether

residents with more complete alarm configurations were more likely to be alerted to the fire.[185]

Table 8-21
Method of Discovery by Smoke Alarm Configuration
(Percent of Unattended Fires)

| Method of Discovery | Interconnected | | In All Bedrooms | | On All Floors | |
|---|---|---|---|---|---|---|
| | Yes | No | Yes | No | Yes | No |
| Nobody home | 0.1 | 3.1 | 2.1 | 3.0 | 2.6 | 3.4 |
| Person present at fire origin | 39.1 | 21.2 | 21.4 | 23.8 | 25.9 | 13.5 |
| Other evidence of fire | | | | | | |
| Smelled smoke | 23.9 | 18.2 | 20.3 | 18.4 | 20.6 | 12.6 |
| Saw flames | 1.3 | 18.5 | 17.1 | 16.4 | 18.2 | 10.8 |
| Saw smoke | 6.5 | 14.9 | 16.2 | 13.2 | 14.9 | 10.6 |
| Heard fire | - | 3.6 | 3.7 | 3.1 | 3.7 | 1.6 |
| Felt heat | - | 2.0 | 2.5 | 1.6 | 1.0 | 4.7 |
| Smoke alarm alerted | 26.0 | 10.0 | 16.0 | 10.4 | 14.5 | 1.9 |
| Someone else provided an alert | 3.3 | 3.8 | 9.1 | 2.0 | 4.8 | - |
| Something else provided an alert | - | 0.9 | 1.8 | 0.4 | 1.0 | - |
| *Estimated number of unattended fires (thousands)* | *805* | *6,370* | *1,779* | *5,397* | *5,618* | *1,557* |

Notes: See Table 8-1.

Table 8-21 shows how a fire was discovered as related to the different smoke alarm configurations.[186] Only the pairs in complementary columns in the table are mutually exclusive. For example, a fire incident can be entered in either the Interconnected-Yes column or the Interconnected-No column but not both. However,

[185] NFPA 72 requires smoke alarms to be installed outside each sleeping area and on every level of the home. In new construction, smoke alarms are also required in every sleeping room. Alarms must be hard wired with battery backup in new construction but may be battery powered in existing homes. For details see National Fire Protection Association (2007), *National Fire Alarm Code, 2007 Edition.* Quincy, MA.
[186] In Chapter 5, it was shown that 82.4 percent of fire households had smoke alarms on all floors, 21.7 percent had smoke alarms in all bedrooms, and 18.3 percent of households with at least two smoke alarms had their alarms interconnected. These estimates are somewhat different from the statistics presented in Table 8-21 because the estimates in Chapter 5 were based on the number of households and used the full 91-day survey period. The statistics presented in this chapter are based on the number of fires and use the 14/21-day recall period.

some of the fires in the In All Bedrooms-Yes column may have been in houses with interconnected alarms and some in houses without interconnected alarms.

In comparing fires where residents had interconnected alarms, the table shows that the interconnected smoke alarms alerted residents to the fire more than twice as often as non-interconnected alarms (26.0 percent versus 10.0 percent). This occurred despite the fact that a person was present at the fire origin almost twice as often in interconnected alarm residence fires than non-interconnected alarm residence fires.

Similar but smaller benefits in terms of the smoke alarm alerting residents are found in the incidents where the alarms were in all bedrooms and the alarms were on all floors. For incidents where there were alarms in all bedrooms, people were alerted to the fire in 16.0 percent of the incidents in contrast to 10.4 percent of the incidents with alarms in some or no bedrooms. When the alarms were on all floors in the residence, a situation that characterized most residences where fire incidents occurred, residents were alerted 14.5 percent of the time by the sounding alarm, in contrast to 1.9 percent of the incidents when the alarms were not on all floors.

Table 8-22
Smoke Alarm Operation by Smoke Alarm Configuration
(Percent of Unattended Fires)

| Smoke Alarm Operation | Interconnected | | In All Bedrooms | | On All Floors | |
|---|---|---|---|---|---|---|
| | Yes | No | Yes | No | Yes | No |
| When the fire started | | | | | | |
| Someone was at home | 99.9 | 96.9 | 97.9 | 97.0 | 97.4 | 96.6 |
| Nobody was home | 0.1 | 3.1 | 2.1 | 2.9 | 2.6 | 3.4 |
| If somebody was home | | | | | | |
| There was a smoke alarm | 99.9 | 84.7 | 97.1 | 82.9 | 97.4 | 46.8 |
| There was no smoke alarm | 0.0 | 11.3 | - | 13.4 | - | 46.4 |
| If there was a smoke alarm and someone home | | | | | | |
| The alarm sounded | 53.3 | 27.0 | 35.9 | 28.0 | 37.1 | 4.1 |
| The alarm did not sound | 46.7 | 57.7 | 61.1 | 54.9 | 60.3 | 42.7 |
| If people were home and the alarm sounded | | | | | | |
| It alerted people to the fire | 26.0 | 10.0 | 16.0 | 10.4 | 14.5 | 1.9 |
| Something else alerted people | 27.3 | 17.0 | 20.0 | 17.6 | 22.7 | 2.1 |
| If the smoke alarm alerted people | | | | | | |
| It provided the only alert | 26.0 | 7.6 | 12.6 | 8.8 | 11.9 | 1.9 |
| Something else also alerted | - | 2.3 | 3.4 | 1.6 | 2.6 | - |
| *Estimated number of unattended fires (thousands)* | *805* | *6,370* | *1,779* | *5,397* | *5,618* | *1,557* |

Notes: See Table 8-2.

In Table 8-22, alarms were reported to have sounded in 53.3 percent of incidents where alarms were interconnected, in contrast to 27.0 percent where alarms were not interconnected. When the sounding alarm alerted people to fires in residences with interconnected alarms, they provided the only alert in every case. In fires in residences lacking interconnected alarms, the comparable statistic for sounding alarms in fires was 7.6 percent.

In comparing between residences with alarms on all floors with those without alarms on all floors, the distinctions were also very sharp. Alarms sounded in 37.1 percent of incidents when alarms were located on all floors, in contrast to 4.1 percent of incidents when they were not on all floors. The alarm provided the only alert in 11.9

percent of incidents where alarms were on all floors, in contrast to 1.9 percent of incidents in residences without alarms on all floors.

The differences were not as sharp for the comparison between fires occurring in residences where alarms were in all bedrooms with those occurring in residences without alarms in all bedrooms. The alarms sounded in a larger proportion of incidents with alarms in all bedrooms (35.9 percent of incidents) compared with residences without alarms in all bedrooms (28.0 percent of incidents). Also with alarms in all bedrooms, the alarm provided the only alert in 12.6 percent of incidents compared with 8.8 percent of incidents when there were not alarms in all bedrooms.

Table 8-23 presents results on why alarms did not operate by the different alarm configurations.

Table 8-23
Reasons for Non-operating Smoke Alarm by Smoke Alarm Configuration
(Percent of Unattended Fires)

| | Interconnected | | In All Bedrooms | | On All Floors | |
|---|---|---|---|---|---|---|
| Reason for Non-operation | Yes | No | Yes | No | Yes | No |
| If alarm did not sound | | | | | | |
| Enough smoke reached the alarm | 17.0 | 4.5 | 6.7 | 5.6 | 5.7 | 6.7 |
| Not enough smoke | 29.7 | 52.9 | 53.4 | 49.3 | 54.6 | 35.0 |
| Don't know/refused | - | 0.3 | 1.0 | - | 0.1 | 1.0 |
| If enough smoke reached the alarm | | | | | | |
| Alarm was in working order | 16.9 | 3.8 | 6.7 | 4.7 | 5.7 | 3.7 |
| Alarm was not in working order | 0.1 | 0.7 | - | 0.9 | - | 3.0 |
| Alarm tested last | | | | | | |
| Less than a month before the fire | 0.1 | 13.0 | 18.3 | 9.3 | 10.7 | 14.6 |
| 1-6 months before | 26.9 | 29.2 | 27.9 | 29.3 | 30.3 | 23.8 |
| 7-12 months before | 11.9 | 6.1 | 8.2 | 6.3 | 7.5 | 4.2 |
| One year or more before | 4.0 | 6.2 | 4.9 | 6.3 | 7.6 | 0.1 |
| Alarm has not been tested | 3.7 | 1.9 | 1.7 | 2.2 | 2.6 | - |
| Don't know/refused | - | 1.4 | - | 1.6 | 1.5 | - |
| *Estimated number of unattended fires (thousands)* | *805* | *6,370* | *1,779* | *5,397* | *5,618* | *1,557* |

Notes: See Table 8-3.

Table 8-23 shows that in 17 percent of incidents with interconnected alarms present, residents reported that enough smoke reached the alarms for the alarms to have

operated. In contrast, in 4.5 percent of fires in homes without interconnected alarms, residents reported that there was enough smoke. Because there were likely to be more alarms in homes that had interconnected alarms, it is possible that residents believed such alarms should have sounded, in contrast to homes where there were fewer alarms.

Similar to previous tables for interconnected alarms and alarms in all bedrooms, most respondents reported that in incidents when enough smoke reached alarms so that the alarms should have sounded, that before the fire, respondents believed that almost all alarms were in working order. The exception to this was in the case where alarms were not on all floors. The 3.0 percent of incidents where enough smoke reached the alarms but they did not operate were attributed to the alarms not being in working order.

Similar to most of the previous tables, residents reported that most alarms were tested within the year.

