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United States
CONSUMER PRODUCT SAFETY COMMISSION
Washington, D.C. 20207

MEMORANDUM

SEP 16 1997

TO : Dale Ray, EC
Project Manager, Upholstered Furniture

Through: Mary Ann Danello, Ph.D. MAD
Associate Executive Director for Epidemiology and Health Sciences

Susan Ahmed, Ph.D. SA
Director, Hazard Analysis Division (EHHA)

FROM : Kimberly Long, EHHA K.L.

SUBJECT: National Fire Estimates for Smoking Material Ignited Upholstered Furniture Fires

This memorandum transmits the most recent national fire estimates for smoking material ignited upholstered furniture fires. Upholstered furniture remains the consumer product associated with more fire deaths than any other product within CPSC's jurisdiction. During 1994 (the latest year available), about 14,300 residential fires involved ignitions of upholstered furniture that resulted in 680 deaths, 1,780 injuries and $244.5 million in property damage.[1] Smoking material ignitions, which include cigarettes, cigars, and pipes, accounted for 6,500 fires or about 45 percent of all upholstered furniture fires, 410 deaths (60%), 960 injuries (54%), and $107.9 million in property damage (44%). Open flame ignition sources such as matches, cigarette lighters, and candles accounted for 3,800 fires or about 25 percent of all upholstered furniture fires, 160 deaths (24%), 540 injuries (30%), and $69.1 million in property loss (28%). The remaining 4,000 fires, 110 deaths, 280 injuries, and 67.5 million were attributed to other sources.

Table 1 presents 1980 - 1994 national fire estimates of upholstered furniture related fires, deaths, injuries, and property loss which occurred in residential structural fires by smoking material ignition sources, mainly cigarettes.

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[1] Smith, Linda and Long, Kimberly (1996). 1994 Residential Fire Loss Estimates. Washington, D.C.: U.S. Consumer Product Safety Commission.

Table 1
U.S. Residential Upholstered Furniture Related Fire Loss Estimates for Smoking Material Ignited Fires, 1980 - 1994

Year	Fires	Deaths	Injuries	Property Loss in Millions	Risk of Injury per 100 fires	Risk of Death per 100 fires
1994	6,500	410	960	107.9	14.77	6.31
1993	7,100	450	1,060	109.3	14.93	6.34
1992	7,300	490	880	75.1	12.05	6.71
1991	8,500	470	1,160	137	13.65	5.53
1990	8,800	610	1,260	143.3	14.32	6.93
1989	9,700	670	1,200	113.3	12.37	6.91
1988	11,200	810	1,450	115.2	12.95	7.23
1987	11,700	710	1,410	101.8	12.05	6.07
1986	12,700	780	1,360	122.5	10.71	6.14
1985	13,200	740	1,500	123.3	11.36	5.61
1984	14,500	870	1,510	126.7	10.41	6.00
1983	14,800	860	1,830	111.3	12.36	5.81
1982	17,600	990	1,760	186.2	10.00	5.63
1981	22,500	1,190	2,000	164.9	8.89	5.29
1980	24,600	1,150	2,110	135.6	8.58	4.67

Source: U.S. Consumer Product Safety Commission / EHHA, from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

Note: Fire estimates have been rounded to the nearest thousand. Death and injury estimates have been rounded to the nearest ten. Property loss estimates have not been adjusted for inflation.

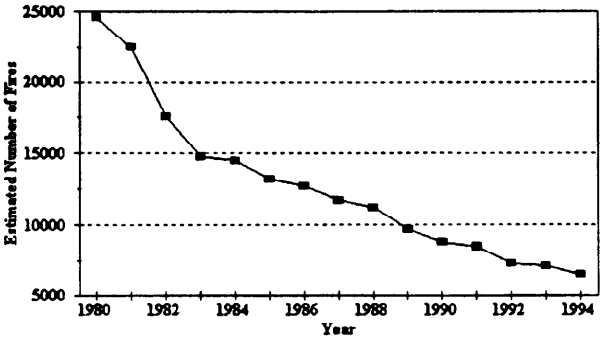
Between 1980 and 1994, smoking material ignited fires associated with upholstered furniture declined by 74 percent, deaths related to these fires declined by 64 percent, and injuries declined by 55 percent. Figure 1 shows this sharp decrease in the estimated number of smoking material fires. Figures 2 and 3 graphically display the risks of death and injury per hundred fires for smoking material ignited upholstered furniture fires, respectively.

A nonparametric test for trends was performed on the estimated number of fires and on the risks of death and injury. A significant downward trend was found for the estimated number of fires for the 1980 to 1994 period.[2] The trend test indicated a significant upward trend in the estimated risks of death and injury per hundred fires during this period. Although the estimated number of smoking material ignited upholstered furniture fires declined since 1980, the significant upward trends in the risks of death and injury indicate that the severity of these fires increased.

[2] Spearman's rank correlation coefficient was used to test for upward and downward trends at the 0.05 significance level. Daniel, Wayne (1990). *Applied Nonparametric Statistics* (p.358 - 374). Boston, MA: PWS-KENT Publishing Company.

