

THE SMOKING-MATERIAL FIRE PROBLEM

**John R. Hall, Jr.
Fire Analysis and Research Division
National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02169-7471
www.nfpa.org**

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Executive Summary

In most years, smoking materials are the leading cause of fire deaths in the U.S. and every other country where fire deaths can be analyzed by cause. (In this analysis, “smoking materials” refer only to lighted tobacco products, not matches or lighters.)

In 2001, smoking-material structure fires decreased, from 32,500 in 2000 to 31,200. These fires resulted in 830 civilian deaths, 1,770 civilian injuries and \$386 million in direct property damage, all decreases from 2000.

More people die in smoking-material fires than in any other type of fire in the U.S.

Trash, mattresses and bedding, and upholstered furniture are the items most commonly ignited in smoking-material home fires.

The risk of dying in a residential structure fire caused by smoking materials rises with age. Two-fifths (40%) of fatal smoking-material-fire victims were age 65 or older, compared to their 12% share of the population. Older adults (age 65 and over) are less likely to smoke than younger adults. Therefore, their high rates of smoking-material fire deaths per million people are even more noteworthy.

In order to continue the downward trend in fire deaths and ensure the continued decline of smoking-material fires, all possible options must be examined and explored. One way to reduce smoking-material fires and deaths, besides smoking cessation, is public fire safety education. It is essential to have programs that will focus on careless behavior because it is such a large part of the smoking-material fire problem. Since behavior is one of the most difficult things to change, other approaches are also needed in addressing this problem.

One of the most important, ongoing efforts aimed at reducing fatal smoking-material fires has been taking place on the legislative front. A recently enacted ASTM standard test method measures a cigarette's ignition strength, its propensity to start fires. In recent years, Canada and New York state have adopted requirements that cigarettes sold either publicize or restrict their propensity to start fires.

Redesign of the products that smoking materials ignite can also reduce the number of fire deaths in smoking-material fires. Fires and fire deaths have been reduced through more stringent standards for cigarette ignition resistance of mattresses and upholstered furniture. However, these are still the leading items ignited in smoking-material structure fires, and thus deserve continued attention.

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Fires Started by Smoking Materials

In 2001, an estimated 31,200 smoking-material fires in structures caused 830 civilian deaths, 1,770 civilian injuries and \$386 million in direct property damage.

Structure fires started by smoking materials (i.e., lighted tobacco products but not matches or lighters) and associated injuries and property damage (adjusted for inflation) reached their lowest levels since analysis began in 1980. Civilian deaths were at the second lowest level since 1980, with only the 1999 fire death toll lower. (See Table 1.)

Canada's smoking-material fire problem is similar to that of the U.S.

Civilian deaths and injuries and direct property damage in smoking-material fires in Canada are less than those in the U.S. by roughly the same ratio as the difference in national populations. (See Table 1.) Note, too, that "smoking-materials" include matches and lighters used to light tobacco products in Canada but not in U.S. fire statistics.

The U.S. population is nearly 9 times that of Canada. The proportion of people who smoke is slightly higher in Canada, by 1-4 percentage points, depending on the year and the studies used for comparison.

Canada has become the first country to require reduced-ignition-strength cigarettes. In the U.S., New York is the first state to adopt such requirements.

Smoking-material fires in U.K. homes have also declined in recent years, but those in Japan structures have been increasing, as have associated deaths.

One-fourth of all 2001 U.S. fire deaths (excluding the events of 9/11) involved smoking materials.

Smoking materials are by far the leading cause of civilian deaths in U.S. fires. One of every four civilian fire deaths (26%) in the U.S. in 2001 (excluding the events of 9/11) were attributed to smoking materials. Out of 12 major causes of structure fires, smoking materials also ranked fourth for civilian fire *injuries*. (Cooking equipment fires accounted for the largest share of civilian injuries in structure fires, followed by open flame and intentional fires.) Despite the high number of casualties, smoking materials ranked only seventh for number of structure *fires* and seventh for *direct property damage*.

Smoking-related structure fires and associated deaths have declined faster than smoking itself. Table 1E shows that cigarette consumption declined by roughly one-third from 1986 to 2001, but fires per million cigarettes and civilian fire deaths per million cigarettes declined substantially as well. However, the rates of fires and deaths relative to cigarette consumption have shown little or no consistent change in the past five years.

Changes in NFIRS pose opportunities and challenges in describing and tracking the problem.

The statistics in this report are national estimates derived from the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS) in combination with NFPA's annual fire department survey. State agencies and local fire departments began implementing NFIRS Version 5.0 in 1999. Data that was collected in an earlier version was converted to Version 5.0.

Some conversions were straightforward and many data elements stayed fairly stable. In other sections, logic and definitions changed significantly, making it harder to track trends.

Several codes in the new and the old coding schemes relate to smoking-material fires.

Version 4.1 Code	Version 5.0 Code for Converted 4.1 Data	Version 5.0 Code Coded Directly
31 – Cigarette	61 – Cigarette	61 – Cigarette
32 – Cigar	62 – Cigar or pipe	62 – Cigar or pipe
33 – Pipe	62 – Cigar or pipe	62 – Cigar or pipe
39 – Unclassified smoking material	63 – Unknown-type smoking material	60 – Unclassified smoking material or open flame
30 – Unknown-type smoking material	63 – Unknown-type smoking material	63 – Unknown-type smoking material

In Version 5.0, cigars and pipes are combined. Neither has ever accounted for a significant share of the problem, which is dominated by cigarettes. Code 60 in Version 5.0 could be a concern, because it combines unclassified smoking materials and unclassified open flame sources. (And given the reported confusion between “unclassified” and “unknown type” in some past coding, there may be some mixing of unknown-type smoking material and unknown-type open flame sources.) The rules for converting Version 4.1 data to Version 5.0 work better to preserve the distinction between smoking material and open flame, which is more important than the distinction between unclassified and unknown-type. Hopefully, Version 5.1, when it arrives, will change the coding definitions to match the conversion rules.

Recognizing that most 1999-2001 data is converted Version 4.1 data, this analysis excludes Code 60 (unclassified open flame or smoking material).

Also not included in the above figures are most smoking-related confined fires in a trash receptacle. The new confined-fire categories do not require completion of detailed cause information, including heat source. This exclusion could affect the number of fires but would not be expected to have any significant effect on estimated deaths, injuries or property damage.

Detailed information about NFIRS, including Version 4.1 and 5.0 codes and conversion tables, can be obtained from <http://www.usfa.gov/>.

Deaths due to smoking-material home structure fires declined 57% from 1980 to 2001.

Smoking-material home structure fires have declined by two-thirds (67%) since 1980, while the number of associated civilian deaths has dropped by 57% and civilian injuries have declined by 62%. Deaths per 100 smoking-material structure fires were 14% higher in 2001 compared with the 1980 rate. The average severity in terms of civilian injuries per 100 fires also increased from 1980 to 2001 (up 20%). (See Table 1 and Figures 1-5.)

Human losses due to smoking-material structure fires nearly all occur in homes.

In 1999-2001, homes were the site of 95% of civilian fire deaths due to smoking materials and 91% of civilian fire injuries due to smoking materials. (See Table 2.)

Smoking-material fires are nearly all cigarette fires.

In 1999-2001 reported home structure fires involving smoking materials, cigarettes outnumbered cigars and pipes as the smoking material 57-to-1 for fires, 34-to-1 for civilian deaths, and 44-to-1 for civilian injuries.

Most victims were asleep when fatally injured but did not fall asleep while smoking.

There are three data fields bearing on what is traditionally called “cause” of fires. The first is called cause, and the other two are factor contributing to ignition and human factor contributing to ignition.

Abandonment or careless discarding of the smoking material was by far the leading factor contributing to ignition for smoking-material fires in homes. (See Table 3.) Smoking materials are not leading heat sources of choice for setters of intentional fires or children playing with fire.

The small percentages of smoking-material home fires and associated civilian deaths and injuries attributed to drug or alcohol impairment (see Table 3C) almost surely understate the frequency of drugs and alcohol as complicating factors. Overall, drug or alcohol impairment has been cited for only 12% of adult home fire fatal victims, compared to 40-50% of adult fire fatalities found to have elevated blood alcohol levels, in the few state studies using autopsy information.

The 1999-2001 percentage of smoking-material home fire deaths in which a sleeping smoker was a human factor contributing to ignition (39%) seems high. Some of the difference exists because multiple factors can now be indicated, a change which should make the 1999 and later statistics more accurate. However, it is also possible that some fire deaths are being coded with asleep as a factor contributing to ignition solely because there was a sleeping victim present who, if awake, might have discovered the smoldering cigarette before a self-sustaining fire was ignited. We will need to wait a while before we can be sure how the Human Factor Contributing to Ignition scale is being used.

Also, what used to be called “suspicious” fires are coded as Intentional if converted from Version 4.1 (analogous to the old combined cause of incendiary or suspicious causes) but are more likely treated as unknown in Version 5.0. This could justify some estimate adjustments, but because incendiary and suspicious fires have traditionally been a very small fraction of smoking-material fires, such adjustments would make little difference in the totals and have not been made.

Outdoor trash or brush fires are not addressed in this analysis.

Outdoor or "other" (e.g., trash, grass or brush) fires have traditionally accounted for the largest share of smoking-material fires but very little of the associated losses. In Version 5.0, cause information is required for outdoor brush fires but not for outdoor trash fires. This is why no analysis of outdoor and other smoking related fires has been attempted.

In home fires, smoking materials mostly ignite trash, mattresses and bedding, and upholstered furniture.

Trash, mattresses and bedding, and upholstered furniture were the items most often ignited by smoking materials in home fires, and together they accounted for the majority of fires and more than two-thirds of associated deaths and injuries. (See Table 4.)

Table 5 shows the trend in smoking-material structure fires since 1980 for these three classes of items.

Standards have made mattresses and upholstered furniture more resistant to smoking-material ignition.

Smoking-related residential fires have declined by 80% and 81% in upholstered furniture and in mattresses and bedding, respectively, since 1980. A mandatory U.S. Standard for the Flammability of Mattresses (and Mattress Pads), Title 16 CFR 1632, was enacted in 1973. A voluntary standard for upholstered furniture, the so-called "Upholstered Furniture Action Council (UFAC) standard," was introduced in the late 1970s and at that time was judged sufficiently substantial as to remove the need for a mandatory action.

The success of these two standards has been measured by studies of shifts in production toward less ignitable materials.* Composite indices of the susceptibility to smoking-material ignitions for upholstered furniture and mattresses in use declined 18.4% and 36.1%, respectively, from 1980 to 1984, compared to declines of 37.8% and 35.1%, respectively, in the number of residential structure fires per billion cigarettes consumed beginning with ignition of these two types of items. This means the ignitability indices matched the decline in mattress fire rates quite well and the decline in upholstered furniture fire rates less well. The gradual impact of these standards helps explain why the mattress, bedding and upholstered furniture share of home smoking-related fires has dropped so much (from 64% to 33% of fires, from 85% to 73% of fire deaths). (See Table 5.)

It is also true that items other than those targeted fuel sources (e.g., trash, clothing) have seen their smoking material fires decline substantially as well. It is possible that favorable changes affecting all smoking-material fires – the decline in the number of smokers, the growth in the use of smoke alarms – have had more of an impact than those changes that specifically targeted smoking-material-fires involving particular items (such as upholstered furniture and mattresses). It is also possible that the full benefits from the targeted programs have yet to arrive. This would be true, for example if smokers are more likely to be poor or old and so more likely to own older furniture and mattresses pre-dating the standards.

Fatal home smoking-related fires are more likely to start in the living room, family room, or den than in the bedroom.

Table 6 shows that these rooms together account for three-fourths of home smoking-related fire deaths and injuries, but living rooms, family rooms and dens account for far more fire deaths than bedrooms.

*See, for example, John R. Hall, Jr., *Final Report: Expected Changes in Fire Damages From Reducing Cigarette Ignition Propensity*, prepared for the Technical Study Group of the Cigarette Safety Act of 1984, Quincy: NFPA, July 16, 1987.

Smoking-related home fires peak in frequency in late afternoon and early evening.