Table 8-24
How the Fire Was Extinguished by Smoke Alarm Configuration
(Percent of Unattended Fires)

| Extinguishment Method | Interconnected | | In All Bedrooms | | On All Floors | |
|---|---|---|---|---|---|---|
| | Yes | No | Yes | No | Yes | No |
| Nobody home | 0.1 | 3.1 | 2.1 | 3.0 | 2.6 | 3.4 |
| What was done to put out fire | | | | | | |
| Put water on the fire | 28.2 | 18.1 | 27.3 | 16.5 | 21.1 | 12.4 |
| Turned off power to appliance | 13.5 | 18.9 | 10.4 | 20.9 | 22.6 | 3.1 |
| Smothered | 4.8 | 17.5 | 8.7 | 18.5 | 13.1 | 26.8 |
| Separated from heat source, moved outside | 21.6 | 10.6 | 16.5 | 10.3 | 12.3 | 10.3 |
| Used baking soda, salt, flour, etc. | 7.4 | 6.8 | 7.1 | 6.8 | 7.4 | 4.9 |
| Blew out the fire | 9.7 | 6.0 | 3.5 | 7.4 | 7.7 | 1.8 |
| Used an extinguisher | 0.1 | 5.1 | 8.4 | 3.3 | 4.1 | 6.0 |
| Other | 7.7 | 1.5 | 5.1 | 1.2 | 2.4 | 1.4 |
| How was fire ultimately extinguished | | | | | | |
| Someone in the household | 80.4 | 79.6 | 68.6 | 83.3 | 84.0 | 64.1 |
| Went out by itself | 15.9 | 18.1 | 29.5 | 14.0 | 13.7 | 32.7 |
| Somebody else put it out | 3.7 | 1.7 | 1.9 | 2.0 | 2.3 | 0.8 |
| *Estimated number of unattended fires (thousands)* | *805* | *6,370* | *1,779* | *5,397* | *5,618* | *1,557* |

Notes: See Table 8-4.

Table 8-24 shows that fires in residences with interconnected alarms were extinguished about the same way as those without interconnected alarms, except that there was more use of water and separation of heat source and fuel in the interconnected alarm residence fires, and more use of removal of power and smothering in non-interconnected alarm residence fires. Also, in residences with interconnected alarms, there was almost no use of extinguishers in contrast to residences that did not have interconnected alarms.

In comparing residences with alarms in all bedrooms against residences with at least one bedroom without an alarm, the pattern was almost the same as with interconnected alarms. The most frequent extinguishment method in residences with alarms in all bedrooms was to put water on the fire followed by separating the ignited item from the heat source, in contrast to turning off the power and smothering the fire in residences without alarms in all bedrooms. Residences with alarms in all bedrooms were more likely to use an extinguisher than residences without alarms in all bedrooms.

However, even in those residences, extinguisher use was limited, at 8.4 percent of incidents.

This pattern was very similar to the comparison between fires in residences with alarms on all floors and those in residences without alarms on all floors. When alarms were not on all floors, the most frequent way fires were put out was by smothering, while when alarms were on all floors, power was removed and water was used to put out the fire most frequently. Extinguishers were used in a slightly larger percentage of fires in homes where alarms were not on all floors. When the residence did not have alarms on all floors, residents were less likely to put out the fire. As shown in Table 8-24, residents were able to extinguish the fire in 84.0 percent of incidents in homes with alarms on all floors in contrast to 64.1 percent of incidents without alarms on all floors.

Table 8-25
Location and Use of Fire Extinguisher by Smoke Alarm Configuration
(Percent of Unattended Fires)

| Extinguisher Location and Use | Interconnected | | In All Bedrooms | | On All Floors | |
|---|---|---|---|---|---|---|
| | Yes | No | Yes | No | Yes | No |
| Nobody home | 0.1 | 3.1 | 2.1 | 3.0 | 2.6 | 3.4 |
| Someone home and extinguisher available | | | | | | |
| In same room where fire started | 61.9 | 29.1 | 39.3 | 30.6 | 35.6 | 22.5 |
| In different room | 27.1 | 28.7 | 29.5 | 28.2 | 31.9 | 16.2 |
| No extinguisher present | 10.9 | 39.1 | 29.0 | 38.2 | 29.9 | 57.9 |
| Someone tried to use an extinguisher | | | | | | |
| Extinguisher was in room of fire origin | - | 3.8 | 4.8 | 2.9 | 4.0 | 1.1 |
| Extinguisher was in a different room | 0.1 | 1.3 | 3.6 | 0.4 | 0.2 | 4.9 |
| Results from using the extinguisher | | | | | | |
| Put out the fire completely | 0.1 | 2.8 | 5.9 | 1.4 | 2.3 | 3.2 |
| Minimized but did not put out fire | - | 1.3 | - | 1.5 | 1.4 | - |
| Had little or no effect | - | 0.7 | 2.4 | - | - | 2.8 |
| *Estimated number of unattended fires (thousands)* | *805* | *6,370* | *1,779* | *5,397* | *5,618* | *1,557* |

Notes: See Table 8-5.

Table 8-25 shows that, for most alarm configurations (interconnected, in all bedrooms, on all floors), extinguishers were more frequently used when located in the same room as where the fire started. The only exception to this was in homes where alarms were not on all floors. In such cases, the extinguisher was more frequently used when it was stored in a different room than the fire.

Tables 8-24 and 8-25 begin to investigate if having a better alarm configuration makes it more likely that extinguishers will be used and, if so, if extinguishers will be more likely to put out the fire. In the best alarm configuration (alarms interconnected), there seemed to be almost no use of extinguishers, despite that there were more incidents in residences that have extinguishers. In the least desirable alarm configuration, that of not having alarms on all levels, extinguishers were used in 6.0 percent of incidents. It therefore appears that the presence of interconnected alarms is not associated with an increased use of extinguishers.

## Conclusion

In summary, smoke alarms were present in homes and were known to have sounded in an estimated 30.3 percent of fire incidents (30.0 percent of unattended fires and 40.0 percent of attended fires).

The remaining statistics presented in this chapter apply to fires that were not attended by fire departments. The percent of fires with someone home when the alarm sounded varied substantially by the area where the fire began, on average ranging from 0.8 percent of fires starting in the bathroom to 36.9 percent of fires in the kitchen. Fires involving stoves had the highest proportion of alarms sounding at 40.9 percent of incidents, followed by other cooking equipment at 30.4 percent, heating and cooling equipment at 17.9 percent, lighting and wiring at 6.4 percent, and other appliances at 3.7 percent. Among lighter, cigarette, and match fires, the alarm was reported to have sounded in 27.7 percent of fires, while in candle fires it was 19.5 percent, and in other non-appliance fires it was 19.4 percent.

When alarms were interconnected, respondents indicated that the alarm sounded in 53.3 percent of incidents in contrast to 27.0 percent of incidents when not interconnected. With alarms in all bedrooms, in 35.9 percent of incidents the alarm sounded; while with alarms not in all bedrooms, they sounded in 28.0 percent of incidents. When the alarms were on all floors, they sounded in 37.1 percent of incidents, in contrast to 4.1 percent otherwise.

Why did alarms not sound more frequently in unattended residential fires? Residents suggested that in most cases where the alarm did not sound, it was because not enough smoke had reached the alarm. In most cases, when the alarm did not sound, respondents believed that the alarm was in working order. Also, when enough smoke reached the alarm but it did not sound, most respondents reported that the alarm had been tested during the previous year.

The 1992 Smoke Detector Operability Study suggested that household residents overstate the proportion of alarms that were in working order. An estimated 78 percent of households thought all their household smoke alarms worked, but tests showed that in 12 percent of these households, at least one alarm did not work.[187] Moreover, more than half the non-working alarms were repaired by either installing new batteries or restoring AC power, implying that residents should have known that the alarms were not working because the alarms did not sound when the test button was operated.[188] There is no reason to believe that residents in the current survey had not similarly overestimated the percent of alarms that were working.

As mentioned in the introduction to this chapter, smoke alarms can provide three levels of benefits. First, the alarm can sound with or without alerting people. If it sounds but people have already become aware of the fire, say by smelling smoke, the sounding alarm can provide confirmation of the fire or can indicate that the fire is of sufficient seriousness for households to activate their escape plans. Second, the alarm can sound at the same time as they become aware of the fire in different ways, which then confirms that there is a fire, not just a nuisance alarm. Third, the alarm can provide the only alert of the fire. This does not mean that there would have been no other evidence of the fire if the alarm had not sounded, just that the other evidence might have occurred later.

Alarms alerted people to the fire in 11.8 percent of incidents, providing the only alert of the fire in 9.8 percent of incidents.[189] The sounding alarm alerted residents in 14.9 percent of fires starting in the kitchen, providing the only alert in 12.0 percent of those incidents. When the fire started in the basement, the sounding alarm alerted people in 12.4 percent of incidents, and the sounding alert was the only alert of those fires. Similarly, in 11.6 percent of fires starting in the bedroom, the alarm alerted residents and, again, the alarm provided the only alert in such cases. In stove/range fire incidents and other cooking equipment incidents, the alarm alerted residents in 15.7 percent and 16.0 percent of incidents, respectively, and was the only alert in 13.4 percent and 10.7 percent of incidents. In electrical lighting and wiring incidents, the alarm alerted people in 5.2 percent of incidents, always providing the only alert. In heating and cooling equipment fire incidents, the alarm alerted people in 4.1 percent of incidents, providing the only alert in 0.6 percent. It appears that alarms did not provide as much warning for heating and cooling incidents because (1) fewer household members were home when this type of fire started and (2) if someone was home, they were likely to be present at the fire origin.[190]

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[187] Smith, CL (1994), *op cit.*, page 15.

[188] *Ibid*., page 13. A small number of alarms failed the smoke test. Residents would not be expected to have tested their alarms with such a kit.

[189] This is similar to the experience in the United Kingdom where the sounding smoke alarm led to discovery of the fire in 12 percent of incidents. The most frequent reasons were someone in the room when the fire started, smelled smoke, and saw smoke/flames/sparks. Office of the Deputy Prime Minister (2006), "Fires in the Home: Findings from the 2004/05 Survey of English Housing." ODPM Publications, West Yorkshire, England.

[190] As discussed previously in the section about appliance fires, about one-third of the heating and cooling incidents involved central heating and cooling equipment, one-third portable heaters, and one-third were unspecified. Central heating equipment would usually be found in the basement. Portable heaters would

With non-appliance fires, alarms alerted people in 7.9 percent of lighter, cigarette, and match incidents and provided the only alert in all those incidents. In candle fires, the alarm alerted people in 6.9 percent of incidents and the only alert in 6.2 percent of incidents. For other non-appliance incidents, alarms alerted people in 2.7 percent of incidents and provided the only alert in 2.7 percent.