Figure 1

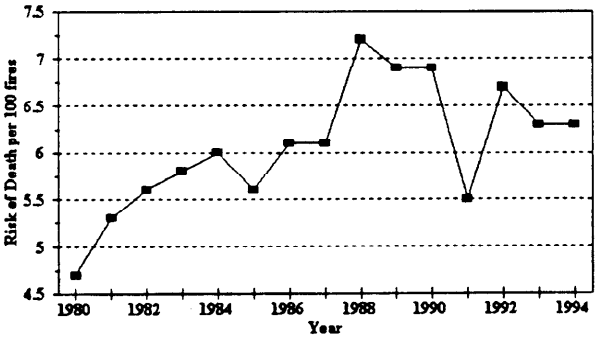
Smoking Material Ignited Upholstered Furniture Fires, 1980 - 1994



Source: U.S. Consumer Product Safety Commission/EHHA from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

Figure 2

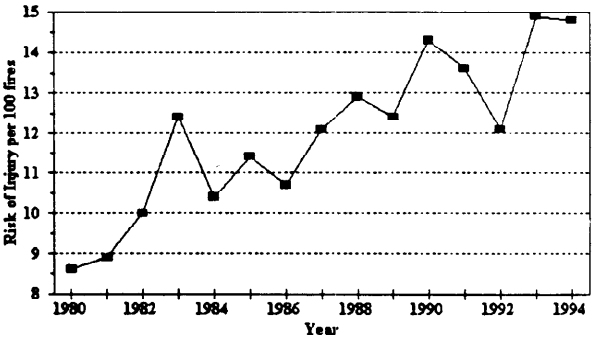
Risk of Death for Smoking Material Ignited Upholstered Furniture Fires, 1980 - 1994



Source: U.S. Consumer Product Safety Commission/EHHA from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

Figure 3

Risk of Injury for Smoking Material Ignited Upholstered Furniture Fires, 1980 - 1994



Source: U.S. Consumer Product Safety Commission/EHHA from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

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Through: Mary Ann Danello, Ph.D.
Associate Executive Director for Epidemiology and Health Sciences

Susan Ahmed, Ph.D.
Director, Hazard Analysis Division (EHHA)

FROM : Kimberly Long, EHHA K.L.

SUBJECT: Final Report on Small Open Flame Upholstered Furniture Fires

This memorandum transmits the 1994 national estimates and the results of the 1994-1997 investigation study on small open flame upholstered furniture fires.

Attachment

Small Open Flame Ignitions of Upholstered Furniture

Final Report
September 1997

Kimberly Long
Directorate for Epidemiology and Health Sciences
Division of Hazard Analysis

U. S. Consumer Product Safety Commission
Washington, D.C. 20207

Small Open Flame Ignitions of Upholstered Furniture

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Small Open Flame Ignitions of Upholstered Furniture
Executive Summary

- The annual average between 1990 and 1994 shows that small open flame ignition sources, including matches, lighters, and candles, accounted for about 3,100 fires or 20 percent of all upholstered furniture fires. These fires were related to an estimated 100 deaths, 460 injuries, and approximately $46 million in property loss. Small open flame ignitions were involved in about 20 percent of all upholstered furniture fires, deaths, injuries, and property loss.

From October 1994 to February 1997, CPSC conducted a special study of upholstered furniture fires associated with small open flame sources. Following are the results of the study.

- Of the 76 investigated fires, 63 involved sofas/couches and sofabeds, 12 fires involved upholstered chairs, and 1 fire involved an upholstered ottoman. The median reported age of furniture involved in these fires was five years.

- Of the 76 investigated fires, 38 fires reported the ignition location. The seating area (consisting of the cushion, the inside of the arm, and the inside back of the sofa/couch or chair) was identified as the portion first ignited in 25 fires. The outer back and outer side were identified as the portion first ignited in nine fires, the underside of the upholstered furniture was cited in three fires, and the skirt was identified as the portion first ignited in one fire.

- The reported small open flame sources associated with the upholstered furniture fires were cigarette lighters (46), matches (14), candles (10), and other ignition sources that included a fireworks sparkler, a spark from a gas heater, and a flare gun. The three remaining fires were said to have been started by either a cigarette lighter or a match, but the fire department could not determine which of the two.

- The probable cause of fire in 65 (86%) of the fires was children playing. The remaining 11 fires were reportedly caused by candles tipping over and falling on the upholstered furniture (8 fires or 11%) and other miscellaneous ignition factors (3%).

- Among the 65 child play fires, 44 fires involved children less than 5 years of age as the fire-setters and 19 fires involved children between 5 and 11. The ages of two children were unknown.

- Of the 46 fires associated with cigarette lighters, 9 of the lighters were reported to be child-resistant lighters, 21 were non child-resistant, and 16 could not be determined whether child-resistant or not. Seven of the nine fires involving child-resistant lighters were started by children under the age of 5. Ten investigations reported that the child involved in starting the fire had some experience playing with lighters and/or matches.

- In the 76 investigated fires, there was a total of 39 deaths and 45 injuries for a combined total of 84 fire casualties. Most of the victims suffered from smoke inhalation or thermal burns.

I. Introduction

A. Background

Since the early 1970s, the U.S. Consumer Product Safety Commission (CPSC) has been interested in upholstered furniture fires. During the 1970s and 1980s, most of the CPSC's efforts focused on cigarette ignitions of upholstered furniture. In 1980, CPSC staff analyzed data on upholstered furniture fires with the main focus on the ignition sources involved.[1] The 1980 report concluded that fire deaths associated with upholstered furniture were more likely to occur in cigarette-ignition fires rather than in open flame fires.