Figure 6 shows these fires peaking during the hours when family members are coming home from their day's activities, but associated civilian fire deaths peak in the early morning (during 2:00 to 2:59 a.m.), which suggests a long smoldering period for unnoticed, discarded cigarettes, which erupt into flames when no one is awake to discover them.

Smoking-related home fires and deaths peak during colder months, when people spend proportionally more time indoors and smokers may do much more of their smoking indoors.

Figure 7 shows fires peaking in March and January while deaths peak in January and December.

Table 1. Trends in the Smoking-Material Fire Problem, by Major Property Use, 1980-2001

A. Fires

Year	U.S.			Vehicles	Canada	U.K. Dwelling	Japan
	Homes	All Other Structures	Total Structures				
1980	70,800	33,500	104,300	23,600			
1981	64,700	30,900	95,600	20,900			
1982	52,400	24,700	77,100	16,600			
1983	45,300	21,500	66,800	14,500			
1984	45,600	21,100	66,700	14,900			
1985	44,900	21,600	66,500	14,500			
1986	42,500	20,100	62,600	12,800			
1987	39,800	18,900	58,700	13,500			
1988	38,900	16,700	55,600	12,300			
1989	34,000	14,600	48,700	10,200			
1990	30,800	13,200	44,000	9,200	5,300	6,700	5,800
1991	29,900	12,700	42,600	8,300	5,200	6,500	5,900
1992	28,000	12,100	40,200	7,200	4,000	6,200	6,200
1993	27,200	11,400	38,600	6,800	3,100	6,300	6,200
1994	26,300	11,200	37,500	6,800	3,600	5,900	7,200
1995	25,400	10,100	35,400	7,500	5,000	5,800	7,200
1996	26,600	10,900	37,600	8,900	4,700	5,700	7,100
1997	23,300	9,800	33,100	6,900	4,300	5,600	7,200
1998	23,200	10,100	33,200	6,700	4,100	5,600	7,300
1999	24,300	9,900	34,200	7,200	3,800	5,500	7,500
2000	23,700	8,800	32,500	6,700		4,500	7,800
2001	23,100	8,000	31,200	6,100		4,900	8,100

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Estimates include a proportional share of fires with unknown heat source. Canada and U.K. statistics refer to “smokers materials,” which include some match and lighter fires not included in U.S. statistics.

Source: National estimates based on NFIRS and NFPA survey, Canadian provincial fire commissioners annual reports, *Fire Statistics United Kingdom* series, analysis of Japanese fire statistics by Dr. Ai Sekizawa, NRIFD.

Table 1. Trends in the Smoking-Material Fire Problem, by Major Property Use, 1980-2001 (Continued)

B. Civilian Deaths

Year	U.S.				Canada	U.K. Dwelling	Japan
	Homes	All Other Structures	Total Structures	Vehicles			
1980	1,820	150	1,960	20			
1981	1,980	210	2,190	20			
1982	1,680	80	1,760	30			
1983	1,510	90	1,600	20			
1984	1,480	110	1,590	10			
1985	1,580	110	1,690	20			
1986	1,350	100	1,460	30			
1987	1,380	80	1,460	30			
1988	1,570	70	1,640	20			
1989	1,190	50	1,240	20			
1990	1,150	70	1,220	30	150	270	160
1991	880	60	930	10	130	230	170
1992	1,000	60	1,060	10	90	240	180
1993	980	40	1,020	10	100	210	220
1994	840	60	900	0	70	190	210
1995	1,040	70	1,110	10	100	200	210
1996	1,090	60	1,150	30	140	220	210
1997	870	40	900	10	130	220	230
1998	850	30	880	20	110	220	210
1999	760	30	790	10	120	160	230
2000	820	30	850	10		190	220
2001	770	50	830	10		190	230

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Estimates include a proportional share of fires with unknown heat source. Canada and U.K. statistics refer to “smokers materials,” which include some match and lighter fires not included in U.S. statistics.

Source: National estimates based on NFIRS and NFPA survey, Canadian provincial fire commissioners annual reports, *Fire Statistics United Kingdom* series, analysis of Japanese fire statistics by Dr. Ai Sekizawa, NRIFD.

Table 1. Trends in the Smoking-Material Fire Problem, by Major Property Use, 1980-2001 (Continued)

C. Civilian Injuries

Year	U.S.				Canada	U.K. Dwelling
	Homes	All Other Structures	Total Structures	Vehicles		
1980	4,190	870	5,050	160		
1981	4,030	1,140	5,160	160		
1982	3,710	640	4,350	230		
1983	3,680	770	4,450	130		
1984	3,340	540	3,880	150		
1985	3,330	440	3,770	160		
1986	2,980	460	3,440	160		
1987	3,100	520	3,620	150		
1988	3,570	610	4,170	110		
1989	2,970	430	3,400	120		
1990	2,930	430	3,360	120	460	2,060
1991	2,730	490	3,220	100	330	2,250
1992	2,740	360	3,100	70	360	1,970
1993	2,850	470	3,320	50	300	2,080
1994	2,380	440	2,820	110	360	1,930
1995	2,230	270	2,500	90	380	1,980
1996	2,480	300	2,780	70	350	2,030
1997	1,990	350	2,330	90	320	2,120
1998	2,010	280	2,290	100	260	2,020
1999	1,830	200	2,040	90	260	1,900
2000	2,190	170	2,350	50		1,870
2001	1,600	180	1,770	70		1,880

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Estimates include a proportional share of fires with unknown heat source. Canada and U.K. statistics refer to “smokers materials,” which include some match and lighter fires not included in U.S. statistics.

Source: NFIRS and NFPA survey, Canadian provincial fire commissioners annual reports, *Fire Statistics United Kingdom* series, analysis of Japanese fire statistics by Dr. Ai Sekizawa, NRIFD.

Table 1. Trends in the Smoking-Material Fire Problem, by Major Property Use, 1980-2001 (Continued)

D. Direct Property Damage

Year	U.S. (Millions)				Total Structures in 2001 Dollars*
	Homes	All Other Structures	Total Structures	Vehicles	
1980	\$314	\$161	\$474	\$20	\$1,020
1981	\$307	\$118	\$424	\$15	\$825
1982	\$332	\$76	\$408	\$20	\$748
1983	\$266	\$90	\$356	\$13	\$632
1984	\$310	\$78	\$388	\$16	\$659
1985	\$304	\$106	\$409	\$9	\$673
1986	\$301	\$87	\$388	\$10	\$627
1987	\$282	\$97	\$379	\$13	\$590
1988	\$300	\$127	\$427	\$13	\$639
1989	\$276	\$187	\$464	\$14	\$662
1990	\$320	\$80	\$400	\$14	\$543
1991	\$398	\$136	\$535	\$16	\$695
1992	\$231	\$72	\$303	\$9	\$382
1993	\$300	\$79	\$379	\$10	\$464
1994	\$294	\$100	\$395	\$13	\$471
1995	\$308	\$176	\$483	\$19	\$561
1996	\$316	\$116	\$432	\$17	\$488
1997	\$320	\$100	\$420	\$12	\$463
1998	\$308	\$69	\$377	\$21	\$410
1999	\$353	\$158	\$511	\$17	\$543
2000	\$376	\$107	\$484	\$16	\$498
2001	\$316	\$70	\$386	\$16	\$386

*Converted using the Consumer Price Index.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation.

Source: NFIRS and NFPA survey

Table 1. Trends in the Smoking-Material Fire Problem, by Major Property Use, 1980-2001 (Continued)

D. Direct Property Damage

Year	Canada			Japan		
	in Canadian \$ (Millions)	in U.S. \$ (Millions)	in 2001 U.S. \$* (Millions)	in Japanese Yen (Billions)	in U.S. \$ (Millions)	in 2001 U.S. \$* (Millions)
1990	\$87	\$75	\$105	12.483	\$86	\$121
1991	\$93	\$81	\$109	13.488	\$100	\$135
1992	\$60	\$49	\$65	12.569	\$99	\$130
1993	\$47	\$36	\$46	15.109	\$136	\$173
1994	\$58	\$42	\$52	15.947	\$156	\$194
1995	\$63	\$46	\$56	15.233	\$162	\$195
1996	\$62	\$45	\$53	15.521	\$143	\$167
1997	\$65	\$47	\$54	15.024	\$124	\$142
1998	\$55	\$37	\$42	11.754	\$90	\$101
1999	\$58	\$39	\$43	13.326	\$117	\$129
2000				13.086	\$121	\$130
2001				12.372	\$102	\$106

*Converted using the Consumer Price Index.

Note: Canadian fires are only those reported to municipal fire departments and so exclude fires reported only to national or state agencies or industrial fire brigades. Direct property damage is estimated to the nearest million dollars. Totals may not equal sums because of rounding. Estimates include a proportional share of fires with unknown heat source.

Source: Canadian provincial fire commissioners annual reports, analysis of Japanese fire statistics by Dr. Ai Sekizawa, NRIFD.

**Table 1. Trends in the Smoking-Material Fire Problem, by Major Property Use, 1980-2001
(Continued)**

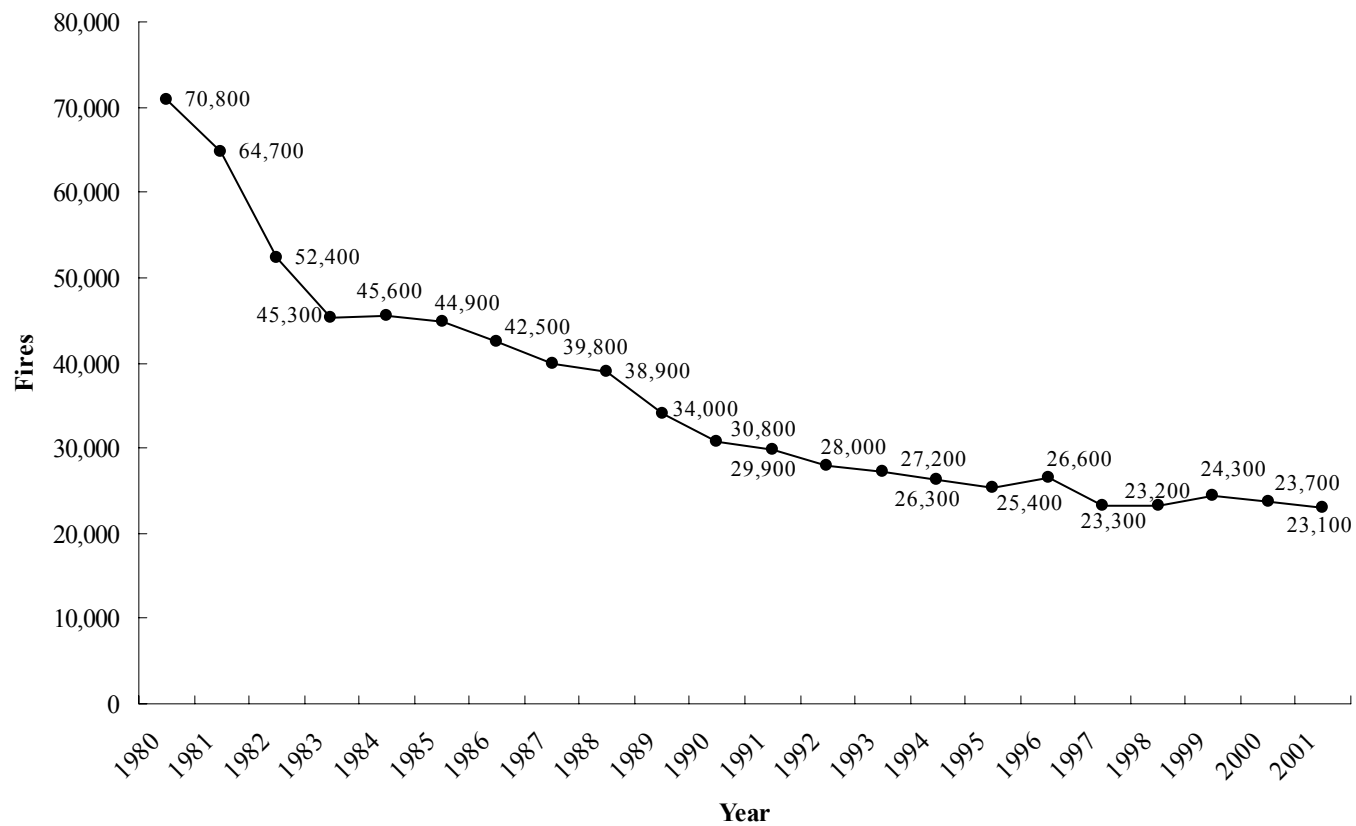
E. Cigarette Consumption and Related Fire Loss Rates

Year	Home Fires	Home Fire Deaths	Cigarettes Consumed (Billions)	Fires per Million Cigarettes	Deaths per Million Cigarettes
1980	70,800	1,820	619	114	2.9
1981	64,700	1,980	628	103	3.1
1982	52,400	1,680	624	84	2.7
1983	45,300	1,510	596	76	2.5
1984	45,600	1,480	600	76	2.5
1985	44,900	1,580	595	76	2.7
1986	42,500	1,350	583	73	2.3
1987	39,800	1,380	577	69	2.4
1988	38,900	1,570	550	71	2.8
1989	34,000	1,190	540	63	2.2
1990	30,800	1,150	525	59	2.2
1991	29,900	880	510	59	1.7
1992	28,000	1,000	500	56	2.0
1993	27,200	980	485	56	2.0
1994	26,300	840	486	54	1.7
1995	25,400	1,040	487	52	2.1
1996	26,600	1,090	487	55	2.2
1997	23,300	870	480	49	1.8
1998	23,200	850	465	50	1.8
1999	24,300	760	435	56	1.7
2000	23,700	820	430	55	1.9
2001	23,100	770	425	54	1.8

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred and civilian deaths to the nearest ten. Fire statistics include a proportional share of fires with heat source unknown.