Did having alarms in all bedrooms, on all floors, and/or interconnected provide residents with additional warning of the fire? For interconnected alarms, the alarms alerted people in 26.0 percent of incidents in comparison with 10.0 percent for non-interconnected alarms. When the interconnected alarm alerted people, the alarms provided the only alert in those 26.0 percent of incidents, while the non-interconnected alarms provided the only alert in 7.6 percent of incidents.

When residents had alarms on all floors, alarms alerted people in 14.5 percent of unattended fire incidents, while if alarms were not on all floors, people were alerted in 1.9 percent of incidents. When on all floors, the sounding alarm provided the only alert in 11.9 percent of incidents compared with 1.9 percent of incidents when the alarms were not on all floors. It is worth noting that the category alarms on all floors, not only describes the placement of the alarms, but also suggests that residents may have had more alarms than those who did not have alarms on all floors.

Alarms in all bedrooms alerted people to the fire more frequently (16.0 percent vs. 10.4 percent), also providing the only alert more frequently (12.6 percent as compared with 8.8 percent).

Most unattended fires were put out by putting water on the fire, removing power, smothering, separating the fuel from the heat source, or some other method. Fire extinguishers were used in 5 percent of fire incidents (4.5 percent of unattended and 17.7 percent of attended fires), sometimes in combination with other methods. Fire extinguishers put out the fire completely in 2.5 percent of incidents, minimized the fire in 1.1 percent, and had little or no effect in 1.0 percent of incidents. Extinguishers were used in other non-appliance fires (19.4 percent of incidents), fires in other cooking equipment (9.9 percent), candle fires (9.5 percent), bedroom fires (8.6 percent of incidents), kitchen fires (5.2 percent), and lighter, cigarette, and match fires (4.6 percent).

There was a somewhat higher likelihood of the extinguisher being used when the extinguisher was located in the room where the fire started. In 45 percent of kitchen fires, the extinguisher was in the kitchen. Someone tried to use an extinguisher in almost 4.8 percent of kitchen fire incidents when it was in the same room and 0.4 percent of incidents when not in the same room. The extinguisher put out the fire completely in 3.1 percent of kitchen fires and minimized but did not put out the fire in the remaining 1.6 percent of kitchen fires when used. Used in lighter, cigarette, and match fires,

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be less likely to be found in the basement and more likely in the living room, dining room, or bedroom; i.e., that is where household members are likely to be. As a result, someone would be likely to be present when the fire started in fires involving portable heating equipment.

extinguishers put out the fire completely in 4.6 percent of incidents (all the incidents when used). Extinguishers were less effective against candle fires, putting out such incidents in 0.2 percent of cases and having little or no effect in 9.3 percent of incidents.

To sum up the findings in this chapter, more smoke alarms were better than fewer alarms in alerting residents to a fire. Alarms on all floors provided better alerting of fires than alarms on some floors, and alarms installed in all bedrooms provided better alerting than alarms in some bedrooms. Interconnected alarms, however, appeared to be best in alerting residents of a fire incident and, in particular, in providing the only alert of the incident.

Fire extinguishers helped in putting out some fires, although, as shown in the survey, their use was somewhat limited to certain types of fires. Also, extinguisher use depended on the location of the extinguisher. When located near the fire origin, extinguishers tended to be used more frequently than in fires that began far from the location of the extinguisher.

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# NATIONAL SAMPLE SURVEY OF RESIDENTIAL FIRES

Hello, I'm _____ calling on behalf of the Consumer Product Safety Commission in Washington, DC. We are conducting a voluntary nationwide survey on residential fires and your responses will be kept completely confidential.

IF REFUSAL OR UNWILLING, SAY:
Your telephone number was selected at random. Your answers to these few questions will provide vital information on the danger of household fires. I will try to keep the interview as brief as possible.

IF BUSY, SAY: I would be glad to call you back. What time would be most convenient for you?

DATE: _____ TIME: _____

IF FURTHER CLARIFICATION NEEDED, SAY:
The Consumer Product Safety Commission is trying to learn more about the kinds of fires people have so it can identify better ways to prevent injuries and deaths that occur in fires. In order to get scientifically accurate results, we are selecting telephone numbers randomly in your community and others across the nation. Under the terms of the Privacy Act of 1974, we are required to treat your answers as completely confidential. The information you give us will be greatly appreciated.

1. Have I reached you at home?

   Home ..... 1
   Business or elsewhere..... 2 →**TERMINATE**

2. Are you one of the heads of this household?

   Yes ..... 1
   No ..... 2 →May I speak with her/him? REPEAT INTRODUCTION. IF NOT AVAILABLE: What time would be most convenient to call back?

DATE: _____ TIME: _____

We are interested in learning about any fires – large or small – that you have had in or around your home. By "fire" I mean any incident – large or small – that resulted in unwanted flames or smoke, and could have caused damage to life or property if left unchecked.
**IF RESPONDENT UNSURE OF WHAT WE MEAN BY "HOME" SAY**: By "home", I mean your house, apartment, or other residence where you live.

OMB 3041-0132 Expires 4/30/07

5. Have any of the following incidents occurred in or around your home in the past three months, that is since **(DATE THREE MONTHS AGO)**? **(ASK EACH, RECORD YES/NO) (AS NECESSARY:)** Have you had any fires due to (INSERT) in the past three months?

| | Yes | No | DK | Ref |
|---|---|---|---|---|
| Unwanted flaming or smoking on the stove or another cooking appliance | 1 | 2 | 8 | 9 |
| A smoking electrical appliance | 1 | 2 | 8 | 9 |
| Burning or smoldering clothing, either being worn or not being worn | 1 | 2 | 8 | 9 |
| Smoldering fabric, mattress, rug, or upholstered furniture | 1 | 2 | 8 | 9 |
| A child igniting something with a match or lighter | 1 | 2 | 8 | 9 |
| A candle igniting something | 1 | 2 | 8 | 9 |
| A fire that started outside your home, and spread to the home | 1 | 2 | 8 | 9 |
| Any other fire – large or small - that produced unwanted flames or smoke | 1 | 2 | 8 | 9 |

**IF YES TO ONE OR MORE ITEMS ON Q5, THIS IS A FIRE HOUSEHOLD - CONTINUE.**

**EVERYONE ELSE, THIS IS A NON-FIRE HOUSEHOLD. A 1/40th SUBSAMPLE SHOULD GO TO Q81; THE REMAINING 39/40ths SHOULD BE THANKED AND TERMINATED.**

RECORD: FIRE HOUSEHOLD 1
NON-FIRE HOUSEHOLD 2

6. How many fires – that is unwanted flames or smoke – have you had in your home or on your property since **(DATE 90 DAYS AGO)**?

One ..... 1
Two ..... 2
Three ..... 3
Four ..... 4
Five ..... 5
Six ..... 6
Seven ..... 7
Eight ..... 8
Nine ..... 9
Ten or more ..... 10
Don't know ..... 11
Refused ..... 12

**PROGRAMMER NOTE: IF Q6 = 2 – 10, ASK Q7-Q102, THEN RETURN TO Q7 AND REPEAT QUESTIONS Q7 – 82b DESCRIBING EACH FIRE WITHIN THE PAST 3 MONTHS.**

7. **(IF Q6 = 1)** Now I have some questions to ask you about the fire or incident. What was the date of the fire?
**(IF Q6 = 2 - 10)** Now I have some questions to ask you about the most recent fire or incident you mentioned. What was the date of the fire?
**(IF Q6 = 11 or 12, READ:)** Let's talk about the most recent one. What was the date of the most recent fire?
**(FOR 2nd, 3rd, etc. fire:)** Now I'd like to ask some questions about the fire before the one you just described. What was the date of that fire?
**(PROBE: During which month did the fire occur?)**

_____ (month)
Don't know **(GO TO Q7a)**
Refused **(GO TO Q7a)**

_____ (Date)
Don't Know **(GO TO Q7a)**
Refused **(GO TO Q7a)**

7a. Just to confirm, the fire did take place on or after **(DATE 90 DAYS AGO)**.

Yes ..... 1
No ..... 2 → **1/40th SUBSAMPLE GO TO Q81; OTHERWISE TERMINATE**
Don't know ..... 3 →**1/40th SUBSAMPLE GO TO Q81; OTHERWISE TERMINATE**
Refused ..... 4 →**1/40th SUBSAMPLE GO TO Q81; OTHERWISE TERMINATE**

8. About what time of day did the fire start? **(INTERVIEWER: IF NOON, ENTER 12:00PM. IF MIDNIGHT, ENTER 12:00AM)**

ENTER TIME _____

Don't know **(GO TO Q8a)**
Refused **(GO TO Q8a)**

8a. **(IF Q8 = DK, REF:)** Could you tell me if the fire happened: **(READ CATEGORIES)**

In the morning (**DO NOT READ:** from 6am until before noon) ..... 1
In the afternoon (**DO NOT READ:** from noon until before 5 PM) ..... 2
In the evening (**DO NOT READ:** from 5 PM until before 9 PM) ..... 3
At night (**DO NOT READ:** from 9 PM until before midnight) ..... 4
Or, overnight (**DO NOT READ:** from midnight until before 6 AM) ..... 5

Don't know ..... 6
Refused ..... 7

9. Did the fire involve the inside of your home, the exterior of your home, or did it happen somewhere else?

Inside your home ..... 1 **GO TO Q12**
Exterior of your home ..... 2 **GO TO Q12**
Somewhere else **(SPECIFY)** _____ ..... 3
Don't know ..... 8
Refused ..... 9

**IF Q9 = 3, 8, OR 9, ASK:**

10. Did the fire spread to your home? **(IF RESPONDENT SEEMS UNAWARE OF FIRE DETAILS, ASK FOR ANOTHER ADULT WHO MAY KNOW MORE ABOUT THE FIRE)**

| | | |
|---|---|---|
| Yes | 1 | **GO TO Q10-1** |
| No | 2 | **1/40th SUBSAMPLE GO TO Q81; OTHERWISE TERMINATE** |
| Don't know | 3 | **ASK FOR OTHER ADULT; IF NO OTHER, GO TO 1/40TH SUBSAMPLE OR TERMINATE** |
| Refused | 4 | **ASK FOR OTHER ADULT; IF NO OTHER, GO TO 1/40TH SUBSAMPLE OR TERMINATE** |

**IF OTHER ADULT IS BROUGHT TO THE PHONE, REINTRODUCE: We are calling from Synovate on behalf of the Consumer Product Safety Commission and would like to ask you some questions about the fire at your home on (DATE FROM Q7) . (IF NO DATE PROVIDED IN Q7, READ: about the recent fire at your home; GO BACK TO Q7 to start the interview).**

**IF DATE IS PROVIDED, RE-ASK Q9 WITH THE NEW RESPONDENT.**

Q10a. **(IF NEW RESPONDENT IS ON THE PHONE)** To confirm, the fire **started (POP-IN RESPONSE FROM Q8 or Q8a)**. Is this correct?