In 1993, the National Association of State Fire Marshals (NASFM) petitioned CPSC to establish mandatory upholstered furniture flammability standards and suggested that such standards should incorporate the state of California's existing requirements. The California requirements specify tests for cigarette ignition, small open flame ignition sources, and large open flame ignition sources. Following this petition, CPSC staff attempted to identify any differences between upholstered furniture fires in California and those fires occurring in the rest of the United States.[2] CPSC staff reported that the risk of fire deaths and injuries had decreased more significantly in California than in the rest of the United States, but that the decrease could not be directly attributable to the California standards. In May 1994, the Commission voted to grant the petition requesting development of a flammability standard to address risks of death, injury, and property loss from small open flame ignitions of upholstered furniture, and published an Advance Notice of Proposed Rulemaking under the Flammable Fabrics Act.

Following the vote of the Commission, CPSC staff began a project addressing small open flame fire risks associated with upholstered furniture. As a part of this project, the Directorate for Epidemiology and Health Sciences conducted an in-depth fire investigation study of small open flame ignitions of upholstered furniture occurring between October 1994 and February 1997. In this study, items of interest included the portion of the upholstered furniture first ignited such as the seating area, the dust cover (underneath the furniture), or the skirt; the age of the person involved in the ignition of the upholstered furniture; the general condition of the

upholstered furniture before the fire; the source of small open flame (match, lighter, candle, etc.); the furniture construction, particularly the presence of skirts or dust covers; the furniture age; the presence and performance of smoke detectors in the residence; and household characteristics.

This report presents national fire estimates for upholstered furniture open flame fires and the findings of the 1994 - 1997 CPSC study.

B. Methodology

1. National Fire Estimates

The estimates of residential fire losses involving upholstered furniture were derived using data from the U.S. Fire Administration's National Fire Incident Reporting System (NFIRS) and the National Fire Protection Association (NFPA). [3] The NFIRS is a nonprobability sample of fires attended by the fire service. It is widely considered to represent the overall national fire loss experience because of its large sample size and coverage of all regions in the U.S. Estimates of aggregate fire losses for the nation are produced annually by the NFPA based on an annual sample survey of public fire departments. The proportions in NFIRS were applied to the NFPA's aggregate estimates of annual residential fire losses.

The estimates presented in this report include residential structure fires where upholstered furniture was the first material to be ignited by an open flame heat source. Proportional shares of fires coded with unknown form of materials first ignited were assigned to all the different forms of known materials. This estimation procedure assumes that fires with unknown or unreported forms of materials have the same proportional distribution as fires where this information is known and reported. Slightly different results may be produced depending on which unknown factors are allocated and the order in which they are allocated. Secondly, unknown forms of heat involved in ignition were allocated over the knowns for each class of fires defined by the form of heat. Fire estimates were rounded to the nearest hundred and estimated civilian deaths and injuries were rounded to the nearest ten.

2. Investigations

In October 1994, CPSC began a data collection effort to identify factors related to open flame ignition of upholstered furniture. CPSC staff collected information on fires occurring in residential structures that involved ignition of upholstered furniture (sofas/couches and chairs)

by small open flame sources such as matches, cigarette lighters, and candles. Every CPSC Regional Field Office and Satellite Office participated in the data collection. The investigators were assigned the responsibility of case identification and follow-up investigations of in-scope incidents. The investigators met with local fire departments to discuss the goals of this study and to gain the fire department's assistance in rapidly identifying all fires that were in-scope. Once fire department cooperation was established, the investigators maintained weekly contact with the fire departments for reviews of the departments' records of relevant cases. The investigations consisted of either on-site visits or telephone interviews with the victims and/or fire departments.

Between October 1994 and February 1997, 201 probable small open flame ignitions of upholstered furniture cases were identified by the CPSC investigators. Of the 201 cases, 76 were determined to be in-scope. An in-scope fire was a residential structural fire that involved ignition of upholstered furniture by a small open flame source. This included any fire occurring in a hotel, motel, dormitory, rooming house, or other conventional residence. In most of the out-of-scope cases, either the ignition source was a cigarette or the fire department could not determine whether the ignition source was a cigarette or a small open flame. Several cases involved children setting paper or another material on fire and then placing the lit paper on or near the upholstered furniture. These cases were eliminated since the upholstered furniture was not ignited directly by a small open flame. Similarly, cases where pillows or blankets on the upholstered furniture were first ignited were eliminated.

The data collection was designed to investigate fires from a reasonably representative sample of upholstered furniture fires reported to U.S. fire departments. It is noted that while the cases investigated were limited in number and were not from a national sample with a known probability of selection, they provided important information about the hazard scenarios associated with small open flame upholstered furniture fires.

II. National Fire Estimates

Upholstered furniture remains the consumer product associated with more fire deaths than any other product within CPSC's jurisdiction. During 1994 (the latest year available), about 14,300 residential fires involved ignitions of upholstered furniture that resulted in 680 deaths, 1,780 injuries and $244.5 million in property damage. Open flame ignition sources such as matches and cigarette lighters accounted for about 3,800 fires or about 25 percent of all upholstered furniture fires, an estimated 160 deaths (24%), an estimated 540 injuries (30%), and about $69 million (28%) in property loss.[4] The principal activities associated with open flame ignitions were children playing and suspected arson. Cigarette ignitions accounted for about 6,500 (45%) of all upholstered furniture fires, 410 deaths (60%), and 960 (54%) injuries. The remaining 4,000 fires, 110 deaths, and 280 injuries were attributed to other or unknown sources.

Table 1 presents 1980 - 1994 national fire estimates of upholstered furniture related fires, deaths, and injuries, which occurred in residential structural fires by open flame ignition sources.