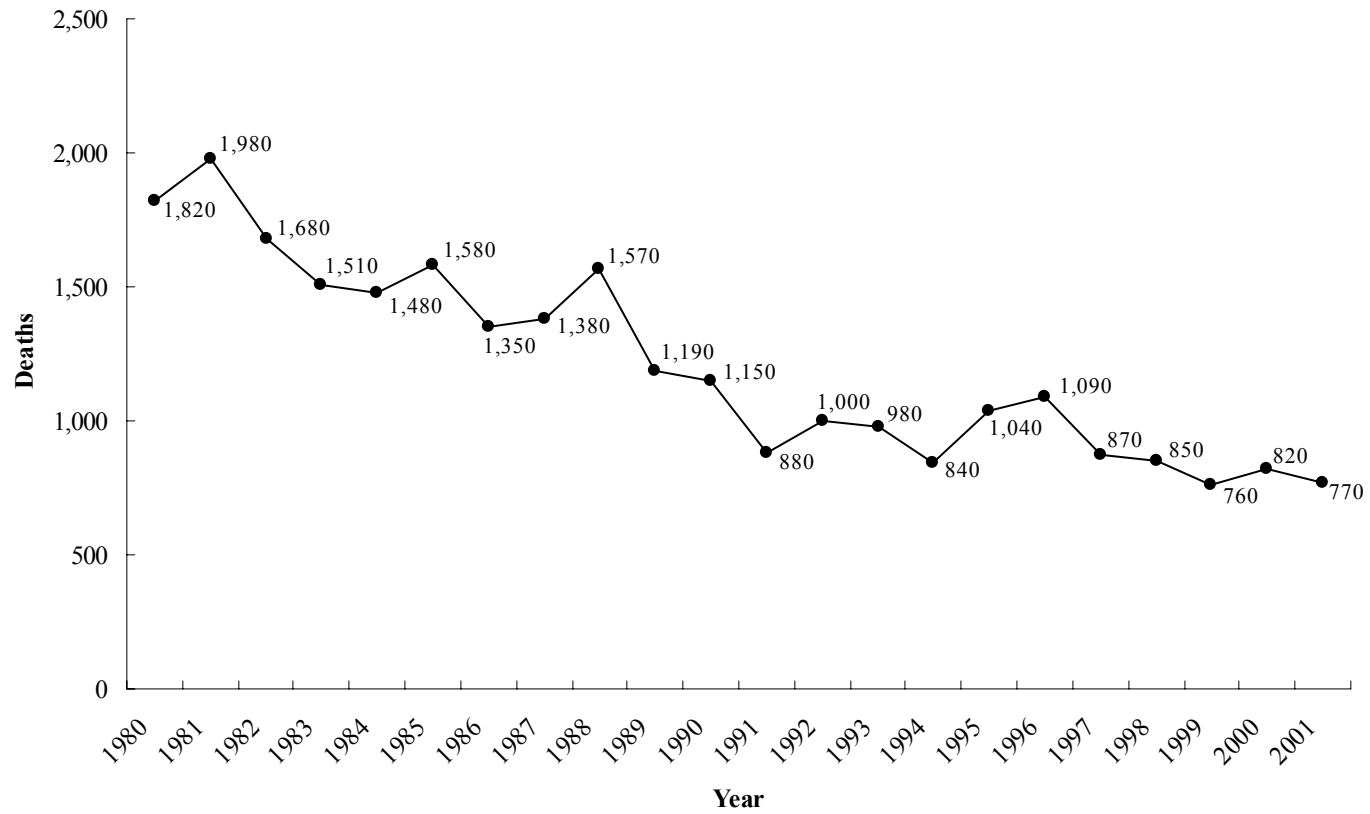
Source: National estimates based on NFIRS and NFPA survey. For 1980-86 data, John C. Maxwell, Jr., *The Maxwell Report: Revised Year-End Sales Estimates for the Cigarette Industry*, New York: Furman, Selz, Mager, Dietz and Birney, February 1981-1987; for 1987 and 1988 data, John C. Maxwell, Jr., *The Maxwell Consumer Report: 1988 Year-End Sales Estimates for the Cigarette Industry*, Richmond, Virginia: Wheat First Securities, January 27, 1989; and for 1994-2003, Tom Capehart, *Tobacco Outlook* U.S. Department of Agriculture www.ers.usda.gov, Oct. 6, 2003.