Yes (GO TO Q9) ..... 1
No (GO BACK TO Q8) ..... 2
Don't know (GO TO Q9) ..... 3
Refused (GO TO Q9) ..... 4

**Q10-1. (ASK IF Q10 =1)** And did the fire reach: **(READ LIST)**

The outside of the house only ..... 1
The inside of your house only ..... 2
Both the inside and the outside of your home ..... 3
DO NOT READ: Did not reach my home ..... 4 **1/40TH SENT TO Q.81, 39/40TH THANK & TERM**
Don't know ..... 5 **1/40TH SENT TO Q.81, 39/40TH THANK & TERM**
Refused ..... 6 **1/40TH SENT TO Q.81 39/40TH THANK & TERM**

**ASK Q12 IF Q9=1 or 2, OR Q10-1 = 1, 2 , 3 DK, or REF:**

12. (IF Q9 = 1, ASK:) In which room of your home did the fire start?
(IF Q9 = 2, ASK:)What part of the exterior of your home caught fire first?
(IF Q9 = 3, 8, OR 9 ASK:)Where did the fire start?

**(DO NOT READ RESPONSES; ACCEPT ONE RESPONSE) (IF RESPONDENT SEEMS UNAWARE OF FIRE DETAILS, ASK FOR ANOTHER ADULT WHO MAY KNOW MORE ABOUT THE FIRE)**

**INTERVIEWER NOTE: IF NEEDED ASK**: In which room or area of your home did the fire start?

Attached garage or carport..... 1
Attic ..... 2
Basement ..... 3
Bathroom ..... 4
Bedroom ..... 5
Dining Room / area..... 6
Kitchen ..... 7
Laundry room ..... 8
Living room (including Den, Rec Room, and Family Room) ..... 9
Porch or deck ..... 10
Roof ..... 11
Siding of the home..... 12
Storage area ..... 13
Utility Room (including heating area/furnace room)..... 14
Within enclosed wall space or space within ceiling and floor above ..... 15
Crawl space, including under mobile home..... 16
Other exterior locations **(Please Specify)**: _____.... 17
Hall, entryway..... 18
Other **(Please Specify)**: _____ 19
Don't know ..... 20
Refused ..... 21

14. Which of the following categories best describes the source of heat that started the fire? **(READ CATEGORIES 1 – 9) (INTERVIEWER: PROBE RESPONSE, IF NECESSARY) (IF RESPONDENT SEEMS UNAWARE OF FIRE DETAILS, ASK FOR ANOTHER ADULT WHO MAY KNOW MORE ABOUT THE FIRE)**

A cooking appliance, such as a stove, toaster, or coffee maker
(IF NECESSARY: including parts such as pipes, wiring, and power cords) ..... 1
Heating or air conditioning equipment, such as a furnace or air conditioner
(IF NECESSARY: including parts such as pipes, wiring, and power cords) ..... 2
Electrical lighting or wiring ..... 3
Another household appliance
(IF NECESSARY: Such as a TV, washer/dryer, iron, hair dryer or power tools) ..... 4
A lit cigarette, cigar, or other smoking materials ..... 5
An open flame, such as a candle, match, torch, or lighter ..... 6 (GO TO Q14a)
A fire that started somewhere else and spread to your home ..... 7
Lightning, or ..... 8
Something else (SPECIFY) ..... 9
Don't know ..... 98
Refused ..... 99

Q14a. **(ASK IF Q14 = 6:)** Specifically, what was the source of the heat? **(READ CODES ONLY IF NECESSARY)**

Candle ..... 1
Match ..... 2
Lighter ..... 3
Torch ..... 4
Spark from a fireplace ..... 5
Other open flame (SPECIFY) ..... 6
Don't know ..... 8
Refused ..... 9

**ASK Q15 IF Q14 = ALL RESPONSES EXCEPT 8; ELSE GO TO Q17a**

15. Was a child younger than age 10 involved in starting this fire?

Yes ..... 1 **GO TO Q15a**
No ..... 2 **GO TO Q17a**
Don't know ..... 3 **GO TO Q17a**
Refused ..... 4 **GO TO Q17a**

15a. How old was the child? **(RECORD IN YEARS, IF CHILD IS LESS THAN 1 YEAR OLD, ENTER 0, AND GO TO Q15B)**

ENTER NUMBER 0 – 9 _____
Don't know 98
Refused 99

15b. **(IF AGE IS LESS THAN 1 YEAR OLD) RECORD AGE IN MONTHS RANGE 1 - 11**

ENTER NUMBER 1 – 11 _____
Don't know 98
Refused 99

17a. Now please think of the items that caught on fire. What item caught fire first? **(RECORD RESPONSES VERBATIM; ACCEPT ONE RESPONSE ONLY)**

17. What other items caught fire? **(RECORD RESPONSES VERBATIM) (PROBE TO GET UP TO 3 RESPONSES: Anything else?)**

**IF "2" IN Q14, CONTINUE;**
**IF "4, OR 9" ON Q14, SKIP TO Q23;**
**IF "1" ON Q14 GO TO Q25;**
**IF "3" ON Q14, SKIP TO Q29;**
**IF "5, 6, 7, 8, 98, 99" ON Q14, SKIP TO INSTRUCTION BEFORE Q31**

20. What kind of heating or air conditioning appliance or equipment was involved in starting the fire? **(DO NOT READ RESPONSES; ACCEPT ONE RESPONSE)**

Central Air Conditioner (except heat pump) ..... 1
Central heating furnace ..... 2
Chimney, chimney connector ..... 3
Fireplace ..... 4
Heat Pump ..... 5
Heating stove ..... 6
Other fixed local heater ..... 7
Portable heater (including kerosene heater) ..... 8
Room Air Conditioner ..... 9
Water Heater ..... 10
Other **(Please Specify)**: _____. 11
Don't know ..... 12
Refused ..... 13

20a. **(IF Q20 = 2,4,6, OR 7:)** Did the fire involve the product itself or an attached chimney or vent?

The product / equipment ..... 1
The chimney / vent ..... 2
Both (DO NOT READ) ..... 3

Don't know ..... 4
Refused ..... 5

20b. **(IF Q20 = 3:)** What kind of heating equipment was the chimney attached to – **READ CODES**

A central heating furnace ..... 1
A fireplace ..... 2
A heating stove ..... 3
Some other fixed local heater ..... 4
Or something else (SPECIFY) _____ ..... 5

Don't know ..... 6
Refused ..... 7

21. What kind of fuel/source of power did it use? **(DO NOT READ RESPONSES; ACCEPT ONE RESPONSE) (IF RESPONDENT SAYS "GAS" PROBE WITH:** What type of gas is that?**)**

Battery only ..... 1
Coal ..... 2
Electricity (including with a battery backup) ..... 3
Fuel Oil ..... 4
Gas (type unknown) ..... 5
Gasoline ..... 6
Kerosene ..... 7
Natural gas ..... 8
Propane, butane (liquid petroleum gas) ..... 9
Wood, pellets ..... 10
Other **(Please Specify)**: _____ 11
Don't know ..... 12
Refused ..... 13

**ASK IF Q20 = 2, 4, 5, 6, 7 OR 8; ELSE GO TO INSTRUCTION BEFORE Q31**

22. Was this the main source of heat for your home at the time of the fire?

Yes ..... 1
No ..... 2 →**SKIP TO INSTRUCTION BEFORE Q31**
Don't know ..... 3
Refused ..... 4

23. What kind of item or equipment provided the heat or flame that started the fire? **(DO NOT READ RESPONSES; ACCEPT ONE RESPONSE)**

| | |
|---|---|
| Clothes dryer | 1 |
| Clothes washer | 2 |
| Dishwasher | 3 |
| Fan | 4 |
| Home entertainment (radio, CD, DVD, VCR players, speakers – excluding TV) | 5 |
| Home office equipment such as a computer, printer, fax, etc. | 6 |
| Iron (such as an iron used for clothing or textiles) | 7 |
| Lawn equipment | 8 |
| Other fixed / installed equipment (e.g. trash compactor) **(Please Specify)**: _____ | 9 |
| Personal grooming equipment (hair dryer, curling iron, etc.) | 10 |
| Power tools | 11 |
| Refrigerator or freezer | 12 |
| Television | 13 |
| Toys | 14 |
| Other portable appliance / equipment **(Please Specify)**: ____ | 15 |
| Other (Please specify) _____ | 16 |
| Don't know | 17 |
| Refused | 18 |

24. What kind of fuel/source of power did it use? **(DO NOT READ RESPONSES; ACCEPT ONE RESPONSE) (IF RESPONDENT SAYS "GAS" PROBE WITH:** What type of gas is that?**)**

| | | |
|---|---|---|
| Acetylene | 1 | |
| Battery only | 2 | |
| Coal | 3 | |
| Electricity (including with a battery backup) | 4 | |
| Fuel Oil | 5 | |
| Gas (type unknown) | 6 | |
| Gasoline | 7 | |
| Kerosene | 8 | |
| Natural gas | 9 | |
| Propane, butane (liquid petroleum gas) | 10 | |
| Wood | 11 | →**SKIP TO INSTRUCTION BEFORE Q31** |
| Other **(Please Specify)**: _____ | 12 | |
| Don't know | 13 | |
| Refused | 14 | |

25. Did this fire involve food, cooking oil, or grease catching on fire?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

27-1. Did the fire involve a cooking stove, range, built-in oven or a cook top?