Table 1
U.S. Residential Upholstered Furniture Related Fire Loss Estimates for Open Flame Ignition Sources, 1980 - 1994

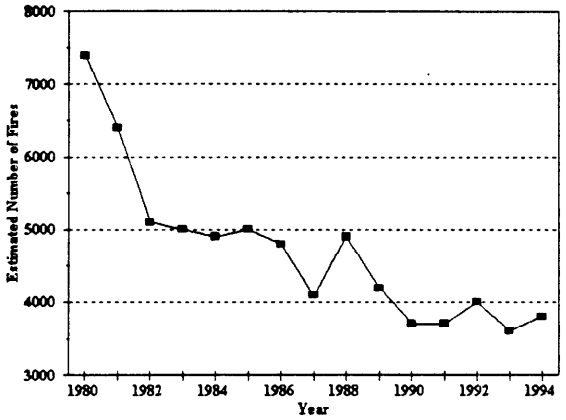
Year	Fires	Deaths	Injuries	Risk of Injury per 100 fires	Risk of Death per 100 fires
1994	3,800	160	540	14.2	4.2
1993	3,600	110	490	13.6	3.1
1992	4,000	80	490	12.3	2.0
1991	3,700	150	580	15.7	4.1
1990	3,700	140	530	14.3	3.8
1989	4,200	130	490	11.7	3.1
1988	4,600	160	460	10.0	3.5
1987	4,100	140	450	11.0	3.4
1986	4,800	140	520	10.8	2.9
1985	5,000	110	480	9.6	2.2
1984	4,900	110	500	10.2	2.2
1983	5,000	180	510	10.2	3.6
1982	5,100	100	450	8.8	2.0
1981	6,400	90	480	7.5	1.4
1980	7,400	200	610	8.2	2.7

Source: U.S. Consumer Product Safety Commission / EHHA, from data obtained from the U.S. Fire Administration and the National Fire Protection Association

Figures 1, 2 and 3 graphically depict the estimated number of residential structural fires ignited by open flame ignition sources, the risk of injury per 100 fires, and risk of death per 100 fires, respectively.

Figure 1

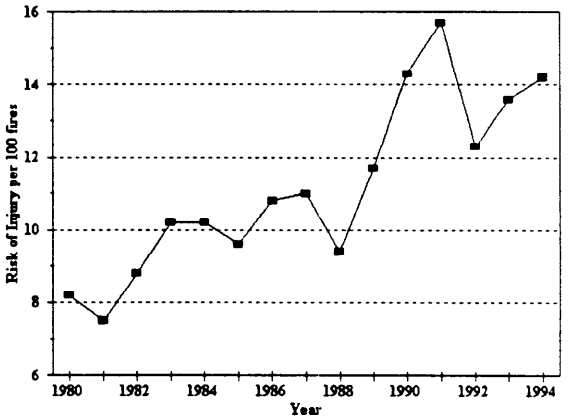
Upholstered Furniture Fires Started by Open Flame Sources, 1980-1994



Source: U.S. Consumer Product Safety Commission/EHHA from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

Figure 2

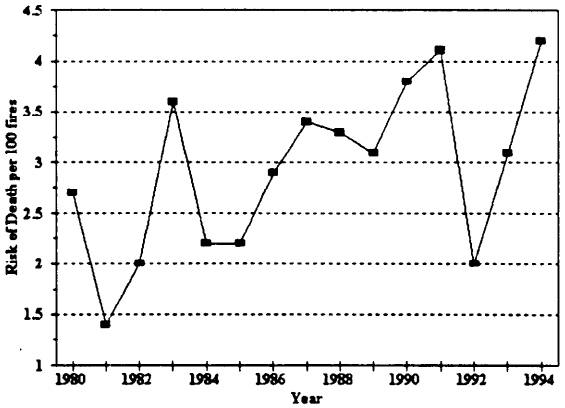
Risk of Injury per 100 Open Flame Upholstered Furniture Fires, 1980-1994



Source: U.S. Consumer Product Safety Commission/EHHA from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

Figure 3

Risk of Death per 100 Open Flame Upholstered Furniture Fires, 1980-1994



Source: U.S. Consumer Product Safety Commission/EHHA from data obtained from the U.S. Fire Administration and the National Fire Protection Association.

As seen in Figure 1, the estimated number of open flame fires associated with upholstered furniture has decreased since 1980. A nonparametric test for trends was performed on the estimated number of fires and on the risks of death and injury. A significant downward trend was found for the estimated number of fires for the 1980 to 1994 period.[5] However, there was a significant upward trend in the estimated risk of injury per 100 fires during this period. The trend test showed neither a significant upward nor downward trend for the estimated risk of death per 100 fires. Therefore, though the number of open flame fires associated with upholstered furniture has been declining, it has not been accompanied by a decline in the risk of injury or death.

Small Open Flame Sources

The open flame ignition sources identified in the NFIRS data consist of small open flame ignition sources (matches, lighters, and candles), torch flames or welding equipment, open fires (campfires, bonfires, warning flares, rubbish fires, open trash burners, open incinerators, and outdoor fireplaces), backfires from combustion engines, other types of open flames not classified above, and unknown open flame sources. Table 2 presents 1990 - 1994 annual average estimated fires, deaths, and injuries associated with upholstered furniture fires by the type of open flame ignition source.