Figure 1. Trend in U.S. Smoking-Material Home Fires



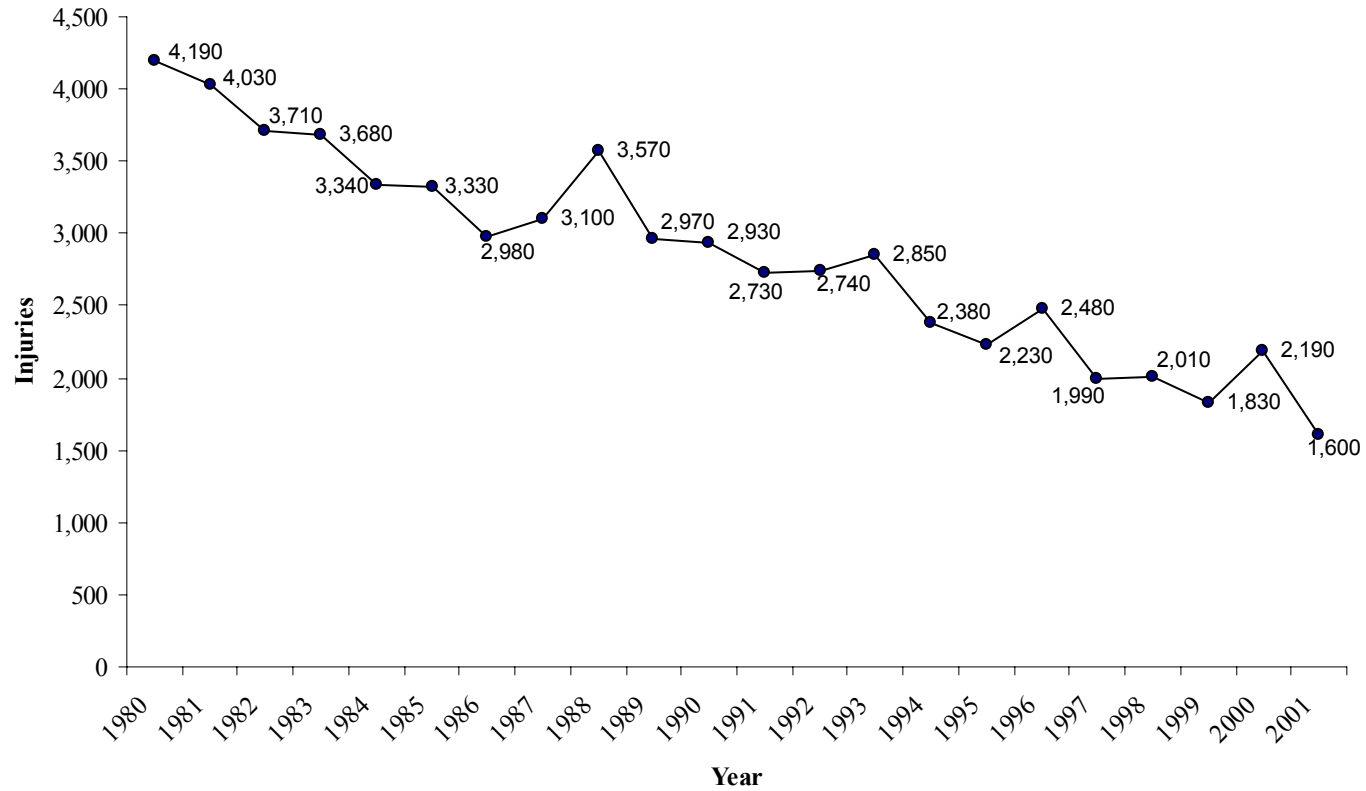
Source: NFIRS and NFPA survey

Figure 2. Trend in Civilian Deaths in U.S. Smoking-Material Home Fires



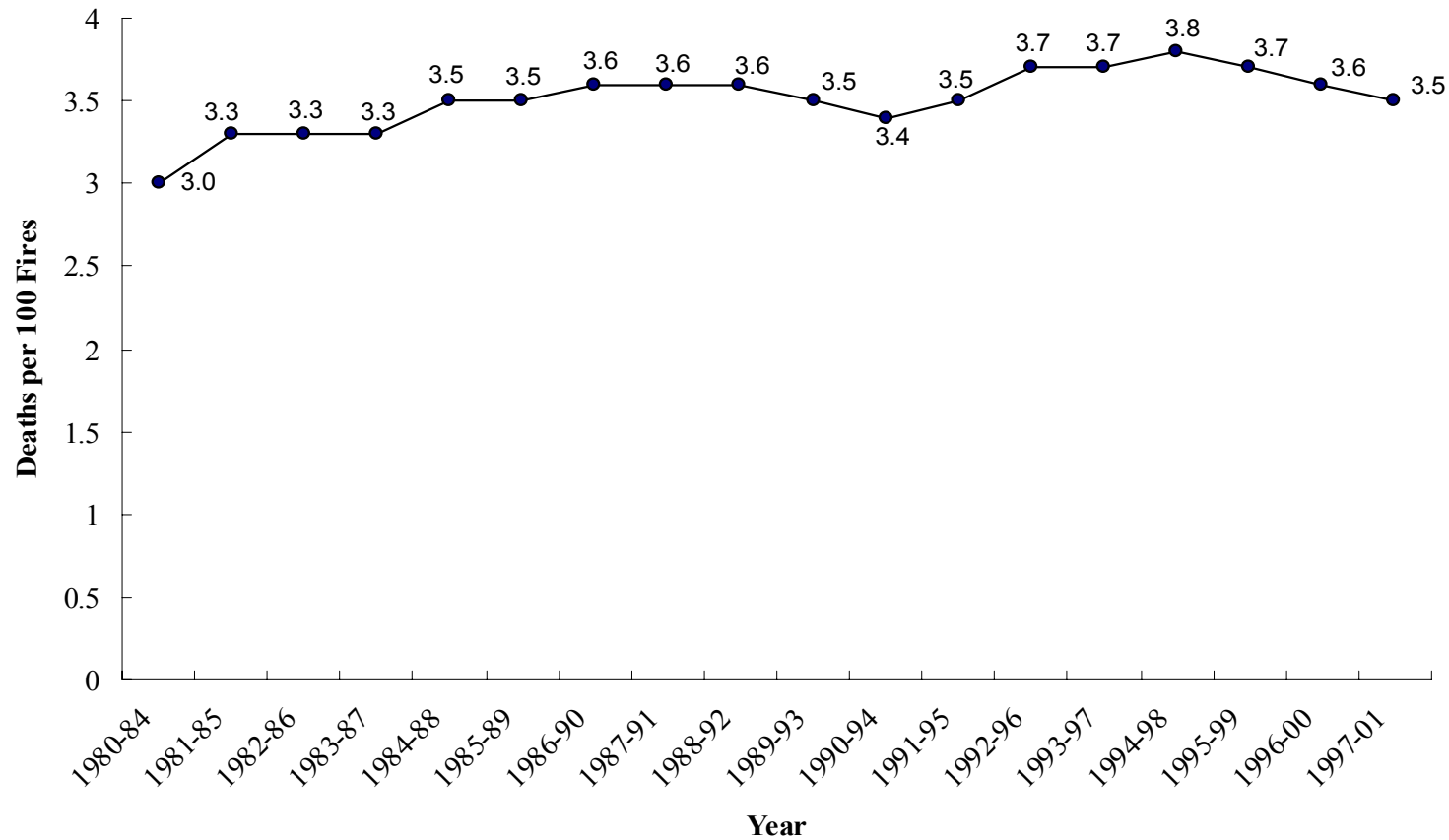
Source: NFIRS and NFPA survey

Figure 3. Trend in Civilian Injuries in U.S. Smoking-Material Home Fires



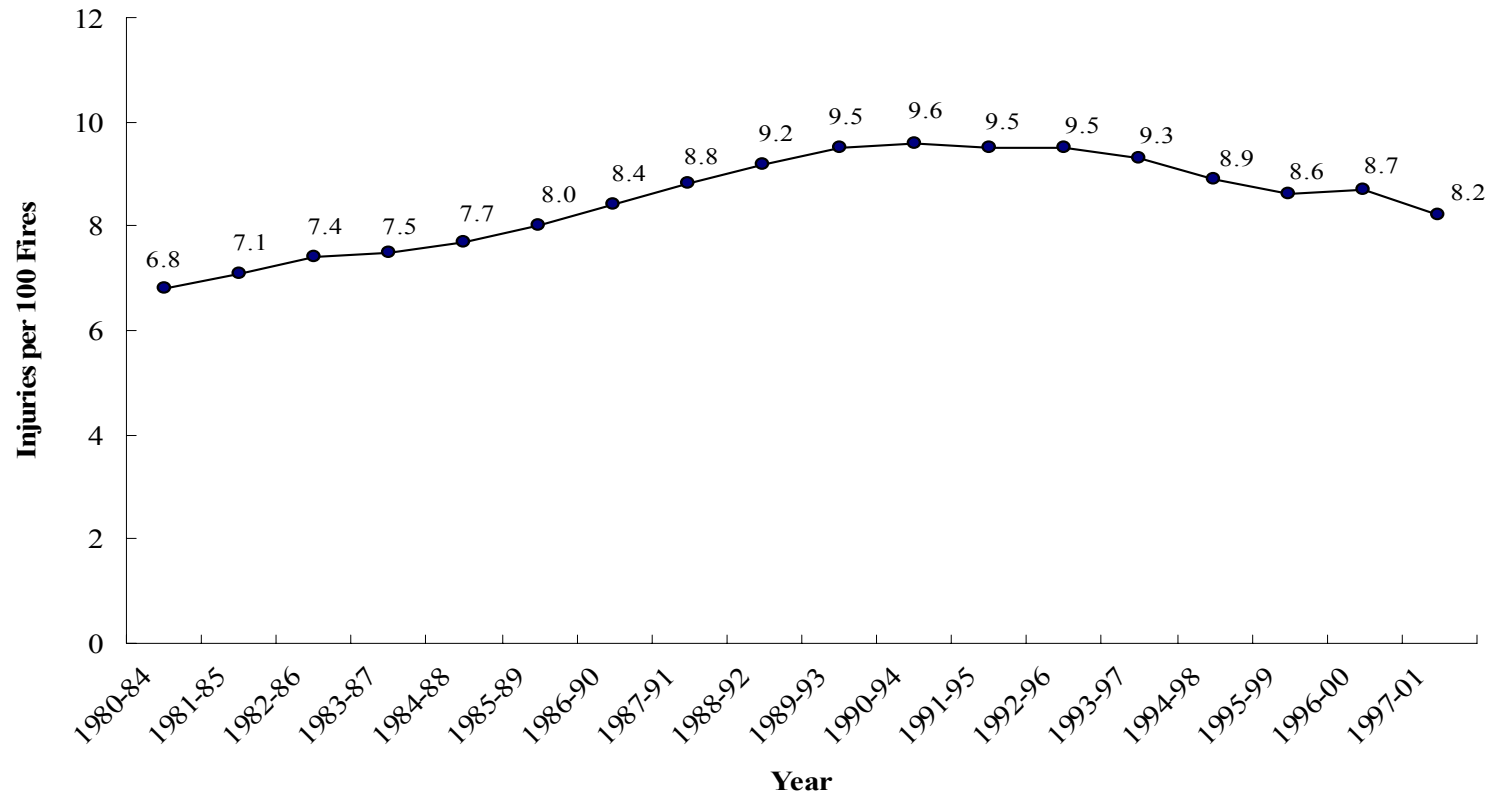
Source: NFIRS and NFPA survey

**Figure 4. Trend in Civilian Deaths
per 100 U.S. Smoking-Material Home Fires
(Five-Year Rolling Averages)**



Source: NFIRS and NFPA survey

**Figure 5. Trend in Civilian Injuries
per 100 Smoking-Material Home Fires
(Five-Year Rolling Averages)**



Source: NFIRS and NFPA survey

Table 2. Smoking-Material Structure Fires, by Property Use
Annual Average of 1999-2001 Structure Fires Reported to U.S. Fire Departments

Property Use	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage	
							(in Millions)	
One- or two-family dwelling, including manufactured home	14,700	(45%)	580	(70%)	1,130	(55%)	\$233	(51%)
Apartment	9,000	(28%)	210	(25%)	750	(36%)	\$115	(25%)
Dwelling garage or other vehicle storage facility	800	(3%)	0	(0%)	10	(1%)	\$5	(1%)
Hotel or motel	800	(2%)	10	(1%)	40	(2%)	\$6	(1%)
Eating or drinking place	800	(2%)	0	(0%)	10	(0%)	\$16	(3%)
Office building	600	(2%)	0	(0%)	0	(0%)	\$8	(2%)
Other or unclassified storage facility	400	(1%)	0	(0%)	0	(0%)	\$2	(0%)
Manufacturing facility	300	(1%)	0	(0%)	10	(0%)	\$11	(2%)
Food or beverage sales store	300	(1%)	0	(0%)	0	(0%)	\$8	(2%)
Boarding or rooming house	300	(1%)	0	(0%)	20	(1%)	\$1	(0%)
Nursing home	300	(1%)	10	(1%)	30	(1%)	\$1	(0%)
General item warehouse or storage facility	300	(1%)	0	(0%)	0	(0%)	\$5	(1%)
Hospital	300	(1%)	0	(0%)	10	(1%)	\$1	(0%)
School up to grade 12	300	(1%)	0	(0%)	0	(0%)	\$3	(1%)
Unclassified residential property	300	(1%)	0	(0%)	10	(0%)	\$2	(1%)
Prison or jail	200	(1%)	0	(0%)	0	(0%)	\$0	(0%)
Dormitory, fraternity or sorority house, or barracks	200	(1%)	0	(0%)	10	(0%)	\$5	(1%)
Service station or motor vehicle repair shop	200	(1%)	0	(0%)	10	(0%)	\$2	(0%)
Other known property use	1,900	(6%)	10	(1%)	20	(1%)	\$29	(6%)
Unknown or unreported property use	700	(2%)	0	(0%)	0	(0%)	\$7	(1%)
Total	32,600	(100%)	820	(100%)	2,050	(100%)	\$461	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

**Table 3. Cause-Related Factors in Smoking-Material Home Fires
Annual Average of 1999-2001 Structure Fires Reported to U.S. Fire Departments**

A. Cause

Cause	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage
Unintentional	22,000	(93%)	730	(93%)	1,760	(94%)	\$321	(92%)
Intentional	800	(3%)	20	(3%)	60	(3%)	\$16	(4%)
Failure of equipment or heat source	400	(2%)	0	(0%)	10	(0%)	\$5	(1%)
Unclassified	300	(1%)	10	(1%)	20	(1%)	\$2	(1%)
Act of nature	0	(0%)	0	(0%)	0	(0%)	\$0	(0%)
Cause under investigation	100	(1%)	20	(3%)	20	(1%)	\$4	(1%)
Total	23,700	(100%)	780	(100%)	1,870	(100%)	\$349	(100%)

Note: The data field labeled “cause” is primarily focused on distinguishing intentional from other fires and in identifying fires under investigation that may have had cause identified later. These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown and smoking-material fires with cause unknown. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

**Table 3. Cause-Related Factors in Smoking-Material Home Fires
Annual Average of 1999-2001 Structure Fires Reported to U.S. Fire Departments (Continued)**

B. Factor Contributing to Ignition

Factor Contributing to Ignition	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Abandoned or discarded material	16,100	(68%)	430	(55%)	1,090	(58%)	\$231	(66%)
Unclassified misuse of material	1,000	(4%)	50	(6%)	120	(6%)	\$19	(5%)
Equipment unattended	900	(4%)	0	(0%)	20	(1%)	\$2	(1%)
None	600	(3%)	40	(5%)	40	(2%)	\$7	(2%)
Heat source too close to combustibles	500	(2%)	30	(3%)	50	(3%)	\$10	(3%)
Unclassified factor contributed to ignition	500	(2%)	20	(2%)	40	(2%)	\$5	(2%)
Playing with heat source	300	(1%)	0	(0%)	10	(1%)	\$13	(4%)
Improper container or storage	200	(1%)	0	(0%)	0	(0%)	\$2	(1%)
Other known factor contributing to ignition	800	(3%)	10	(1%)	40	(2%)	\$9	(3%)
Not reported	2,900	(12%)	210	(26%)	480	(25%)	\$51	(15%)
Total	23,700	(100%)	780	(100%)	1,870	(100%)	\$349	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown and smoking-material fires with unknown factor contributing to ignition. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

**Table 3. Cause-Related Factors in Smoking-Material Home Fires
Percentage of 1999-2001 Structure Fires Reported to U.S Fire Departments (Continued)**

C. Human Factor Contributing to Ignition*

Human Factor Contributing to Ignition	Percent Fires	Percent Deaths	Percent Injuries	Percent Direct Damage
None	66%	34%	37%	60%
Asleep	13%	39%	39%	15%
Unattended or unsupervised person	8%	3%	6%	6%
Possibly impaired by alcohol or drugs	7%	12%	26%	13%
Age was a factor	3%	14%	5%	4%
Physically disabled	1%	12%	6%	3%
Possibly mentally disabled	1%	3%	2%	1%
Multiple persons involved	1%	0%	2%	2%
Not reported	4%	7%	2%	4%

*Percents can add up to more than 100% because more than one factor is allowed per incident. Percents based only on incidents coded in NFIRS Version 5.0, not converted.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire.