Yes ..... 1 **(GO TO Q28)**
No ..... 2 **(GO TO Q27-2)**
Don't know ..... 3 **(GO TO Q27-2)**
Refused ..... 4 **(GO TO Q27-2)**

27-2. **(ASK IF Q27-1 NE 1:)** What kind of cooking or food preparation appliance or equipment provided the heat that started the fire? **(IF UNSURE OF RESPONSE, PROBE: Is this item supposed to produce heat?) (DO NOT READ RESPONSES; ACCEPT ONE RESPONSE)**

Coffeemaker, teapots ..... 1
Deep fryer, crock pot ..... 2
Frying pan/Skillet ..... 3
Hot Plate ..... 4
Indoor grill (countertop) ..... 5
Microwave oven ..... 6
Oven - countertop ..... 7
Pressure cooker/Canner ..... 8
Rotisserie (countertop) ..... 9
Toaster oven ..... 10
Toaster ..... 11
Turkey fryer ..... 12
Other appliance intended to provide heat for cooking **(SPECIFY)** ..... 13
Outdoor grill ..... 14
Other **(Specify)** ..... 15
Don't know ..... 16
Refused ..... 17

28. What kind of fuel/source of power did it use? **(DO NOT READ RESPONSES; ACCEPT ONE RESPONSE) (IF RESPONDENT SAYS "GAS" PROBE WITH:** What type of gas is that?**)**

Aerosol ..... 1
Battery ..... 2
Charcoal ..... 3
Coal ..... 4
Electricity (including battery backup) ..... 5
Fuel Oil ..... 6
Gas (type unknown) ..... 7
Gasoline ..... 8
Kerosene ..... 9
Lighter fluid ..... 10
Natural gas ..... 11
Propane, Butane (liquid petroleum gas) ..... 12
Wood ..... 13
Other **(Please Specify)**: _____ .... 14
Don't know ..... 15
Refused ..... 16

**SKIP TO INSTRUCTION BEFORE Q31**

29. What part of the electrical wiring or lighting system was involved <u>in starting the fire</u>? **(DO NOT READ RESPONSES; ACCEPT ONE RESPONSE)**

Lamp cord ..... 1
Extension cord ..... 2
Fuse, circuit breaker panel ..... 3
Light fixture ..... 4
Other installed wiring ..... 5
Portable lamp, light bulb ..... 6
Power strip / surge protector ..... 7
Switch or outlet ..... 8
Other **(Please Specify)**: _____ ... 9
Don't know ..... 10
Refused ..... 11

**ASK IF Q14 = 1,2,3,4, 6, OR 9; ELSE, GO TO Q34**

31. Did the source of heat that started the fire seem to be working properly just before the fire?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

**IF Q25 = 1, SKIP TO Q34**

32. Did any flammable liquids, gases, or vapors ignite?

| | | |
|---|---|---|
| Yes | 1 | |
| No | 2 | **SKIP TO Q34** |
| Don't know | 3 | **SKIP TO Q34** |
| Refused | 4 | **SKIP TO Q34** |

**IF YES, ASK;**

33. What kind of flammable liquids, gases, or vapors were involved in the fire? **(DO NOT READ RESPONSES; ACCEPT ONE RESPONSE)**

| | |
|---|---|
| Adhesives | 1 |
| Aerosol | 2 |
| Cleaning materials | 3 |
| Gasoline | 4 |
| Kerosene | 5 |
| Natural gas | 6 |
| Propane, butane (liquid petroleum gas) | 7 |
| Gas (type unknown) | 8 |
| Lighter fluid | 9 |
| Other **(Please Specify)**: _____ | 10 |
| Don't know | 11 |
| Refused | 12 |

34. How many people were in the home when the fire started?

ENTER NUMBER _____

**IF 0, SKIP TO Q36 IF FIRST FIRE DISCUSSED; Q35a FOR ALL OTHER FIRES.**
**IF 1, SKIP TO Q35a5 IF FIRST FIRE DISCUSSED THEN GO TO Q36. FOR ALL OTHER FIRES THEN GO TO Q35a.**
**IF MORE THAN 1, CONTINUE WITH Q35.**

| | | |
|---|---|---|
| Don't know | 98 | **(SKIP TO Q36/35a)** |
| Refused | 99 | **(SKIP TO Q36/35a)** |

35. Of the (POP-IN) people in the home at the time of the fire, how many were between the ages of 18 and 64?

ENTER NUMBER _____

| | | |
|---|---|---|
| Don't know | 98 | **(SKIP TO Q35a1)** |
| Refused | 99 | **(SKIP TO Q35a1)** |

**IF RESPONSE AT Q35 EQUALS RESPONSE AT Q34, GO TO Q36/35a. IF RESPONSE AT Q35 IS LESS THAN RESPONSE AT Q34, ASK Q35a1.**

35a1. Were there any people in the home under the age of 18?

| | | |
|---|---|---|
| Yes | 1 | **(GO TO Q35a2)** |
| No | 2 | **(SKIP TO Q35a3)** |
| Don't know | 3 | **(SKIP TO Q35a3)** |
| Refused | 4 | **(SKIP TO Q35a3)** |

**IF YES, ASK:**
35a2. How many were: **ENTER NUMBERS**

Less than 5 years old..... ____
5 to 9 years old..... ____
10 to 14 years old..... ____
15 to 17 years old..... ____

Don't know ..... 98
Refused ..... 99

**IF SUM OF RESPONSES AT Q35 AND Q35a2 EQUALS RESPONSE AT Q34, GO TO Q36/35a. IF Q35a1 = 2,3,4 OR SUM OF RESPONSES AT Q35 AND Q35a2 IS LESS THAN RESPONSE AT Q34, ASK Q35a3.**

35a3. Were there any people in the home over the age of 64?

Yes ..... 1 **(GO TO Q35a4)**
No ..... 2 **(SKIP TO Q36/35a)**
Don't know ..... 3 **(SKIP TO Q36/35a)**
Refused ..... 4 **(SKIP TO Q36/35a)**

**IF YES, ASK:**
35a4. How many were: **ENTER NUMBERS**

65 – 74 years old ..... ____
75 or older ..... ____

Don't know ..... 98
Refused ..... 99

**IF THIS IS THE FIRST FIRE DISCUSSED, GO TO Q36; ASK Q35a – Q35c WHEN ASKING ABOUT ALL SUBSEQUENT FIRES**

35a5. **(ASK IF Q34 = 1)** What was the age of this person? **DO NOT READ LIST. ONLY READ LIST IF NEEDED.**

Less than 5 years old..... 1
5 to 9 years old……..2
10 to 14 years old……..3
15 to 17 years old……..4
18 to 64 years old……..5
65 – 74 years old ..... 6
75 or older ..... 7

Don't know ..... 8
Refused ..... 9

**IF THIS IS THE FIRST FIRE DISCUSSED, GO TO Q36; ASK Q35a – Q35c WHEN ASKING ABOUT ALL SUBSEQUENT FIRES**

Q35a. Did this fire occur in the same property as the fire we just discussed?

Yes ..... 1 **(GO TO Q35B)**
No ..... 2 **(SKIP TO Q36)**
Don't know ..... 3 **(SKIP TO Q36)**
Refused ..... 4 **(SKIP TO Q36)**

Q35b. Did you make any changes in the number or type of smoke detectors in this property between this fire and the last fire discussed?

Yes ..... 1 **(GO TO Q35C)**
No ..... 2 **(SKIP TO Q42)**
Don't know ..... 3 **(SKIP TO Q42)**
Refused ..... 4 **(SKIP TO Q42)**

Q35c. Did you make any changes to the detectors on the (lowest/next) level?

Yes ..... 1 **(GO TO Q38 and Q39)**
No ..... 2
Don't know ..... 3
Refused ..... 4

**REPEAT Q35C / Q38-Q39 FOR ALL LEVELS. THEN GO TO INSTRUCTION BEFORE Q42**

36. Did you have any smoke detectors in this home or apartment at the time of the fire? Do not include heat detectors or CO detectors.

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

37. **(READ INTRO IF Q36 = 1:)** Now I would like to find out how many smoke detectors you had on each level of your home at the time of this fire…

**INTERVIEWER NOTE: IF NEEDED FOR PEOPLE WHO LIVE IN SHARED HOUSING SITUATION, SAY**: I only need to know about your unit, not the entire building.

How many levels does your home or apartment have? Please include an unfinished basement, but do not include an unfinished attic.

ENTER NUMBER _____

Don't know ..... 98 **(SKIP TO INSTRUCTION BEFORE Q42)**
Refused ..... 99 **(SKIP TO INSTRUCTION BEFORE Q42)**

**IF Q36 NE 1, GO TO Q39a**

38. **(IF MORE THAN ONE LEVEL, ASK:** How many smoke detectors did you have in the lowest level of your home or apartment at the time of the fire? / How many smoke detectors did you have on the (other / next) level of your home) at the time of the fire?
**(IF ONE LEVEL IN HOME, ASK:** How many smoke detectors did you have in your home or apartment at the time of the fire?

ENTER NUMBER _____

Don't know ..... 98 **(SKIP TO INSTRUCTION BEFORE Q42)**
Refused ..... 99 **(SKIP TO INSTRUCTION BEFORE Q42)**

39. We're now going to ask you about how the smoke detectors on this level of your home or apartment are powered. Smoke detectors can be powered by battery, by AC connection, or by a combination of battery and AC connection. Thinking about this level of your home… **(READ INTRO ONLY WHEN RESPONDENT ASKED Q39 FOR THE FIRST TIME. DO NOT READ INTRO FOR SUBSEQUENT TIMES Q39 IS ASKED.)**

**(IF MORE THAN ONE DETECTOR, ASK:)** How many of the (POP-IN) detectors on this level were **(IF ONE DETECTOR ON THIS LEVEL, ASK:)** Was your detector on this level **(READ OPTIONS, ENTER A "1" FOR THE POWER SOURCE.)**

Operated only by battery ..... _____
Operated by AC connection without battery back-up.... _____
Operated by a combination of AC and battery ..... _____

Don't Know ..... 98
Refused ..... 99

**(ASK 39_1 IF ANSWERED 98 OR 99 WHEN ASKED Q39 FOR THE 1ST TIME. IF DID NOT ANSWER 98 OR 99 WHEN ASKED FOR THE 1ST TIME, REPEAT Q's 38 and 39 for each level in the home); ASK Q39_1 ONLY ONCE.**

39_1 Are you familiar with how any of the smoke detectors in your home are powered?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

**IF Q39_1 = 1, REPEAT Q38 AND Q39 FOR EACH LEVEL IN THE HOME. IF Q39_1 = 2,3,4 REPEAT ONLY Q38 FOR EACH LEVEL IN THE HOME. THEN GO TO Q39A IF THIS IS THE FIRST FIRE IN THIS PROPERTY; ELSE GO TO INSTRUCTION BEFORE Q42.**

39a. Did you make any changes in the number or type of detectors in this property since this fire?