Table 2
U.S. Residential Upholstered Furniture Related Fire Loss Estimates for Open Flame Ignition Sources, Annual Average for 1990 - 1994

Fire Loss Estimate	Fires	Deaths	Injuries
All Open Flame Sources	**3800**	**130**	**530**
Matches	1700 (45%)	40 (31%)	190 (36%)
Lighters	1000 (26%)	40 (31%)	210 (40%)
Candles	400 (11%)	20 (15%)	60 (11%)
Other Open Flame	300 (8%)	10 (8%)	20 (4%)
Unknown Open Flame	500 (13%)	20 (15%)	60 (11%)

Source: U.S. Consumer Product Safety Commission / EHHA, from data obtained from the U.S. Fire Administration and the National Fire Protection Association.
Note: Detail may not add to total due to rounding.

The annual average between 1990 and 1994 shows that approximately 80 percent of the fires reported as open flame ignitions of upholstered furniture resulted from use of matches (45%), lighters (26%), and candles (11%). (See Table 2.) Less than ten percent of the fires (8%) consisted of other open flame sources, such as torch flames or welding equipment, open fires such as campfires, bonfires, warning flares, or open trash burners, backfires from combustion engines, other types of open flames or sparks. Similarly, estimated deaths and injuries associated with matches, lighters, and candles accounted for approximately 80 percent of all open flame deaths and injuries. Eight percent of the deaths and only four percent of the injuries were associated with open flames other than matches, lighters, and candles. The remaining portions for fires, deaths, and injuries were associated with unknown open flame sources. Due to the small percentage for other open flame sources (namely large open flame sources), the national estimates for open flame ignitions of upholstered furniture generally reflect the hazard associated with small open flame ignitions. Table 3 shows the upholstered furniture related fire loss estimates for matches, lighters, and candles between 1990 and 1994.

Table 3
U.S. Residential Upholstered Furniture Related Fire Loss Estimates for Matches, Lighters, and Candles, 1990 - 1994

Year	Fires	Deaths	Injuries	Risk of Injury per 100 fires	Risk of Death per 100 fires
Average	3,100	100	460	15.0	3.0
1994	3,100	150	470	15.2	4.8
1993	3,100	80	400	12.9	2.6
1992	3,300	70	450	13.6	2.1
1991	2,900	110	490	16.9	3.8
1990	3,000	100	470	15.7	3.3

Source: U.S. Consumer Product Safety Commission / EHHA, from data obtained from the U.S. Fire Administration and the National Fire Protection Association

Table 4 presents the 1990 - 1994 annual average estimates of fire losses associated with child play fires where upholstered furniture was first ignited by open flame sources. An estimated 40 deaths resulted from child play with lighters in fires where upholstered furniture was first ignited (about 30% of all open flame ignited upholstered furniture fire deaths) and 20

deaths resulted from child play with matches.

Table 4
U.S. Residential Upholstered Furniture Related Fire Loss Estimates for Child Play Fires by Open Flame Sources, Annual Average 1990 - 1994

Fire Loss Estimate	Fires	Deaths	Injuries
All Open Flame Sources	**1620**	**70**	**310**
Matches	750	20	110
Lighters	760	40	180
Candles	40	*	*
Other Open Flame	30	*	*
Unknown Open Flame	30	10	10

Source: U.S. Consumer Product Safety Commission / EHHA, from data obtained from the U.S. Fire Administration and the National Fire Protection Association.
Note: Detail may not add to total due to rounding. Asterisks denote that estimate is less than five.

III. Investigation Study Results

A. Furniture Characteristics

There were 76 completed in-scope investigations of upholstered furniture fires. Several furniture characteristics were collected including the type of upholstered furniture involved, whether the furniture had been slip-covered and/or reupholstered, and the approximate age of the furniture.

Of the 76 in-scope fires, 63 fires involved sofas/couches and sofabeds, 12 fires involved upholstered chairs, and 1 fire involved an upholstered ottoman. Some upholstered furniture was described as sofas having three removable cushions or overstuffed sofas and chairs. One sofa was described as having reclining units on either side of the sofa. Other sofas were described as "love seats" containing only two cushions. Several chairs were described as recliner-type chairs.

Of the 76 in-scope fires, 36 of the investigations reported whether the upholstered furniture was slip-covered. Twenty-nine of the investigations reported that the piece of upholstered furniture was not slip-covered and seven were reported as slip-covered. Of the 76 in-scope fires, 29 reported whether the upholstered furniture was reupholstered. Twenty-eight of the investigations reported that the upholstered furniture was not reupholstered, and only one reported that the furniture had been reupholstered. Table 5 shows the percentages of known information and the respective frequencies.

Of the 76 in-scope fires, 35 of the investigations reported whether the upholstered furniture was acquired new or used; 20 of these said that the upholstered furniture was either purchased new at furniture stores or received new as a gift and that 15 were used when acquired. The used upholstered furniture was said to have been bought at garage sales, received as a gift from others, or was a family heirloom.

Table 5
Characteristics of Upholstered Furniture Involved in Fires

Characteristic	Yes		No		Unknown	Total
	Number	Percent of Known	Number	Percent of Known		
Slip-covered	7	19%	29	81%	40	**76**
Reupholstered	1	3%	28	97%	47	**76**
Acquired New	20	57%	15	43%	41	**76**

Source: U.S. Consumer Product Safety Commission / EHHA
In-depth Investigation File, Upholstered Furniture Data Collection, October 1994 - February 1997.

Of the 76 in-scope fires, 31 of the investigations reported a specific age of the upholstered furniture at the time of the fire and 6 reported that the upholstered furniture was "old" without any reference to a specific age. When specified, the reported median age of all furniture involved in these fires was five years. The distribution of the age of the upholstered furniture is shown in Table 6.