Source: NFIRS and NFPA survey

**Table 4. Smoking-Material Fires in Homes, by Item First Ignited
Annual Average of 1999-2001 Structure Fires Reported to U.S. Fire Departments**

Item	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
	Count	(%)	Count	(%)	Count	(%)	Count	(%)
Trash or waste	4,800	(20%)	30	(3%)	160	(9%)	\$37	(11%)
Mattress or bedding	4,500	(19%)	190	(25%)	600	(32%)	\$78	(22%)
Upholstered furniture	3,900	(16%)	340	(43%)	510	(27%)	\$91	(26%)
Structural member or framing	1,000	(4%)	10	(1%)	20	(1%)	\$7	(2%)
Exterior wall covering	900	(4%)	0	(0%)	10	(1%)	\$10	(3%)
Clothing	900	(4%)	40	(4%)	80	(4%)	\$10	(3%)
Unclassified furniture	800	(3%)	50	(6%)	140	(8%)	\$16	(5%)
Exterior trim, including doors	700	(3%)	0	(0%)	10	(0%)	\$7	(2%)
Floor covering	700	(3%)	30	(3%)	50	(3%)	\$9	(2%)
Papers	600	(3%)	10	(1%)	40	(2%)	\$10	(3%)
Unclassified item	600	(3%)	10	(1%)	50	(3%)	\$7	(2%)
Multiple items first ignited	600	(2%)	20	(2%)	30	(1%)	\$16	(5%)
Box or bag	500	(2%)	10	(1%)	30	(2%)	\$8	(2%)
Interior wall covering	300	(1%)	0	(0%)	10	(1%)	\$4	(1%)
Grass or other plants	300	(1%)	0	(0%)	0	(0%)	\$4	(1%)
Unclassified soft goods or clothing	200	(1%)	30	(4%)	20	(1%)	\$4	(1%)
Unclassified structural component or finish	200	(1%)	0	(0%)	0	(0%)	\$4	(1%)
Other known item first ignited	2,100	(9%)	30	(3%)	110	(6%)	\$27	(8%)
Total	23,700	(100%)	780	(100%)	1,870	(100%)	\$349	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown and smoking-material fires with unknown item first ignited. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

**Table 5. Trend in Leading Materials First Ignited in Home Smoking-Material Fires, 1980-2001
Structure Fires Reported to U.S. Fire Departments**

A. Fires

Year	Mattress or Bedding	Upholstered Furniture	Trash	Clothing	All Other Items	Percentage That Are Not Mattress, Bedding, or Upholstered Furniture
1980	24,200	21,500	11,200	1,900	12,000	36%
1981	22,100	20,100	10,200	2,000	10,200	35%
1982	17,900	15,800	8,300	1,500	8,900	36%
1983	16,000	13,100	7,100	1,400	7,700	36%
1984	15,500	13,000	7,300	1,200	8,600	37%
1985	15,800	12,000	7,000	1,300	8,800	38%
1986	14,600	11,300	6,700	1,300	8,600	39%
1987	13,300	10,500	6,400	1,200	8,400	40%
1988	12,500	10,100	6,400	1,300	8,600	42%
1989	11,200	8,600	5,400	1,100	7,700	42%
1990	9,500	7,800	5,300	1,100	7,100	44%
1991	9,000	7,300	4,800	1,200	7,600	45%
1992	8,600	6,500	4,500	1,100	7,300	46%
1993	7,900	6,200	4,500	1,100	7,500	48%
1994	7,400	5,900	4,300	1,000	7,800	50%
1995	6,500	5,700	4,100	1,100	8,000	52%
1996	6,600	5,300	4,400	1,100	9,100	55%
1997	5,400	4,700	3,700	1,000	8,400	56%
1998	5,500	4,600	3,700	1,000	8,400	56%
1999	4,800	4,200	4,200	900	10,200	63%
2000	4,500	3,900	5,100	900	9,200	64%
2001	4,200	3,500	5,300	800	9,300	67%

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown and smoking-material fires with unknown item first ignited. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

**Table 5. Trend in Leading Materials First Ignited in Home Smoking-Material Fire Deaths, 1980-2001
Structure Fires Reported to U.S. Fire Departments (Continued)**

B. Civilian Deaths

Year	Mattress or Bedding	Upholstered Furniture	Trash	Clothing	All Other Items	Percentage That Are Not Mattress, Bedding, or Upholstered Furniture
1980	520	1,030	10	70	180	15%
1981	550	1,090	110	80	150	17%
1982	480	960	40	40	150	14%
1983	490	800	50	60	100	14%
1984	380	910	20	30	150	13%
1985	510	740	80	60	180	20%
1986	350	740	30	40	190	20%
1987	370	680	40	70	220	24%
1988	450	820	60	50	180	19%
1989	350	670	20	30	120	15%
1990	320	590	50	40	150	21%
1991	280	450	30	20	90	16%
1992	300	480	30	60	140	22%
1993	340	460	30	20	130	18%
1994	200	400	30	40	160	28%
1995	270	490	50	60	170	27%
1996	350	450	30	70	190	27%
1997	200	440	20	70	130	25%
1998	250	410	20	60	120	23%
1999	160	330	20	30	220	36%
2000	220	330	40	40	200	34%
2001	200	360	20	40	160	27%

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown and smoking-material fires with unknown item first ignited. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

**Table 5. Trend in Leading Materials First Ignited in Home Smoking-Material Fire Injuries, 1980-2001
Structure Fires Reported to U.S. Fire Departments (Continued)**

C. Civilian Injuries

Year	Mattress or Bedding	Upholstered Furniture	Trash	Clothing	All Other Items	Percentage That Are Not Mattress, Bedding, or Upholstered Furniture
1980	1,410	1,910	190	120	560	21%
1981	1,420	1,810	210	110	470	20%
1982	1,260	1,680	250	80	430	21%
1983	1,370	1,670	200	100	330	17%
1984	1,200	1,420	200	80	440	21%
1985	1,210	1,410	200	90	430	21%
1986	1,110	1,230	220	60	370	22%
1987	1,150	1,270	190	90	390	22%
1988	1,300	1,400	210	120	540	24%
1989	1,070	1,090	200	110	500	27%
1990	1,100	1,170	220	80	370	22%
1991	990	1,020	140	130	460	26%
1992	1,170	810	170	140	450	28%
1993	1,020	990	200	80	570	30%
1994	800	860	250	90	380	31%
1995	720	800	130	60	520	32%
1996	780	880	150	190	470	33%
1997	710	650	150	70	400	32%
1998	660	690	140	60	460	33%
1999	570	530	160	80	490	40%
2000	730	540	180	90	650	42%
2001	480	460	150	80	440	41%

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown and smoking-material fires with unknown item first ignited. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

**Table 5. Trend in Leading Materials First Ignited in Home Smoking-Material Fire Damage, 1980-2001
Structure Fires Reported to U.S. Fire Departments (Continued)**

D. Direct Property Damage (in Millions)

Year	Mattress or Bedding	Upholstered Furniture	Trash	Clothing	All Other Items	Percentage That Are Not Mattress, Bedding, or Upholstered Furniture
1980	\$82	\$124	\$27	\$38	\$43	34%
1981	\$87	\$129	\$32	\$10	\$49	30%
1982	\$75	\$185	\$28	\$6	\$38	22%
1983	\$82	\$106	\$27	\$8	\$44	30%
1984	\$86	\$125	\$31	\$15	\$52	32%
1985	\$101	\$119	\$26	\$7	\$51	28%
1986	\$87	\$115	\$31	\$8	\$60	33%
1987	\$71	\$101	\$33	\$6	\$70	39%
1988	\$89	\$109	\$30	\$9	\$63	34%
1989	\$84	\$104	\$28	\$6	\$55	32%
1990	\$78	\$136	\$35	\$8	\$63	33%
1991	\$105	\$116	\$34	\$12	\$130	44%
1992	\$70	\$73	\$24	\$7	\$58	38%
1993	\$93	\$96	\$30	\$7	\$73	37%
1994	\$69	\$101	\$31	\$13	\$81	42%
1995	\$77	\$106	\$32	\$8	\$85	41%
1996	\$76	\$92	\$37	\$10	\$100	47%
1997	\$69	\$84	\$42	\$10	\$115	52%
1998	\$71	\$86	\$32	\$10	\$109	49%
1999	\$79	\$98	\$34	\$10	\$132	50%
2000	\$87	\$103	\$44	\$14	\$129	50%
2001	\$67	\$69	\$34	\$7	\$139	57%

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown and smoking-related material fires with unknown item first ignited. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

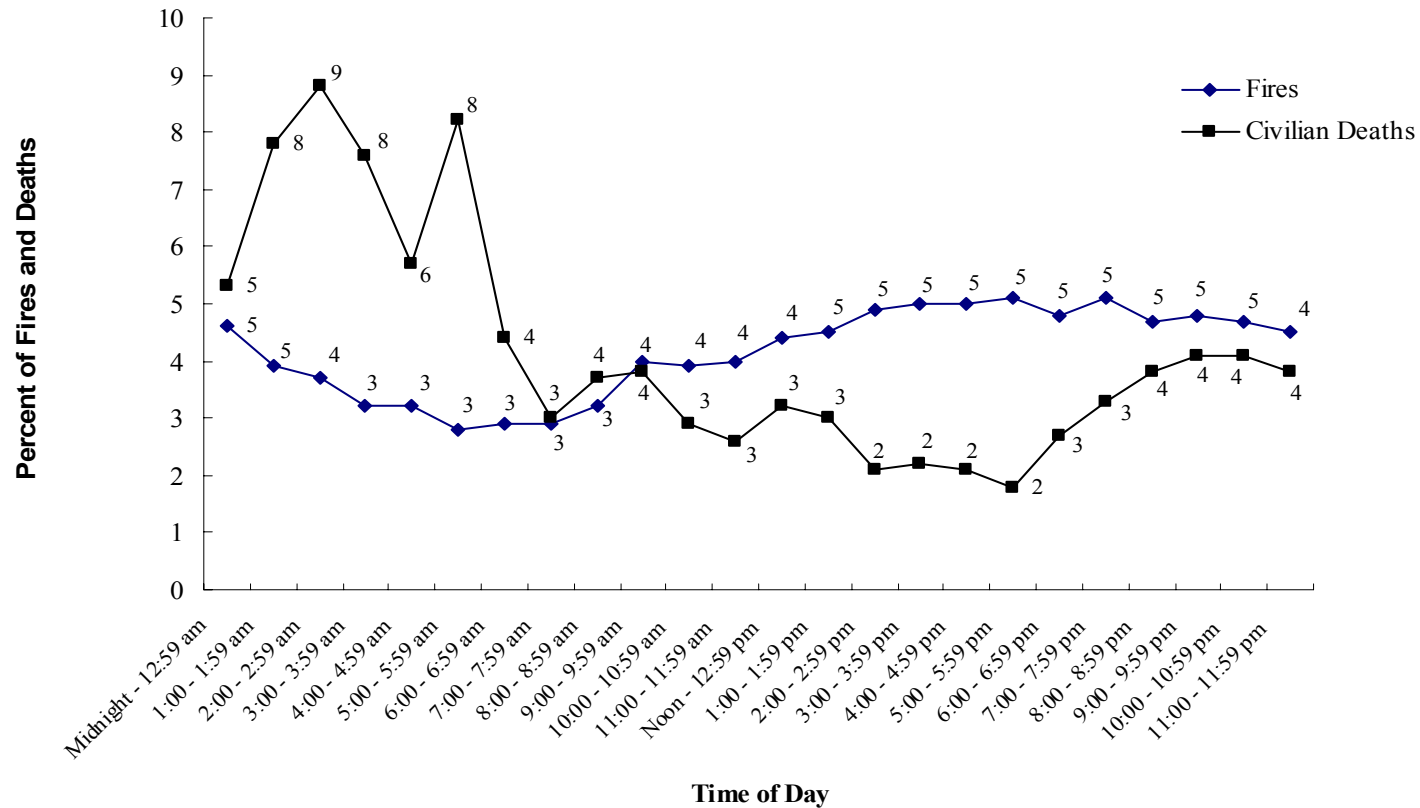
**Table 6. Smoking-Material Fires in Homes, by Area of Fire Origin
Annual Average of 1999-2001 Structure Fires Reported to U.S. Fire Departments**