Yes ..... 1 **(GO TO Q39B)**
No ..... 2 **(IF Q36 = 1, SKIP TO Q42; ELSE SKIP TO Q50)**
Don't know ..... 3 **(IF Q36 = 1, SKIP TO Q42; ELSE SKIP TO Q50)**
Refused ..... 4 **(IF Q36 = 1, SKIP TO Q42; ELSE SKIP TO Q50)**

39b. How many detectors do you have now on the (lowest/next) level?

ENTER NUMBER _____

Don't know ..... 98 **(SKIP TO INSTRUCTION BEFORE Q42)**
Refused ..... 99 **(SKIP TO INSTRUCTION BEFORE Q42)**

39c. **(IF MORE THAN ONE DETECTOR, ASK:)** How many of the (POP-IN) detectors on this level are **(IF ONE DETECTOR ON THIS LEVEL, ASK:)** Is your detector on this level **(READ OPTIONS, ENTER A "1" FOR THE POWER SOURCE.)**

Operated only by battery ..... _____
Operated by AC connection without battery back-up.... _____
Operated by a combination of AC and battery ..... _____
Unknown ..... _____

Refused ..... 99

**REPEAT Q39B and Q39C for each level in the residence, then go to instruction before Q42**

**ASK Q42 – Q49 ONLY IF SOMEONE WAS HOME WHEN THE FIRE STARTED – Q 34 = 1 OR MORE; ELSE GO TO INSTRUCTION BEFORE Q50**

42. What alerted someone in the household to respond to the fire? **(DO NOT READ, RECORD ALL THAT APPLY) (NOTE: APPLIES TO THE PERSON WHO RECOGNIZED THE FIRE)**

**INTERVIEWER NOTE: PROBE WHEN NECESSARY:** Did anything happen before that? Anything else?

Animal alerted person…… 1
CO detector sounded..... 2
Felt heat from the fire ..... 3
Heard fire burning..... 4
Heat detector sounded..... 5
Noticed/smelled smoke..... 6
Person was there when fire started ..... 7
Saw flames..... 8
Saw smoke ..... 9
Smoke detector alarm sounded ..... 10
Someone in the house noticed the fire ..... 11
Someone outside the house alerted ..... 12
Some other way **(Please Specify)**: _____.. 13
Don't know ..... 14
Refused ..... 15

Now let's talk about flames and smoke

42a. When the fire was discovered, were there… **(READ RESPONSES)**

No flames visible ..... 1
Flames visible but confined to one item ..... 2
Flames spread to several items ..... 3
Flames spread to whole room ..... 4
Flames spread beyond the room ..... 5
Don't know ..... 6
Refused ..... 7

42b. Tell me about the smoke. When the fire was discovered, was there… **(READ RESPONSES)**

No visible smoke ..... 1
Smoke only around the fire source ..... 2
Smoke filled the room of origin..... 3
Smoke spread outside the room of origin ..... 4
Don't know ..... 5
Refused ..... 6

**IF Q36 = 2,3, OR 4, GO TO INSTRUCTION BEFORE Q50**
**IF Q10-1 = 1 , SKIP TO INSTRUCTION BEFORE Q50**
**IF RESPONSE 10 NOT MENTIONED IN Q42, ASK Q42c – Q49a; ELSE GO TO Q50**

42c. Was there a detector in the room where the fire started?

| | | |
|---|---|---|
| Yes | 1 | **(SKIP TO Q43)** |
| No | 2 | **(CONTINUE)** |
| Don't know | 3 | **(SKIP TO Q43)** |
| Refused | 4 | **(SKIP TO Q43)** |

42d. Was there a door between the location where the fire started and the nearest detector?

| | | |
|---|---|---|
| Yes | 1 | **(GO TO Q42e)** |
| No | 2 | **(GO TO Q43)** |
| Don't know | 3 | **(GO TO Q43)** |
| Refused | 4 | **(GO TO Q43)** |

42e. And was this door: **(READ CODES 1 – 3)**

| | |
|---|---|
| Fully open | 1 |
| Partially closed, or | 2 |
| Fully closed | 3 |
| Don't know | 4 |
| Refused | 5 |

Now I have some questions about the smoke detector closest to the fire's origin, or the one you think was most likely to have been exposed first to smoke from the fire.

43. Did that smoke detector sound an alarm at any time during the fire?

| | | |
|---|---|---|
| Yes | 1 | **SKIP TO Q49a** |
| No | 2 | **CONTINUE** |
| Don't know | 3 | **SKIP TO Q49a** |
| Refused | 4 | **SKIP TO Q49a** |

44. Do you think that enough smoke reached the smoke detector that it should have sounded?

| | | |
|---|---|---|
| Yes | 1 | **CONTINUE** |
| No | 2 | **SKIP TO Q48** |
| Don't know | 3 | **SKIP TO Q48** |
| Refused | 4 | **SKIP TO Q48** |

45. Before the fire, did you think that this smoke detector was in working order?

| | | |
|---|---|---|
| Yes | 1 | **SKIP TO Q48** |
| No | 2 | **CONTINUE** |
| Don't know | 3 | **SKIP TO Q48** |
| Refused | 4 | **SKIP TO Q48** |

46. Why do you think the smoke detector was not in working order? **(DO NOT READ)**

| | | |
|---|---|---|
| Had a dead battery | 1 | **SKIP TO Q48** |
| No battery or power | 2 | **CONTINUE** |
| It was just broken | 3 | **SKIP TO Q48** |
| Some other reason **(SPECIFY)** _____ | 4 | **SKIP TO Q48** |
| Don't know | 5 | **SKIP TO Q48** |
| Refused | 6 | **SKIP TO Q48** |

47. Why was there no battery or power to this smoke detector? **(DO NOT READ) (RECORD ALL THAT APPLY)**

| | |
|---|---|
| The alarm sounded continuously | 1 |
| Nuisance alarms | 2 |
| It was beeping / chirping | 3 |
| Took the battery for something else | 4 |
| Needed to buy a new battery | 5 |
| Some other reason **(SPECIFY)**_____ | 6 |
| Don't know | 7 |
| Refused | 8 |

48. When was the last time before the fire that you tested this smoke detector to see if it worked? Would you say… **(READ CATEGORIES)**

| | |
|---|---|
| Less than 1 month before the fire | 1 |
| 1 to 6 months before the fire | 2 |
| 7 months to a year before the fire | 3 |
| More than one year before the fire | 4 |
| Had not checked the smoke detector | 5 |
| Don't know | 6 |
| Refused | 7 |

49a. Did this detector contain a long-life battery that does not need to be replaced every year?

| | |
|---|---|
| Yes | 1 |
| No | 2 |
| Don't know | 3 |
| Refused | 4 |

**(ASK IF Q36 = 1 OR Q39a = 1; ELSE GO TO Q51)**

50. Is there a smoke detector in the bedroom where you sleep?

| | | |
|---|---|---|
| Yes | 1 | GO TO Q50o |
| No | 2 | GO TO INSTRUCTION BEFORE Q50a |
| Don't know | 3 | GO TO INSTRUCTION BEFORE Q50a |
| Refused | 4 | GO TO INSTRUCTION BEFORE Q50a |

50o. **(ASK IF Q50 = YES:)** Currently, do you have a smoke detector in every bedroom in your home or apartment?

| | |
|---|---|
| Yes | 1 |
| No | 2 |
| Don't know | 3 |
| Refused | 4 |

**ASK Q50a ONLY IF THE HOUSE HAS MORE THAN ONE DETECTOR; ELSE GO TO Q51**

50a. Are your detectors connected to each other, so that if one sounds, they all sound?

| | |
|---|---|
| Yes | 1 |
| No | 2 |
| Don't know | 3 |
| Refused | 4 |

50a1. Are your detectors connected to a home security service?

| | |
|---|---|
| Yes | 1 |
| No | 2 |
| Don't know | 3 |
| Refused | 4 |

51. Did you have any fire extinguishers in your home at the time of the fire?

| | | |
|---|---|---|
| Yes | 1 | **(CONTINUE)** |
| No | 2 | **(SKIP TO Q57)** |
| Don't know | 3 | **(SKIP TO Q57)** |
| Refused | 4 | **(SKIP TO Q57)** |

51a. How many fire extinguishers did you have?