Table 6
Reported Upholstered Furniture Age

Furniture Age (In Years)	Frequency	Percent of Known
Less than 5	13	35%
5 to 10	9	24%
11 to 15	3	8%
Over 15	6	16%
"Old"	6	16%
Unknown	39	-
Total	**76**	**100%**

Source: U.S. Consumer Product Safety Commission / EHHA
In-depth Investigation File, Upholstered Furniture Data Collection, October 1994 - February 1997.

Note: Detail may not add to total due to rounding.

B. Types of Material Found

Of the 76 investigations, 22 reported some information about the type of covering or filling material of the upholstered furniture. Most of the investigations contained only sketchy information about the texture and general appearance of the outer fabric covering and filling materials. The distribution of covering materials and fillings involved in these fires could not be determined due to the scant information obtained in this set of investigations.

Regarding the materials covering the upholstered furniture, some investigations included descriptions such as: "light and soft cotton," "a knit fabric with a fuzzy surface," "some type of rayon/nylon synthetic fabric," "corduroy type fabric," "a velvet type of material," a brand-named plastic cover, "a synthetic velour type fabric," and "fabric was a hard fabric, not a textured fabric." Some investigations reported the type of filling material used in the upholstered furniture. These materials were described as "foam cushions and cotton batting stuffing," "cushions made of hard foam," "foam filling material," "cubed foam," and "foam rubber cushions or petroleum-based product." One couch was reported to be covered in leather and labeled as meeting the UFAC requirements.

C. Area First Ignited

Information on the area of the upholstered furniture first ignited was reported in 38 of the 76 fires. Of these, 25 indicated that the ignition occurred somewhere in the seating area consisting of the cushion, the inside of the arm, and the inside back of the sofa/couch or chair. The outer back or outer sides were identified as the portion first ignited in nine fires, the underside of the upholstered furniture was cited in three fires, and the skirt was identified as the portion first ignited in one fire. Table 7 presents the locations of the upholstered furniture ignitions by the source of ignition.

Typically, the seating area ignitions involved a child sitting on the sofa or chair and playing with either matches or a lighter. Most of these ignitions started in the cushions of the upholstered furniture. In one case, a child ignited the filling material identified as cotton batting in the cushion of the sofa and the fire report noted that the heaviest fire damage was seen in the center of the sofa.

In the investigations that cited the outer back or side as the portion of the furniture first ignited, it could not be determined whether a skirt was involved. In one case that involved a cigarette lighter and a sofabed, it was reported that the ignition was in or on the corner of the sofabed nearest the front door. Another case involved a candle and an upholstered chair where it was reported that the chair was ignited when "the candle fell behind the chair." In both

investigations, there was no indication of a skirt on the upholstered furniture.

In one investigation that reported the underside as the portion first ignited, "the child lit a cigarette lighter under the sofa and ignited the material covering the bottom of the frame." In another investigation where the underside was ignited, two children lit a wooden match to search for a bird that flew under the sofa. In this fire, their grandfather who was asleep on the sofa was killed by the fire. In the single investigation that reported the skirt as the portion first ignited, the child ignited the skirt on the side of an easy chair with a lighter.

Table 7
Portion of Upholstered Furniture Ignited by the Source of Ignition in Upholstered Furniture Fires

Portion of Upholstered Furniture Ignited	Source of Small Open Flame Ignition					
	Cigarette Lighter	Match	Candle	Other	Not Specified	**Total**
Seating Area	14	5	3	2	1	**25**
Outer Back / Side	7	0	2	0	0	**9**
Skirt	1	0	0	0	0	**1**
Underside	2	1	0	0	0	**3**
Not Specified	22	8	5	1	2	**38**
Total	**46**	**14**	**10**	**3**	**3**	**76**

Source: U.S. Consumer Product Safety Commission / EHHA
In-depth Investigation File, Upholstered Furniture Data Collection, October 1994 - February 1997.

D. Small Open Flame Sources

As shown in Table 7, the source of the small open flame ignition was reported in 73 of the 76 fires. The three remaining fires were started by either a cigarette lighter or a match, but the fire department could not determine which of the two. The reported sources of ignition were cigarette lighters (46), matches (14), candles (10), and other ignition sources included a fireworks sparkler, a flare gun, and a spark from a gas heater. Of the 46 fires ignited by cigarette lighters, nine of the lighters were reported to be child-resistant lighters, 21 were non child-resistant, and 16 could not be determined whether child-resistant or not. Of the 21 non child-resistant lighters,

five of the lighters were grill lighters. Information was not collected on whether the child resistant lighters had been modified.

E. Child Play

According to the NFPA, matches and lighters are the leading ignition sources cited when child fire play is reported as the cause of residential fires. Between 1989 and 1993, upholstered furniture ranked fourth as the leading form of material first ignited in residential child play fires, behind mattresses and bedding, clothing, and trash.[6] The CPSC child-resistant lighter standard, which is intended to reduce the risk of child play fires started by children under age five, went into effect in 1994. Evidence of its effect may be available from 1996 national fire data, not yet available, though the maximum beneficial effect may not be observed until future years.

Of the 76 investigations, the probable cause of fire in 65 (86%) of the fires was children playing. The remaining 11 fires were reportedly caused by candles tipping over and falling on the upholstered furniture (8 fires or 11%), careless adult use of lighters (2 fires or 3%), and a malfunctioning gas heater (1 fire or 1%).