Area of Origin	Fires		Civilian Deaths		Civilian Injuries		Direct Property Damage (in Millions)	
Bedroom	6,800	(29%)	270	(34%)	860	(46%)	\$109	(31%)
Living room, family room or den	3,600	(15%)	330	(43%)	490	(26%)	\$79	(23%)
Exterior balcony or unenclosed porch	1,800	(8%)	0	(1%)	30	(2%)	\$28	(8%)
Trash chute or container	1,700	(7%)	0	(0%)	20	(1%)	\$14	(4%)
Kitchen	1,600	(7%)	30	(3%)	70	(4%)	\$19	(5%)
Bathroom	1,100	(4%)	10	(1%)	50	(3%)	\$6	(2%)
Exterior wall surface	900	(4%)	0	(0%)	20	(1%)	\$7	(2%)
Garage or carport	600	(3%)	0	(0%)	30	(1%)	\$11	(3%)
Exterior stairway, ramp, or fire escape	400	(2%)	0	(0%)	0	(0%)	\$1	(0%)
Substructure area or crawl space	400	(2%)	10	(1%)	20	(1%)	\$5	(1%)
Laundry area	400	(2%)	0	(0%)	20	(1%)	\$4	(1%)
Courtyard, patio, or terrace	400	(2%)	0	(0%)	10	(0%)	\$4	(1%)
Hallway or corridor	300	(1%)	0	(0%)	10	(0%)	\$1	(0%)
Dining room	300	(1%)	30	(4%)	40	(2%)	\$7	(2%)
Unclassified area of origin	300	(1%)	20	(2%)	30	(1%)	\$5	(1%)
Unclassified function area	200	(1%)	30	(4%)	30	(2%)	\$4	(1%)
Closet	200	(1%)	0	(0%)	10	(1%)	\$4	(1%)
Unclassified structural area	200	(1%)	10	(1%)	10	(0%)	\$4	(1%)
Other known area of origin	2,500	(11%)	50	(6%)	130	(7%)	\$37	(11%)
Total	23,700	(100%)	780	(100%)	1,870	(100%)	\$349	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Fires are rounded to the nearest hundred, civilian deaths and civilian injuries are expressed to the nearest ten and property damage is rounded to the nearest million dollars. Property damage figures have not been adjusted for inflation. Fire statistics include a proportional share of fires with heat source unknown and smoking-material fires with unknown area of origin. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey

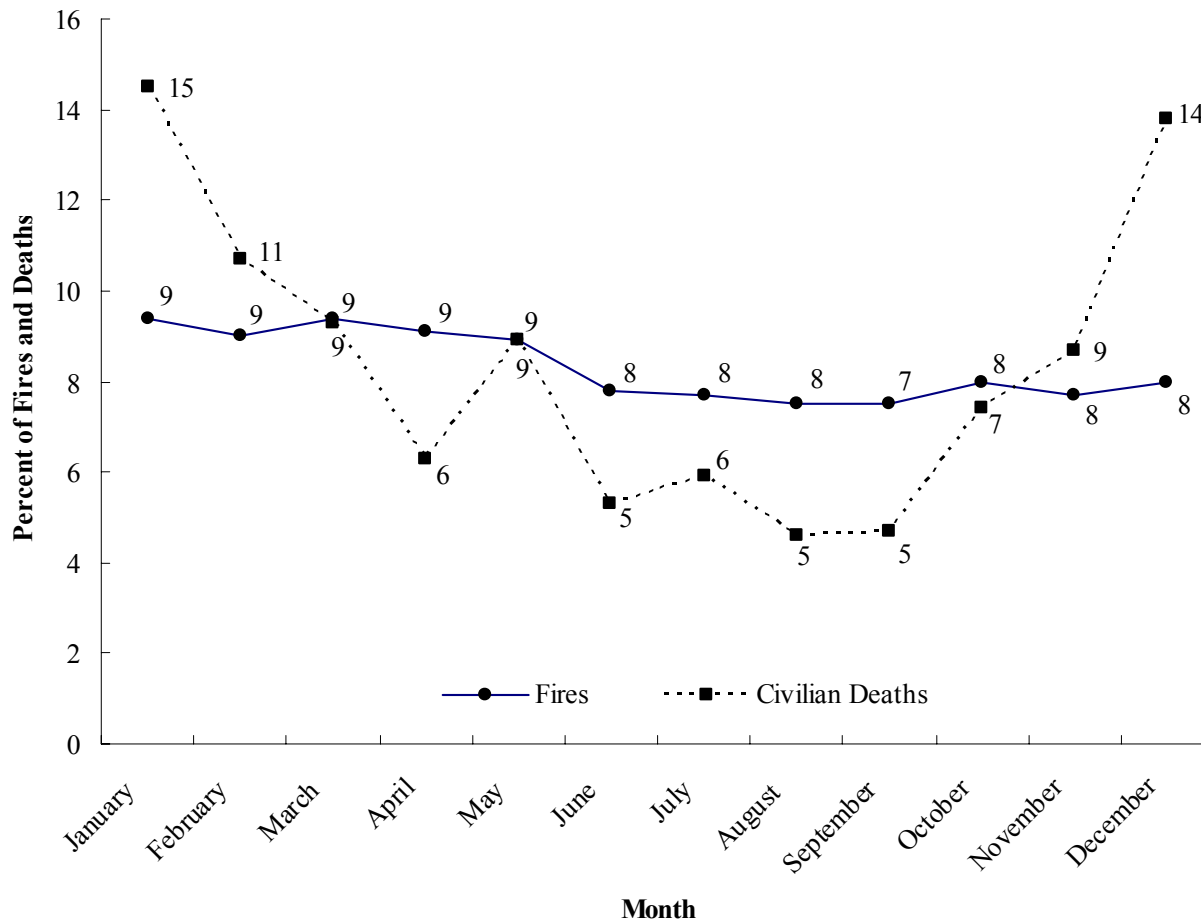
**Figure 6. Smoking-Material Home Structure Fires and Deaths,
by Time of Day
Annual Average of 1999-2001 Reported Fires**



Note: Time refers to alarm time to fire department, not ignition time.

Source: NFIRS and NFPA survey.

**Figure 7. Smoking-Material Home Structure Fires and Deaths, by Month
Annual Average of 1999-2001 Reported Fires**



Source: NFIRS and NFPA survey.

Victim Patterns for Smoking-Material Fires

The decline in smoking-material fires is partly due to a decline in cigarettes smoked per adult per year.

From 1987 to 2003, cigarette consumption declined by 31%, but the number of cigarettes consumed per adult declined by 40%. (See Table 7.) This in turn reflects that the population is growing.

Older adults are at highest risk of death or injury from home smoking-material fires, even though they are less likely to smoke than younger adults.

Children and others under age 18 have the lowest fire death risks, although the fire death risk for children under age 5 is nearly as high as for young adults aged 20 to 29. For adults, death rates rise with age, and people age 85 and over have the highest rates. (See Table 8.)

The child victims of smoking-material fires reflect children who smoke but even more reflect children living in households with adults who smoke.

The high risk of death for older adult smokers may be even higher than Table 8 indicates, because the percentage of people over age 65 who are current smokers is less than half of the percentage for 18- to 64-year-olds. (See Table 9B.) While one cannot assume that all victims of smoking-material fires are themselves smokers, this large disparity in the likelihood of being a smoker, running counter to the risk of dying in a smoking-material fire, suggests that the risk of death for older smokers may be much higher than Table 8 indicates.

If the data from Table 7 on cigarettes consumed per adult is combined with the data from Table 9A on percent of adults who smoke, it suggests the decline in cigarettes consumed per *smoker* from 1985 to 2001 is only 15%, compared to a 40% decline in cigarettes consumed per adult.

Male death and injury rates from home smoking-material fires are much higher than female rates – and by more than the difference in smoking propensity.

The 1999-2001 differences between the percentages of men and women who smoke range from 3.3 to 4.1 percentage points, or higher by 15-20%. (See Table 9A.) In 1999-2001, male death rates from smoking in related home fires were higher than female rates by 43%, and male injury rates were higher by 39%. (See Table 10.) Again, even allowing for the fact that not all victims of smoking-material fires are themselves the smokers who caused the fire, it appears that male smokers have a risk of death and injury due to smoking material fires that is considerably higher than the risk for female smokers.

Fewer people smoke, proportionally, in the U.S. than in most other countries of at least one million population, and this is even more true for males.

Among countries of at least one million population, the proportion of the population that smokes ranges from a high of 52% to a low of 4%, with the U.S., at 24%, having a higher smoking rate than roughly one-third of the countries. (See Table 11.) Smoking rates for men range from a high of 68% to a low of 7%, with the U.S., at 26%, higher than only 13 countries with lower male smoking rates.

Bearing in mind the earlier finding that the fire risk to male smokers appears to be considerably greater than to female smokers, it is notable that, in most countries, smoking rates are not as similar for the two sexes as they are in the U.S. and Canada. There is a 4 percentage point gap in the U.S. (26% of males smoke vs. 22% of females), and in Canada, as shown in Table 11. Only 12 countries have male and female smoker rates that are closer. The highest female smoker rates are in Guinea (44% vs. 60% for men and the highest overall smoking rate of 52%), Yugoslavia (42% vs. 52% for men), and Venezuela (39% vs. a fairly similar 42% for men). Norway is the only country known to have a higher female smoking rate than male (by only 1 percentage point), and Sweden and New Zealand are the only countries where rates are known to be the same.

Japan has a much lower smoking fire death rate than the U.S., even though they have a much higher smoking rate, and even more so for high-risk males. Sweden has a lower smoking rate and a lower smoking fire death rate than the U.S., but smoking fires are a larger share of their fire deaths, because they are so much more effective than the U.S. in preventing all other types of fires. All of this is a reminder that smoking behavior is only one of the factors driving smoking fire rates.

Most fatal victims of home smoking-material fires are located in the room of fire origin when fire begins.

A substantial majority (60%) of fatal victims of home smoking-material fires are in the same room as the fire. (See Table 12.) This is much higher than the percentage of fatal victims of all types of home fires with known location at ignition who are in the same room as the fire. That percentage has typically been closer to 40%.

Nearly half of fatal home smoking-material fire victims were sleeping when injured, but more than one-fourth were taking protective action.

Fatal victims who were sleeping were 46% of the total, while fatal victims who were attempting to escape, to fight fire, or to rescue collectively totaled 29%. For non-fatal victims, those taking action totaled 49%, compared to 36% for those who were sleeping.

Most home smoking-material fire victims had some condition that reduced their ability to respond effectively to fire, with sleeping the primary such condition.

Most victims of residential smoking-material fires were either asleep or slowed by alcohol or other drug impairment or disability prior to the fire. (See Table 14.)

Data on contributing factors, similar to the old data element of condition preventing escape, have not yet developed any strong patterns. (See Table 15.)

Table 7. Annual U.S. Cigarette Consumption, 1987-2001

Year	Billions of Cigarettes Consumed	Per Person 18 Years or Older
1987	577	3,197
1988	550	3,096
1989	540	2,945
1990	525	2,834
1991	510	2,727
1992	500	2,647
1993	485	2,543
1994	486	2,524
1995	487	2,505
1996	487	2,482
1997	480	2,423
1998	465	2,320
1999	435	2,136
2000	430	2,092
2001	425	2,026*
2002	415*	1,979*
2003	400*	1,903*

* Preliminary data; final statistics will be issued later and may differ.

Sources: For 1987 and 1988 data, John C. Maxwell, Jr., *The Maxwell Consumer Report: 1988 Year-End Sales Estimates for the Cigarette Industry*, Richmond, Virginia: Wheat First Securities, January 27, 1989; for 1994-2003, Tom Capehart, *Tobacco Outlook*, U.S. Department of Agriculture, www.ers.usda.gov, Oct. 6, 2003; and for 1989-1993, earlier reports in the *Tobacco Situation and Outlook Report* series.

**Table 8. Ages of Victims of 1999-2001 Smoking-Material Fires in U.S. Home Structures
Unknown-Age Victims Allocated Proportionally**

Age	2000 Population (in Millions)		Annual Average Civilian Deaths		Death Rate per Million Persons	Annual Average Civilian Injuries		Injury Rate per Million People
4 and under	19.2	(7%)	20	(2%)	1.0	50	(3%)	2.5
5 to 9	20.6	(7%)	20	(2%)	0.8	20	(1%)	1.0
10 to 14	20.5	(7%)	10	(1%)	0.4	30	(2%)	1.5
15 to 17	12.0	(4%)	10	(1%)	0.8	50	(3%)	4.3
18 to 29	46.5	(17%)	50	(7%)	1.2	330	(18%)	7.0
30 to 49	85.8	(30%)	200	(26%)	2.3	630	(34%)	7.4
50 to 64	41.9	(15%)	170	(21%)	4.0	380	(20%)	9.1
65 to 74	18.4	(7%)	140	(18%)	7.9	180	(10%)	10.0
75 to 84	12.4	(4%)	120	(15%)	9.7	130	(7%)	10.4
85 and over	4.2	(2%)	50	(6%)	10.9	70	(4%)	15.5
Total	281.4	(100%)	780	(100%)	2.8	1,870	(100%)	6.7
14 and under	60.3	(21%)	40	(5%)	0.7	100	(5%)	1.7
65 and over	35.0	(12%)	310	(40%)	8.9	380	(20%)	10.8
75 and over	16.6	(6%)	170	(21%)	10.0	190	(10%)	11.7

Note: These are fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies, industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are estimated to the nearest ten and include a proportional share of home fire casualties where the heat source was unknown and home smoking-fire casualties where victim age was unknown. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey, *Statistical Abstract of the United States*, Washington: U.S. Department of Commerce Bureau of the Census, 2003.