ENTER NUMBER _____
**(RANGE 1 – 9)**

| | |
|---|---|
| Don't know | 98 |
| Refused | 99 |

52. Where (was/were) the fire extinguisher(s) kept? **(DO NOT READ; RECORD ALL THAT APPLY)**

Basement ..... 1
Bathroom ..... 2
Bedroom ..... 3
Car ..... 4
Closet / hall closet ..... 5
Garage ..... 6
Kitchen ..... 7
Laundry room ..... 8
Other **(Please Specify)**: _____ ..... 9
Don't know ..... 10
Refused ..... 11

**(ASK IF Q34 = 1 OR MORE; ELSE GO TO Q57)**

53. Did anyone attempt to use a fire extinguisher to put out the fire?

| | | |
|---|---|---|
| Yes ..... | 1 | **CONTINUE** |
| No ..... | 2 | **SKIP TO Q57** |
| Don't know ..... | 3 | **SKIP TO Q57** |
| Refused ..... | 4 | **SKIP TO Q57** |

54. Did the fire extinguisher…**(READ CATEGORIES 1 - 3)**

| | | |
|---|---|---|
| Put out the fire entirely ..... | 1 | **GO TO Q56** |
| Minimize the fire, but not put it out completely, or ..... | 2 | **GO TO Q55** |
| Have little or no impact on the fire ..... | 3 | **GO TO Q55** |
| Don't know ..... | 4 | **GO TO Q56** |
| Refused ..... | 5 | **GO TO Q56** |

55. **ASK IF Q54 = 2 OR 3; ELSE GO TO Q56:** Why didn't the fire extinguisher put out the fire completely? **(DO NOT READ; RECORD ALL THAT APPLY)**

Didn't know how to use it ..... 1
It wasn't charged / it was empty ..... 2
It was used incorrectly ..... 3
It was partially empty ..... 4
The equipment failed / didn't work ..... 5
The fire was too large ..... 6
Other **(Please specify)** ..... 7
Don't know ..... 8
Refused ..... 9

56. How many fire extinguishers did you try to use on this fire?

One ..... 1
Two ..... 2
Three ..... 3
Four or more ..... 4
Don't know ..... 5
Refused ..... 6

57. How many fire extinguishers do you currently have in your home?

ENTER NUMBER _____

Don't know ..... 98
Refused ..... 99

**IF Q10-1 = 1, SKIP TO Q63**

58. At the time of the fire, was there a sprinkler system installed in your home?

| | | |
|---|---|---|
| Yes | 1 | **CONTINUE** |
| No | 2 | **SKIP TO Q63** |
| Don't know | 3 | **SKIP TO Q63** |
| Refused | 4 | **SKIP TO Q63** |

58a. Was your sprinkler system connected to a home security service?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

59. Did the sprinkler system spray water at the time of the fire?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

59a. Was there a sprinkler head in the room or immediate area where the fire started?

| | | |
|---|---|---|
| Yes | 1 | |
| No | 2 | **(GO TO INSTRUCTION BEFORE Q61)** |
| Don't know | 3 | **(GO TO INSTRUCTION BEFORE Q61)** |
| Refused | 4 | **(GO TO INSTRUCTION BEFORE Q61)** |

**IF Q12 = 15, SKIP TO INSTRUCTION BEFORE Q61**

60. Did the flames spread beyond the room where the fire started or were the flames kept just to the room where the fire started?

Spread beyond ..... 1
Kept to room where it started ..... 2
Don't know ..... 3
Refused ..... 4

**ASK IF Q59 = 2, THEN GO TO Q63**

61. To the best of your knowledge, at the time of the fire, was the water supply to your sprinkler system turned on?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

**ASK IF Q59 = 1; ELSE GO TO Q63**

62. Did the sprinkler system…**(READ CATEGORIES 1 - 3)**

Put out the fire entirely ..... 1
Minimize the fire, but not put it
out completely, or ..... 2
Have little or no impact on the fire ..... 3
Don't know ..... 4
Refused ..... 5

63. Do you currently have a sprinkler system installed in your home?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

**ASK IF Q34 = 1 OR MORE; ELSE GO TO Q67**

Now I'd like to talk about some of the things people do or actions they take when they discover a fire. Again, by fire, we mean any unwanted flames or smoke.

**(ASK IF Q53 NE 1) (IF Q53 = 1, GO TO Q64a)**

64. Did anyone in the house try to put out the fire?

Yes ..... 1
No ..... 2 | →**SKIP TO Q66**
Don't know ..... 3 |
Refused ..... 4 |

64a. In addition to using a fire extinguisher, did anyone do anything else to put out the fire?

Yes ..... 1 **(CONTINUE)**
No ..... 2 **(GO TO Q66)**
Don't know ..... 3 **(GO TO Q66)**
Refused ..... 4 **(GO TO Q66)**

65. What did that person do to try to put out the fire? **(DO NOT READ; ENTER ALL THAT APPLY)**

Brought burning item to tap water ..... 1
Brought tap water to burning item ..... 2
Cut off power to involved equipment ..... 3
Moved burning item outside ..... 4
Separated burning/smoldering material and heat source ..... 5
Smothered with pot lid, blanket, etc. ..... 6
Used baking soda, salt, other common product ..... 7
Used flour ..... 8
Used home fire extinguisher ..... 9
Used hose ..... 10
Other **(Please Specify)**: _____ . 11
Don't know ..... 12
Refused ..... 13

66. Was the fire serious enough to cause people to leave the residence, or try to leave?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

67. Did the fire department come?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

68. Who finally put out the fire?

Fire Department ..... 1
Household member ..... 2
Neighbor ..... 3
Went out by itself ..... 4
Other person **(Please Specify)**: _____ . 5
Don't know ..... 6
Refused ..... 7

69. By the time the fire was put out, how would you describe the extent of flame damage? Would you say there was **(READ CATEGORIES 1 – 7)**

No flame damage ..... .1
Flame damage but confined to first item ..... .2
Flame damage spread to several items ..... .3
Flame damage spread to whole room ..... 4
Flame damage spread beyond the room ..... 5
Flame damage through the whole house…… 6
Flame damage only to the outside of the house . 7
Don't know ..... 8
Refused……9

70. And by the time the fire was put out, how would you describe the extent of the smoke damage? Would you say there was: **(READ CATEGORIES 1 – 6)**

No smoke damage ..... 1
A little smoke damage ..... 2
Smoke damage in most of the room ..... 3
Smoke damage spread to another room or area 4
Smoke damage spread through the whole house 5
Smoke damage only to the outside of the house 6
Don't know ..... 7
Refused ..... 8

70a. Did you and your family need to stay somewhere other than your home or apartment for one night or more because of the fire?

Yes ..... 1
No ..... 2 **(GO TO Q71)**
Refused ..... 4 **(GO TO Q71)**

**IF SECOND OR SUBSEQUENT FIRE, GO TO Q70B**

70a1. And are you back in your home now?

Yes ..... 1 **(GO TO Q70b)**
No ..... 2 **(GO TO Q70a1)**
Refused ..... 4 **(GO TO Q71)**

70a1. How long do you expect it will be before you will move back into your house? (READ CATEGORIES 1 - 6)

Less than one week ..... 1
1 – 2 weeks ..... 2
3 – 4 weeks ..... 3
5 – 6 weeks ..... 4
More than 6 weeks ..... 5
Will not be able to move back into the home ... 6
Don't know ..... 7
Refused ..... 8

70b. How long did you have to stay somewhere other than your home? (READ CATEGORIES 1 - 5)

Less than one week ..... 1
1 – 2 weeks ..... 2
3 – 4 weeks ..... 3
5 – 6 weeks ..... 4
More than 6 weeks ..... 5
Had to move permanently ..... 6 **(DO NOT READ)**
Don't know ..... 7
Refused ..... 8

71. What was the total dollar value of the property loss or damage to your household from the fire? Please include the cost of repairing your home and replacing the contents of the damaged area. **(PROBE: All we need here is your best estimate) (AS NECESSARY: Please include your out-of-pocket costs plus whatever costs are covered by insurance. We're interested in the total amount of damage caused by the fire.)**

$_____
RANGE (0 – 9,999,999)

Don't know
Refused

72. Was anyone in your home hurt, get sick, or die as a result of the fire?

| | | |
|---|---|---|
| Yes | 1 | **CONTINUE** |
| No | 2 | **GO TO Q81** |
| Don't know | 4 | **GO TO Q81** |
| Refused | 5 | **GO TO Q81** |

73. Were there any deaths as a result of the fire?

| | | |
|---|---|---|
| Yes | 1 | |
| No | 2 | →**SKIP TO Q76** |
| Don't know | 3 | |
| Refused | 4 | |

74. How many deaths were a result of the fire?

ENTER NUMBER 1 – 10 _____

| | | |
|---|---|---|
| Don't know | 11 | →**CONTINUE WITH Q75** |
| Refused | 12 | →**SKIP TO Q76** |

75. What was/were the age(s) of each person who died? **(ALLOW UP TO 10 MENTIONS)**

| | Person 1 | Person 2 | Person 3 | Person 4 | Person 5 |
|---|---|---|---|---|---|
| ENTER AGE | ____ | _____ | _____ | _____ | _____ |
| **(RANGE 0 – 96) (ENTER 0 IF CHILD IS LESS THAN 1 YEAR OLD; ENTER 97 IF AGE IS 97 OR MORE)** | | | | | |
| Don't know | 98 | 98 | 98 | 98 | 98 |
| Refused | 99 | 99 | 99 | 99 | 99 |

76. How many people were hurt or got sick as a result of the fire?

ENTER NUMBER 0 – 97 _____

**VERIFY ANY NUMBER OVER 10**

Don't know 98
Refused 99

**IF Q76 = 0, SKIP TO INSTRUCTION BEFORE Q81**

Let's talk about each person injured or ill.

Person No. 1

77. What type of medical attention was required? **(DO NOT READ CATEGORIES; RECORD ALL THAT APPLY)**

None ..... 1
Call to the doctor ..... 2
Visit to the doctor's office / clinic / HMO ..... 3
Treatment in the emergency room ..... 4
Admitted to the hospital ..... 5
First aid at site ..... 6
Other **(Please Specify)**: _____ ... 7
Don't know ..... 8
Refused ..... 9

78. What type of fire-related injury or illness did this person have? **(READ CATEGORIES IF NECESSARY, RECORD ALL THAT APPLY)**

Burns ..... 1
Smoke inhalation ..... 2
Cuts and bruises ..... 3
Broken bones / fractures ..... 4
Other **(Please Specify)** _____ ..... 5
Don't know ..... 6
Refused ..... 7

79. What is his/her age?

ENTER AGE _____
**RANGE (0 – 97) (ENTER 97 IF AGE IS 97 OR MORE; ENTER 0 IF LESS THAN 1 YEAR OLD)**

Don't know ..... 98
Refused ..... 99

80. As a result of the fire-related injury or illness, did he/she cut down on the things he/she usually does for one or more days?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

**REPEAT Q77 – Q80 FOR ALL INJURED/ILL**

**If Q6 = 1, 11, OR 12 OR (NON-FIRE HOUSEHOLD – ALL ITEMS IN Q5 = NO, DK, REF, OR ALL ITEMS IN Q5a = NO, DK, REF, READ:)** These last few questions are about your home and your household.
**IF Q6 = 2 – 10, READ:** These questions are about your home and your household.