The age of the children reported as starting the fires ranged from 2 years of age to 11 years of age. Among the 65 child play fires, 44 fires involved children less than 5 years as the fire-setters and 19 fires involved children between 5 and 11. The ages of two children were unknown. Table 8 shows the distribution of the ages of the children involved in the fires by the type of small open flame ignition source. Seven of the nine fires involving child-resistant lighters were started by children under the age of 5. Ten investigations reported that the child involved in starting the fire had some experience playing with lighters and/or matches.

Table 8
Age Distribution of Children Setting Upholstered Furniture Fires by Small Open Flame Source

Small Open Flame Source	Age of Child			
	Less than 5 Years	5 - 11 Years	Unknown	**Total**
Child-Resistant Lighter	7	2	0	**9**
Nonchild-Resistant Lighter	17	4	0	**21**
Unknown Type of Lighter	11	3	0	**14**
Matches	3	9	2	**14**
Other	6	1	0	**7**
Total	**44**	**19**	**2**	**65**

Source: U.S. Consumer Product Safety Commission / EHHA
In-depth Investigation File, Upholstered Furniture Data Collection, October 1994 - February 1997.

In 57 of the 65 child play fire incidents, there was an adult in the home, usually a parent (43). Grandparents (8) and other adults over the age of 15 (6) were also reported as supervising the child. In three incidents, the child was supervised by a person under the age of 15 and in another two incidents the child was left alone in the home. In the remaining three incidents, supervision of the child was unknown. Most of the supervising adults were sleeping when the fire started. Typically, the fires started in the early morning when the child got up before the adult. Other activities of the supervising adults included watching TV, cooking, talking on the phone, attending other children, or engaging in household chores. Although the persons who were supervising the children were in the home when the child started the fire, most did not become aware of the fire until they were alerted by the child's cry for help or by the smell of smoke.

As ignition was not witnessed by adults, it was generally unknown how long the fire burned before discovery. In these instances, the fire was often said to have progressed to such an extent that it was difficult to extinguish, although many tried to do so. Sometimes the intensity of the fire or smoke produced made escape difficult.

F. Fire Losses

In the 76 fire incidents investigated, there were 39 deaths and 45 injuries for a combined total of 84 fire casualties. Table 9 presents the diagnosis and age of the victims in the 76 fires investigated. All of the victims suffered from smoke inhalation or thermal burns. Many injured victims had burns to the hands and arms, due to their efforts to extinguish the fires. Thirty-two of the 39 fatalities resulted from smoke inhalation and 7 of the fatalities resulted from thermal burns. Of the 45 injured victims, 25 suffered from smoke inhalation and 19 suffered from thermal burns; the diagnosis of 1 injured victim was unknown. The sample odds ratio[7] for diagnosis indicated that victims who suffered smoke inhalation were more likely to die in these fires than those victims who suffered from burns. This is consistent with the general fire experience where smoke inhalation accounted for the largest share of civilian home fire casualties between 1989 and 1993.[8]

According to NFPA, the leading cause of fire deaths for preschool children was playing with fire.[9] In the upholstered furniture fire study, one half of the deaths (19) and one third (15) of the injuries involved children less than 5 years of age (See Table 9.)

Forty-two of the 76 fires investigated involved either a fatality or an injury. Nineteen fires involved only one victim, 11 fires involved two victims, 8 fires involved three victims, 1 fire involved four victims, and 3 fires involved five victims.

Table 9
Fire Casualties in Upholstered Furniture Fires by Diagnosis and Age

Fire Casualties	Diagnosis			Age			Total
	Burns	Smoke Inhalation	Known Total	Less than 5 Years	5 Years & Over	Known Total	
Deaths	7	32	39	19	19	38	**39**
Injuries	19	25	44	15	21	36	**45**
Total	**26**	**57**	**83**	**34**	**40**	**74**	**84**

Source: U.S. Consumer Product Safety Commission / EHHA
In-depth Investigation File, Upholstered Furniture Data Collection, October 1994 - February 1997.
Note: The diagnosis of one injured victim was unknown. The age of one fatality and nine injured victims was unknown.

In addition to fire casualties, financial loss and physical property damage were described in the fire investigations. These were typically expressed as the extent of fire damage, whether the fire was confined to the object of origin or whether the fire extended beyond the object to the structure, and the dollar amount of property loss. Property loss included the dollar loss of both the structure and the contents.

Fire damage was described for 64 of the 76 fires. (See Table 10.) Nine of the fires were confined to the upholstered furniture, an additional 23 fires were confined to the room of origin, an additional 9 fires were confined to the floor of origin, and the remaining 23 fires consumed more than the floor of origin. One death resulted from a fire confined to the furniture. Three deaths occurred in fires confined to the room of origin. In the fire where the fire damage was confined to the upholstered furniture, an 8 year old boy ignited a seat cushion of a sofa while playing with matches. While trying to extinguish the flames in the seat cushion, he accidentally ignited his shirt, resulting in his death. The remaining 35 deaths occurred in fires where more than the room of origin was destroyed.

Table 10
Extent of Fire Damage for Upholstered Furniture Fires

Fire Damage	Number	Percent of Known
Confined to Furniture	9	14%
Confined to Room of Origin	23	36%
Confined to Floor or Origin	9	14%
Consumed more than Floor of Origin	23	36%
Unknown	12	-
Total	**76**	**100%**

Source: U.S. Consumer Product Safety Commission / EHHA
In-depth Investigation File, Upholstered Furniture Data Collection, October 1994 - February 1997.