Table 9. Percent of U.S. Population Smoking

A. Trends by Age or Sex

Sex	1970*	1985*	1990*	1995*	1997*	1998*	1999*	2000*	2001*
Male	44.3%	33.2%	28.0%	26.5%	25.5%	25.9%	24.2%	25.2%	24.7%
Female	30.8%	28.0%	22.9%	22.9%	21.3%	22.1%	20.9%	21.1%	20.8%
Age		1985	1990	1995	1997	1998	1999	2000	2001
12-17		29.4%	22.4%	20.2%	19.9%	18.2%	15.9%	13.4%	13.0%
18-25		47.4%	40.9%	35.3%	40.6%	41.6%	41.0%	38.3%	39.1%
26-34		45.7%	42.4%	34.7%	33.7%	32.5%	34.4%	} 24.2%	} 24.2%
35 or older		35.5%	28.9%	27.2%	27.9%	25.1%	28.5%		

*1970 populations included 17 years old and over, 1985 population included 20 years old and over, and 1990 and after included 18 years old and over.

Sources: For patterns by sex 1970 and 1985, U.S. Centers for Disease Control, Office of Smoking and Health, *Reducing the Health Consequences of Smoking, 1989*. For 1990-1999 patterns and 1985 patterns by age, *Statistical Abstract of the United States, 2001*, and *2003*.

Table 9. Percent of U.S. Population Smoking (Continued)

B. Trends by Age and Sex

Male	1990	1995	2000	2001
18 - 24	26.6%	27.8%	28.5%	30.4%
25 - 34	31.6%	29.5%	29.0%	27.2%
35 - 44	34.5%	31.5%	30.2%	27.4%
45 - 64	29.3%	27.1%	26.4%	26.4%
65 or older	14.6%	14.3%	10.2%	11.5%
All age groups over 18	28.4%	27.0%	25.7%	25.2%
Female	1990	1995	2000	2001
18 - 24	22.5%	21.8%	25.1%	23.4%
25 - 34	28.2%	26.4%	22.5%	23.0%
35 - 44	24.8%	27.1%	26.2%	25.7%
45 - 64	24.8%	24.0%	21.6%	21.4%
65 or older	11.5%	11.5%	9.3%	9.2%
All age groups over 18	22.8%	22.6%	21.0%	20.7%

Source: *Statistical Abstract of the United States, 2003*, U.S. Department of Commerce, Bureau of the Census.

Table 10.
Age by Sex of Victims of 1999-2001 Smoking-Material
Home Structure Fires Reported to U.S. Fire Departments
Victims of Unknown Age or Sex Allocated Proportionally

Age	2000 Population (in Millions)		Annual Average Civilian Deaths		Death Rate per Million People	Annual Average Civilian Injuries		Injury Rate per Million People
Male								
4 and under	9.8	(7%)	10	(1%)	0.6	20	(2%)	2.4
5 to 9	10.5	(8%)	10	(3%)	1.2	10	(1%)	1.0
10 to 14	10.5	(8%)	0	(1%)	0.4	10	(1%)	1.4
15 to 17	6.2	(4%)	10	(2%)	1.5	30	(3%)	5.1
18 to 29	23.7	(17%)	30	(7%)	1.4	200	(19%)	8.6
30 to 49	42.7	(31%)	130	(28%)	3.0	380	(35%)	8.9
50 to 64	20.3	(15%)	110	(24%)	5.4	240	(22%)	11.7
65 to 74	8.3	(6%)	80	(17%)	9.4	80	(8%)	9.9
75 to 84	4.9	(4%)	50	(12%)	11.1	60	(5%)	12.0
85 and over	1.2	(1%)	20	(4%)	15.5	30	(3%)	26.5
Total	138.1	(100%)	450	(100%)	3.3	1,070	(100%)	7.8
14 and under	30.9	(22%)	20	(5%)	0.7	50	(52%)	1.6
65 and over	14.4	(10%)	150	(33%)	10.5	170	(16%)	12.0
75 and over	6.1	(4%)	70	(16%)	12.0	90	(8%)	14.9
Female								
4 and under	9.4	(7%)	10	(4%)	1.3	20	(3%)	2.6
5 to 9	10.0	(7%)	0	(1%)	0.4	10	(1%)	1.1
10 to 14	10.0	(7%)	0	(1%)	0.4	20	(2%)	1.7
15 to 17	5.8	(4%)	0	(0%)	0.0	20	(3%)	3.5
18 to 29	22.9	(16%)	20	(6%)	0.9	120	(15%)	5.4
30 to 49	43.1	(30%)	70	(22%)	1.6	250	(32%)	5.9
50 to 64	21.6	(15%)	60	(17%)	2.7	150	(18%)	6.8
65 to 74	10.1	(7%)	70	(20%)	6.6	100	(13%)	10.0
75 to 84	7.5	(5%)	70	(20%)	8.9	70	(9%)	9.4
85 and over	3.0	(2%)	30	(8%)	9.0	30	(4%)	11.0
Total	143.4	(100%)	330	(100%)	2.3	800	(100%)	5.6
14 and under	29.4	(21%)	20	(6%)	0.7	50	(7%)	1.8
65 and over	20.6	(14%)	160	(49%)	7.8	200	(26%)	9.9
75 and over	10.5	(7%)	90	(28%)	8.9	100	(13%)	9.9

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and civilian injuries are expressed to the nearest ten and include a proportional share of residential fire casualties where the heat source was unknown and home smoking-fire casualties where victim age was unknown. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey, *Statistical Abstract of the United States*, Washington: U.S. Department of Commerce, Bureau of the Census, 2003.

Table 11. Smoking Rates in Selected Countries

Country	Percentage Who Smoke		
	Total	Male	Female
Guinea	52%	60%	44%
Namibia	50%	65%	35%
Kenya	49%	67%	32%
Bosnia and Herzegovina	48%	NA	NA
Yugoslavia	47%	52%	42%
Mongolia	47%	68%	26%
Yemen	45%	60%	29%
Turkey	44%	60-65%	20-24%
Romania	44%	62%	25%
Slovakia	43%	55%	30%
Lebanon	41%	46%	35%
Venezuela	41%	42%	39%
Argentina	40%	47%	34%
Albania	39%	60%	18%
Bangladesh	39%	64%	24%
Nepal	39%	48%	29%
Panama	38%	56%	20%
Greece	38%	47%	29%
Laos	38%	41%	15%
Kyrgyzstan	38%	60%	16%
Georgia	38%	61%	15%
Cuba	37%	48%	26%
Benin	37%	NA	NA
Cambodia	37%	66%	8%
Papua	37%	46%	28%
Russian Federation	37%	63%	10%
Bulgaria	37%	49%	24%
Macedonia	36%	40%	32%
Cameroon	36%	NA	NA
China	36%	67%	4%
Hungary	36%	44%	27%
Ukraine	35%	51%	19%
Republic of (South) Korea	35%	65%	5%
Germany	35%	39%	31%
Tunisia	35%	62%	8%

Table 11. Smoking Rates in Selected Countries (Continued)

Country	Percentage Who Smoke		
	Total	Male	Female
Mexico	35%	51%	18%
Uganda	35%	52%	17%
Poland	35%	44%	25%
France	35%	39%	30%
Brazil	34%	38%	29%
Kazakhstan	34%	60%	7%
Switzerland	34%	39%	28%
Lithuania	33%	51%	16%
Spain	33%	42%	25%
Japan	33%	53%	13%
Netherlands	33%	37%	29%
Croatia	33%	34%	32%
Myanmar	33%	44%	22%
Armenia	33%	64%	1%
Philippines	32%	54%	11%
Moldova	32%	46%	18%
Estonia	32%	44%	20%
Ecuador	32%	46%	17%
Ireland	32%	32%	31%
Norway	32%	31%	32%
Indonesia	31%	59%	4%
Tanzania	31%	50%	12%
Latvia	31%	49%	13%
Denmark	31%	32%	29%
Bolivia	30%	43%	18%
Syria	30%	51%	10%
Belarus	30%	55%	5%
Uzbekistan	29%	49%	9%
Jordan	29%	48%	10%
Czech Republic	29%	36%	22%
Peru	29%	42%	16%
Israel	29%	33%	24%
Belgium	28%	30%	26%
Guatemala	28%	38%	18%
Viet Nam	27%	51%	4%

Table 11. Smoking Rates in Selected Countries (Continued)

Country	Percentage Who Smoke		
	Total	Male	Female
South Africa	27%	42%	11%
United Kingdom	27%	27%	26%
Malaysia	26%	49%	4%
Algeria	25%	44%	7%
Slovenia	25%	30%	20%
Trinidad and Tobago	25%	42%	8%
El Salvador	25%	38%	12%
Canada	25%	27%	23%
New Zealand	25%	25%	25%
Italy	25%	32%	17%
Austria	25%	30%	19%
Mauritius	24%	45%	3%
United States of America	24%	26%	22%
Honduras	24%	36%	11%
Finland	24%	27%	20%
Thailand	23%	44%	3%
Uruguay	23%	32%	14%
Iraq	23%	40%	5%
Pakistan	23%	36%	9%
Zambia	23%	35%	10%
Columbia	22%	24%	21%
Chile	22%	26%	18%
Ivory Coast	22%	42%	2%
Botswana	21%	NA	NA
Dominican Republic	21%	24%	17%
Lesotho	20%	39%	1%
Australia	20%	21%	18%
Sweden	19%	19%	19%
Portugal	19%	30%	7%
Sierra Leone	19%	NA	NA
Egypt	18%	35%	2%
Morocco	18%	35%	2%
Zimbabwe	18%	34%	1%
Gambia	18%	34%	2%
Costa Rica	18%	29%	7%

Table 11. Smoking Rates in Selected Countries (Continued)

Country	Percentage Who Smoke		
	Total	Male	Female
India	16%	29%	3%
Ghana	16%	28%	4%
Ethiopia	16%	NA	NA
Azerbaijan	16%	30%	1%
Kuwait	16%	30%	2%
Iran	15%	27%	3%
Singapore	15%	27%	3%
Paraguay	15%	24%	6%
Jamaica	15%	NA	NA
Malawi	15%	20%	9%
Turkmenistan	14%	27%	1%
Sri Lanka	14%	26%	2%
Sudan	13%	24%	1%
Saudi Arabia	12%	22%	1%
Haiti	10%	11%	9%
United Arab Emirates	9%	18%	<1%
Nigeria	9%	15%	2%
Oman	9%	16%	2%
Rwanda	6%	7%	4%
Senegal	5%	NA	NA
Libya	4%	NA	NA

NA: Not Available

Note: Percentages are based on some definition of adulthood and some definition of smoking frequency and recency; definitions may vary between countries. Countries shown in bold are those for which fire statistics are given in this report.

Source: Dr. Judith MacKay and Dr. Michael Eriksen, *The Tobacco Atlas*, World Health Organization, Brighton, UK, 2002, Table A. Actual year of data varies but is usually late 1990's.

**Table 12. Location of Victims at Ignition
Annual Average of 1999-2001 Smoking-Material Home Fires
Reported to U.S. Fire Departments**

Location	Civilian Deaths		Civilian Injuries	
In area of origin and involved (includes intimately involved with ignition)	280	(36%)	470	(25%)
In area of origin and not involved	190	(24%)	510	(27%)
Not in area of origin	310	(40%)	890	(48%)
Unclassified location	0	(0%)	10	(0%)
Total	780	(100%)	1,870	(100%)

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and civilian injuries are expressed to the nearest ten and include a proportional share of home fire casualties where the heat source was unknown and home smoking-fire casualties where victim location was unknown. Totals may not equal sums because of rounding.

Source: NFIRS and NFPA survey, *Statistical Abstract of the United States*, Washington: U.S. Department of Commerce, Bureau of the Census, 2003.