**READ Q81 FOR ALL FIRST-FIRE RESPONDE NTS AND THOSE NON-FIRE HOUSEHOLDS THAT ARE CONTINUING THROUGH THE DEMOGRAPHIC SECTION.**

**IF Q35A NOT EQUAL TO YES, AND THIS IS THE SECOND OR SUBSEQUENT FIRE, ASK Q81 AND Q82/82A. IF Q35A = YES, THEN GO TO Q82B.**

81. IF NON-FIRE HOUSEHOLD: Is your home a…
IF FIRE HOUSEHOLD: What type of home was involved in the fire we've been discussing? Would you say it is a …**(READ CATEGORIES 1 – 5; ACCEPT ONE RESPONSE)**

Detached single family home ..... 1
Mobile home or manufactured home..... 2
Two-family dwelling ..... 3
Apartment building..... 4
Townhouse or rowhouse..... 5
Other **(Please Specify)**: _____... 6
Refused ..... 7

82. About how old is your home? **ASK ONLY IF NEEDED:** Would you say…**(READ CATEGORIES 1 - 6) (IF RESPONDENT SAYS THE HOME WAS BUILT AT DIFFERENT TIMES, READ:** How old is the part where the fire started?**)**

5 years old or less ..... 1
6 to 15 years old..... 2
16 – 25 years old..... 3
26 – 35 years old..... 4
36 – 45 years old..... 5
46 years old or older ..... 6
Don't know ..... 7
Refused ..... 8

**IF DON'T KNOW OR REFUSED IN Q82, ASK**

82a. Could you estimate in what year your home was built?

RECORD YEAR _____

Don't know 9998
Refused 9999

82b. **IF FIRE HOUSEHOLD:** At the time of the fire, how many people in your household smoked tobacco at least once a day?

**IF NON-FIRE HOUSEHOLD:** How many people in your household smoke tobacco at least once a day?

ENTER NUMBER _____

**(RANGE 0 – 8) (ENTER 8 IF 8 OR MORE)**
Refused 9

**FIRE HOUSEHOLDS – FIRST FIRE DISCUSSED – SKIP TO Q91;**
**FIRE HOUSEHOLDS – ALL OTHER FIRES, THANK AND TERMINATE**
**NON-FIRE HOUSEHOLDS CONTINUE**

83. Do you have any smoke detectors in your home or apartment?

Yes ..... 1
No ..... 2 **(SKIP TO Q89)**
Don't know ..... 3 **(SKIP TO Q89)**
Refused ..... 4 **(SKIP TO Q89)**

84. How many levels does your home or apartment have? Please include an unfinished basement, but do not include an unfinished attic.

ENTER NUMBER _____
Don't know ..... 98 **(SKIP TO Q87)**
Refused ..... 99 **(SKIP TO Q87)**

85. **IF MORE THAN ONE LEVEL, ASK**: How many smoke detectors do you have in the lowest level of your home or apartment? Do not include heat detectors or CO detectors.
**IF ONE LEVEL IN HOME, ASK**: How many smoke detectors do you have in your home or apartment? Do not include heat detectors or CO detectors.

ENTER NUMBER _____
Don't know ..... 98 **(SKIP TO Q87)**
Refused ..... 99 **(SKIP TO Q87)**

86. **(IF MORE THAN ONE DETECTOR, ASK:)** How many of the **(POP-IN)** detectors on this level are **(IF ONE DETECTOR ON THIS LEVEL, ASK:)** Is your detector on this level **(READ OPTIONS, ENTER A "1" FOR THE POWER SOURCE.)**

Operated only by battery ..... _____
Operated only by a connection to the electrical system. _____
Operated by a combination of battery and connection to the electrical system _____
Unknown ..... _____

Refused ..... 99

**REPEAT Q's 85 and 86 for each level in the home; ELSE GO TO Q87**

**ASK Q87 ONLY IF THE HOUSE HAS MORE THAN ONE DETECTOR; ELSE GO TO Q88**

87. Are your detectors connected to each other, so that if one sounds, they all sound?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

87a. Are your detectors connected to a home security system?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

88. Is there a smoke detector in the bedroom where you sleep?

Yes ..... 1 GO TO Q88o
No ..... 2 GO TO Q89
Don't know ..... 3 GO TO Q89
Refused ..... 4 GO TO Q89

88o. **(ASK IF Q88 = YES:)** Do you have a smoke detector in every bedroom in your home or apartment?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

89. How many fire extinguishers do you currently have in your home?

ENTER NUMBER _____
**(RANGE 0 – 9)**
Don't know ..... 98
Refused ..... 99

90. Do you currently have a sprinkler system installed in your home?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

91. Do you own or rent this home?

Own ..... 1
Rent ..... 2
Other **(Please Specify)**: _____ .. 3
Refused ..... 4

93. How many people live in this household?

ENTER NUMBER _____
**(RANGE 1 – 20)**

Refused ..... 99

**IF ANSWER IS ONE SKIP TO Q.94a5.**

94. Of the **(POP-IN)** people living in your household, how many are between the ages of 18 and 64?

ENTER NUMBER _____

Don't know ..... 98 **(SKIP TO Q94a1)**
Refused ..... 99 **(SKIP TO Q94a1)**

**IF RESPONSE AT Q94 EQUALS RESPONSE AT Q93, GO TO Q95. IF RESPONSE AT Q94 IS LESS THAN RESPONSE AT Q93, ASK Q94a1.**

94a1. Are there any people in the household under the age of 18?

Yes ..... 1 **(GO TO Q94a2)**
No ..... 2 **(SKIP TO Q94a3)**
Don't know ..... 3 **(SKIP TO Q94a3)**
Refused ..... 4 **(SKIP TO Q94a3)**

**IF YES, ASK:**
94a2. How many are: **ENTER NUMBERS**

Less than 5 years old..... ____
5 to 9 years old..... ____
10 to 14 years old..... ____
15 to 17 years old..... ____

Don't know ..... 98
Refused ..... 99

**IF SUM OF RESPONSES AT Q94 AND Q94a2 EQUALS RESPONSE AT Q93, GO TO Q95. IF Q94a1 = 2,3,4 OR SUM OF RESPONSES AT Q94 AND Q94a2 IS LESS THAN RESPONSE AT Q93, ASK Q94a3.**

94a3. Are there any people in the household over the age of 64?

Yes ..... 1 **(GO TO Q94a4)**
No ..... 2 **(SKIP TO Q95)**
Don't know ..... 3 **(SKIP TO Q95)**
Refused ..... 4 **(SKIP TO Q95)**

**IF YES, ASK:**
94a4. How many are: **ENTER NUMBERS**

65 – 74 years old ..... ____
75 or older ..... ____

Don't know ..... 98
Refused ..... 99

94a5. What is the age of this person?
**DO NOT READ LIST. ONLY READ LIST IF NEEDED.**

Less than 5 years old..... 1
5 to 9 years old……..2
10 to 14 years old……..3
15 to 17 years old……..4
18 to 64 years old……..5
65 – 74 years old ..... 6
75 or older ..... 7

Don't know ..... 8
Refused ..... 9

95. What is the highest grade in school that you or another head of household completed?
**NOTE: ONLY READ LIST IF NEEDED.**

Less than high school..... 1
Some high school..... 2
High school graduate ..... 3
Technical/Vocational school training ..... 4
Some College..... 5
College Graduate ..... 6
Postgraduate work ..... 7
Don't know ..... 8
Refused ..... 9

96. Please tell me which of the following categories best describes your household income for 2003? **(READ CATEGORIES 1 –4)**

Less than $15,000 ..... 1
$15,000 to less than $35,000 ..... 2
$35,000 to less than $75,000 ..... 3
$75,000 or more..... 4
Don't know ..... 8
Refused ..... 9

98. Is any head of the household of Hispanic or Latino descent?

Yes ..... 1
No ..... 2
Don't know ..... 3
Refused ..... 4

99. What do you consider to be the race of the heads of household? Is any head of household…**(READ CATEGORIES 1 – 6) WHEN FIRST "YES" RESPONSE IS OBTAINED, ASK:** Are there any other races that might apply to one of the heads of household? **(ENTER ALL THAT APPLY)**

White ..... 1
Black or African-American ..... 2
Asian ..... 3
Native Hawaiian or Pacific Islander ..... 4
American Indian ..... 5
Alaskan native ..... 6
Or some other race **(Please specify)** ..... 7
Refused ..... 8

101. Not including the telephone number which I called you on, how many additional phone numbers do you have in your household? Please do not count numbers for cellular phones, or phone lines that are exclusively for computer or fax use.

ENTER NUMBER OF PHONE LINES _____
**(RANGE 0 – 8) (ENTER 8 IF 8 OR MORE LINES)**

Refused ..... 9

102. **INTERVIEWER: INDICATE SEX OF RESPONDENT**

Male ..... 1
Female ..... 2

**(IF Q6 = 2 – 10:)** Now I'd like to ask some questions about the (other / next most recent) fire you mentioned. **(INTERVIEWER: OFFER TO CONTINUE OR RESCHEDULE AT RESPONDENT"S CONVENIENCE) (IF RESCHEDULING, GET FIRST NAME AND SCHEDULE TIME FOR THE INTERVIEW)**

**RETURN TO Q7**

**ELSE, THANK AND TERMINATE:**

I'd like to thank you for taking the time to help us answer these important questions. The information you have given us will be very helpful. Thank you for your cooperation.

COMPLETION CODES

Subsample – Non-fire household that was asked demographic section
Subsample – Non-fire household that was immediately terminated
Complete – Fire household that had a full and/or abbreviated interview

**NOTE: Q50a, Q50a1, Q57, and Q63 ONLY ASKED DURING FIRST TIME THROUGH THE SURVEY. NOT ASKED FOR SECOND, THIRD, etc. FIRE.**