The estimated property loss in dollars was reported in 62 of the 76 investigated fires. Table 11 presents the estimated property loss for the investigated fires. Most of the fires investigated were said to have resulted in less than $45,000 in property damage. The larger property losses occurred mainly in apartment buildings and other large residential structures.

Table 11
Estimated Property Loss of Fires Involving Upholstered Furniture

Estimated Property Loss	Number	Percent of Known
Less than $10,000	15	24%
$10,000 to $24,999	14	23%
$25,000 to $44,999	14	23%
$45,000 to $64,999	6	10%
$65,000 to $84,999	4	6%
More than $85,000	9	15%
Unknown	14	-
Total	**76**	**100%**

Source: U.S. Consumer Product Safety Commission / EHHA
In-depth Investigation File, Upholstered Furniture Data Collection, October 1994 - February 1997.

Note: Detail may not add to total due to rounding.

G. Household Characteristics

Information on formal education level of the head of the household was reported in 32 of the investigations. The education levels were almost equally distributed among the three categories of less than a high school education (10), a high school education (11), and some college education (11). Household income was reported for 33 of the households. Eleven of the households reported income of less than $15,000, 15 reported income between $15,000 and $34,999, and 7 reported income more than $35,000. The type of tenure in the residence was reported in 71 of the 76 investigations. It was reported that 41 rented and 30 owned the residence.

H. Smoke Detectors Present

Of the 76 investigations, 48 reported that there was a smoke detector present in the dwelling, 18 reported that no smoke detector was present, and 10 reported that it was unknown whether a smoke detector was present or not. (See Table 12.) In this study, the death rate for the nondetector-equipped households (14 deaths out of 18 fires) was higher than the death rate for

those households (23 deaths out of 48 fires) that had a smoke detector. These results, while based on a relatively small number of fires, are consistent with the national fire experience where most households without smoke detectors have a higher tendency to have fatal fires[10]. Twenty-five of the 48 smoke detectors in use alarmed and notified the victims of the fire and 13 of the smoke detectors did not alarm. Reasons given for why smoke detectors did not alarm were no batteries, dead batteries, and insufficient smoke.

Table 12
Frequency of Fires, Deaths, and Injuries by
Smoke Detector Presence in Upholstered Furniture Fires

Frequency	Smoke Detector Present			Total
	Yes	No	Unknown	
Fires	48	18	10	**76**
Deaths	23	14	2	**39**
Injuries	30	10	5	**45**

Source: U.S. Consumer Product Safety Commission / EHHA
In-depth Investigation File, Upholstered Furniture Data Collection, October 1994 - February 1997.

IV. Discussion

The national fire estimates indicate that the severity of open flame upholstered furniture fires may be increasing. Though the number of open flame upholstered furniture fires declined from 1980 to 1994, the risk of injury in these fires increased and no significant downward trend in the estimated risk of death was found; thus, these fires continued to be hazardous throughout the period. The decrease in open flame fires associated with upholstered furniture should not be taken as an overall indication that flammability of upholstered furniture is a diminishing problem.

The data collected in the 1994-1996 investigation study provided useful information on upholstered furniture fires involving small open flames, the areas of the upholstered furniture ignited, and the fire scenarios. Although these upholstered furniture fires were not from a random sample, the information contained in these investigations allows some observations to be made concerning small open flame upholstered furniture fires.

The most common scenario reported in the investigations involved preschool children playing with cigarette lighters and igniting the seating area of the upholstered furniture. In any open flame standard, ignition of the item being tested depends in part on the exposure time of the flame. The investigation data suggest that lighter ignition exposure times may be more representative of fire scenarios than match (shorter) or candle (longer) ignition times. When developing a small open flame standard for upholstered furniture, this finding should be considered in determining a flame exposure time.

The investigations reveal some information about the characteristics of upholstered furniture involved in small open flame ignited fires. Most products involved were sofas and chairs, including some motion products (e.g., recliners) and several slip-covered items. Additionally, the investigations show that seating areas, the outer back or sides, and the undersides of upholstered furniture were first ignited by small open flames, and suggest that protective measures for these areas would help reduce fire losses. Thus, the investigation results may be considered in establishing the scope and effect of a possible standard.

With 86 percent of the fires investigated resulting from children playing with cigarette

lighters and matches, parents of small children should be made more aware of the dangers of upholstered furniture small open flame ignition fires. In one investigation, a parent was aware that the child was playing with a lighter and did not attempt to stop or discourage the child.

As may have been expected, the death rate per fire investigated was higher for fires where the household was not equipped with a smoke detector. According to the NFPA, most nondetector-households tend to be low-income and have a greater risk for fires.[11] Also, children less than 5 years of age accounted for a large portion of the deaths in the fires investigated for this study. These findings are consistent with the national fire experience that suggests that children less than 5 years of age and low income households may have a higher risk of death in upholstered furniture fires.

Endnotes

1. Harwood, Beatrice and Kale, Deborah. (1980). Fires in Upholstered Furniture. Washington, DC: U.S. Consumer Product Safety Commission.

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5. Spearman's rank correlation coefficient was used to test for upward and downward trends at the 0.05 significance level.
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8. Slayton, Donna and Miller, Alison (1995). Patterns of Fire Casualties in Home Fires by Age and Sex, 1989-1993.Quincy, MA: National Fire Protection Association

9. Ibid.

10. Hall, John (1995). U.S. Fire Experience with Smoke Detectors and Other Fire Detectors. Quincy, MA: National Fire Protection Association.

11. Ibid.