**Table 13. Activity of Victims When Injured
Annual Average of 1999-2001 Smoking-Material Home Fires
Reported to U.S. Fire Departments**

Activity	Civilian Deaths		Civilian Injuries	
Sleeping	360	(46%)	670	(36%)
Attempting to escape	170	(21%)	410	(22%)
Unable to act	100	(13%)	100	(5%)
Attempting to fight fire	40	(6%)	380	(20%)
Unclassified activity	40	(5%)	90	(5%)
Acting irrationally	30	(4%)	80	(4%)
Attempting rescue	20	(2%)	130	(7%)
Returning to vicinity of fire before control*	10	(2%)	10	(1%)
Returning to vicinity of fire after control*	0	(0%)	0	(0%)
Total	780	(100%)	1,870	(100%)

*These categories were not available in NFIRS 4.1 and so are likely underrepresented in these statistics, which are dominated by converted Version 4.1 data.

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are expressed to the nearest ten and include a proportional share of fires with heat source unknown and home smoking-material fire casualties with victim activity unknown. Property damage figures have not been adjusted for inflation.

Source: NFIRS and NFPA survey

**Table 14. Human Factors (Condition Before Injury) of Victims
1999-2001 Smoking-Material Home Fires Reported to U.S. Fire Departments
(Only Incidents Reported in NFIRS Version 5.0)**

Factor	Civilian Deaths	Civilian Injuries
Asleep	35%	35%
Possibly impaired by alcohol	27%	18%
Physically disabled	20%	7%
None	16%	30%
Unattended or unsupervised person	4%	3%
Unconscious	4%	1%
Possibly impaired by other drug or chemical	3%	4%
Possibly mentally disabled	2%	2%
Not reported	17%	17%

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are expressed to the nearest ten and include a proportional share of fires with heat source unknown and home smoking-material fire casualties with victim factor unknown.

Source: NFIRS and NFPA survey

**Table 15. Contributing Factors for Victims
1999-2001 Smoking-Material Home Fires Reported to U.S. Fire Departments
(Only Incidents Reported in NFIRS Version 5.0)**

Factor	Civilian Deaths	Civilian Injuries
None	30%	26%
Unclassified factor contributed to injury	12%	13%
Exits blocked by flame	6%	7%
Vision blocked or impaired by smoke	6%	3%
Clothing burned, not while escaping	4%	4%
Locked exit or other problem with exit	4%	0%
Unclassified escape problem	3%	3%
Unclassified egress problem	3%	1%
Trapped above fire	3%	0%
Exits blocked by smoke	2%	3%
Unfamiliar with exits	2%	0%
Chose inappropriate exit route	2%	2%
Unclassified fire pattern problem	1%	1%
Unclassified equipment-related factor	1%	0%
Re-entered building	0%	4%
Clothing caught fire while escaping	0%	1%
Window type impeded egress	0%	1%
Not reported	23%	30%

Note: These are national estimates of fires reported to U.S. municipal fire departments and so exclude fires reported only to Federal or state agencies or industrial fire brigades. National estimates are projections. Casualty and loss projections can be heavily influenced by the inclusion or exclusion of one unusually serious fire. Civilian deaths and injuries are expressed to the nearest ten and include a proportional share of fires with heat source unknown and home smoking-material fire casualties with victim factor unknown.

Source: NFIRS and NFPA survey

Conclusions and Recommendations

Smoking-material fires are a major cause of concern because they result in more deaths than any other type of fire. In 2001, civilian deaths in smoking-related structure fires decreased from the previous year but still easily accounted for the largest share of structure fire deaths. Realistically, any efforts to reduce fire deaths in this country must address the smoking-material fire problem.

In the seventies and early eighties, efforts to reduce smoking-material fires were focused on modifying the items most frequently ignited by smoking-materials - mattresses and upholstered furniture. These new products were designed using materials more resistive to cigarette ignitions. Since those initiatives, there have been major reductions in the number of fires involving upholstered furniture and mattresses. However, we have also seen reductions in all other smoking-material fires and the reasons for this are unclear. This initiative alone is not enough to ensure continued decreases in smoking-material fires and fire deaths. And although these products are more resistant to ignitions by smoking materials, some may burn faster or more intensely or produce more toxic smoke once ignited.

Attention shifted in the early eighties from products ignited by smoking-materials to the smoking material itself. Early efforts resulted in the *Cigarette Safety Act of 1984*, which established the Technical Study Group (TSG) on Cigarette and Little Cigar Fire Safety to conduct studies on the feasibility of developing cigarettes and little cigars that would be less likely to start fires. In 1987, the TSG reported that it was technically feasible to develop a cigarette with less of a propensity to ignite other items. As a result of continuing efforts in this area, the *Fire Safe Cigarette Act of 1990* was passed in August of that year.

Section 2 of the *Fire Safe Cigarette Act of 1990* required the Center for Fire Research, National Institute of Standards and Technology (NIST), under the direction of the U.S. Consumer Product Safety Commission (CPSC), to carry out three tasks. The first task was to "develop a standard test method to determine cigarette ignition propensity." The second task entailed compiling "performance data for cigarettes using the standard test method developed." And the third was to "conduct laboratory studies on and computer modeling of ignition physics to develop valid, user friendly predictive capabilities."

In addition, the CPSC was responsible for carrying out three tasks. The first two were to: "(1) design and implement a study to collect baseline and follow-up data about the characteristics of cigarettes, products ignited, and smokers involved in fires and (2) develop information on societal costs of cigarette-ignited fires." Subsection (C) required CPSC, working with the Secretary of Health and Human Services, "to develop information on changes in the toxicity of smoke and resultant health effects from cigarette prototypes."

All of these tasks were completed. The NFPA worked with eight fire departments nationwide collecting data on cigarette fires for this project. The results of this data proved consistent with the findings from lab tests performed by NIST. Both showed ignition propensity is related to physical characteristics of cigarettes.

A final report on the activities carried out by the groups involved was presented to Congress in August of 1993. The purpose of the *Fire Safe Cigarette Act of 1990* was to advance the development of a cigarette with a reduced propensity to ignite other items, but not to direct how those cigarettes will be manufactured.

In February 1994, the late Congressman Joseph Moakley sponsored a bill that would have required the CPSC to issue a safety standard for cigarettes. This would have been done in accordance with the findings from the final report completed under the *Fire Safe Cigarette Act of 1990* and in consultation with NIST. Several large-city fire chiefs rallied around Congressman Moakley in support of this legislation. The bill did not pass.

In recent years, ASTM has adopted as a standard the so-called filter paper method for testing cigarette ignition strength, and both Canada and New York state have implemented requirements that cigarettes publicize or restrict their ignition strength. Other states are actively considering similar bills.

We are hopeful about the overall downward trend in smoking-material fires and fire deaths, but we must continue to look for new approaches to ensure continued declines. Strategies to enact safety measures after fire has begun - such as smoke alarms or home sprinklers - have potential, particularly since smoking-material fires often smolder for a significant period before the first flame. Such fires afford more time for early detection.

But the potential of post-ignition strategies also is limited by the unusually high percentage of smoking-material fire deaths involving drug or alcohol impairment or limitations because of age or physical or mental disabilities. Also, a significant number of smoking-material fire deaths involve victims in the same room as the room of fire origin. Victims who are close to the fire or unable to respond effectively are difficult to save by strategies which operate after the fire has begun. But if such fires are to be prevented outright, then one is led back to the options of the previous paragraphs.

Smoking-material fires continue to be one of the most difficult fire problems in the U.S. to address. Thus far, no single attempt has proven to be the solution to this particular fire problem. The ignitability and burning properties of items most frequently ignited need to be reexamined to see whether other opportunities exist. Public education possibilities need to be reconsidered. Smokers who cannot or will not quit can be taught some more self-protective behaviors, such as using sturdy, large ashtrays and not smoking in bed. Fire protection systems need to be analyzed as options. But changes in the cigarette itself have now been confirmed as technically feasible and likely to be effective, so this approach deserves to be a major part of our strategy, including legislative efforts at the national and state level in support of what is often called the "fire-safe" cigarette.

Appendix A: How National Estimates Statistics Are Calculated

Estimates are made using the National Fire Incident Reporting System (NFIRS) of the Federal Emergency Management Agency's (FEMA's) United States Fire Administration (USFA), supplemented by the annual stratified random-sample survey of fire experience conducted by the National Fire Protection Association (NFPA), which is used for calibration.

Data Bases Used

NFIRS provides annual computerized data bases of fire incidents, with data classified according to a standard format based on the NFPA 901 Standard. Roughly three-fourths of all states have NFIRS coordinators, who receive fire incident data from participating fire departments and combine the data into a state data base. These data are then transmitted to FEMA/USFA. Participation by the states, and by local fire departments within participating states, is voluntary. NFIRS captures roughly one-third to one-half of all U.S. fires each year. More than one-third of all U.S. fire departments are listed as participants in NFIRS, although not all of these departments provide data every year.

The strength of NFIRS is that it provides the most detailed incident information of any national data base not limited to large fires. NFIRS is the only data base capable of addressing national patterns for fires of all sizes by specific property use and specific fire cause. (The NFPA survey separates fewer than 20 of the hundreds of property use categories defined by NFPA 901 and solicits no cause-related information except for incendiary and suspicious fires.) NFIRS also captures information on the avenues and extent of flame spread and smoke spread and on the performance of detectors and sprinklers.

The NFPA survey is based on a stratified random sample of roughly 3,000 U.S. fire departments (or just over one of every ten fire departments in the country). The survey includes the following information: (1) the total number of fire incidents, civilian deaths, and civilian injuries, and the total estimated property damage (in dollars), for each of the major property use classes defined by the NFPA 901 Standard; (2) the number of on-duty firefighter injuries, by type of duty and nature of illness; and (3) information on the type of community protected (e.g., county versus township versus city) and the size of the population protected, which is used in the statistical formula for projecting national totals from sample results.

The NFPA survey begins with the NFPA Fire Service Inventory, a computerized file of about 30,000 U.S. fire departments, which is the most complete and thoroughly validated such listing in existence. The survey is stratified by size of population protected to reduce the uncertainty of the final estimate. Small rural communities protect fewer people per department and are less likely to respond to the survey, so a large number must be surveyed to obtain an adequate sample of those departments. (NFPA also makes follow-up calls to a sample of the smaller fire departments that do not respond, to confirm that those that did respond are truly representative of fire departments their size.) On the other hand, large city departments are so few in number and protect such a large proportion of the total U.S. population that it makes sense to survey all of them. Most respond, resulting in excellent precision for their part of the final estimate.

Projecting NFIRS to National Estimates

To project NFIRS results to national estimates, one needs at least an estimate of the NFIRS fires as a fraction of the total so that the fraction can be inverted and used as a multiplier or scaling ratio to generate national estimates from NFIRS data. But NFIRS is a sample from a universe whose size cannot be inferred from NFIRS alone. Also, participation rates in NFIRS are not necessarily uniform across regions and sizes of community, both of which are factors correlated with frequency and severity of fires. This means NFIRS may be susceptible to systematic biases. No one at present can quantify the size of

these deviations from the ideal, representative sample, so no one can say with confidence that they are or are not serious problems. But there is enough reason for concern so that a second data base - the NFPA survey - is needed to project NFIRS to national estimates and to project different parts of NFIRS separately. This multiple calibration approach makes use of the annual NFPA survey where its statistical design advantages are strongest.

There are separate projection formulas for four major property classes (residential structures, non-residential structures, vehicles, and other) and for each measure of fire severity (fire incidents, civilian deaths, and civilian injuries, and direct property damage).

For example, the scaling ratio for 1998 civilian deaths in residential structures is equal to the total number of 1998 civilian deaths in residential structure fires reported to fire departments, according to the NFPA survey (3,250), divided by the total number of 1998 civilian deaths in residential structure fires reported to NFIRS (1,224). Therefore, the scaling ratio is $3,250/1,224 = 2.66$.

The scaling ratios for civilian deaths and injuries and direct property damage are often significantly different from those for fire incidents. Except for fire service injuries, average severity per fire is generally higher for NFIRS than for the NFPA survey. Use of different scaling ratios for each measure of severity is equivalent to assuming that these differences are due either to NFIRS under-reporting of small fires, resulting in a higher-than-actual loss-per-fire ratio, or possible biases in the NFIRS sample representation by region or size of community, resulting in severity-per-fire ratios characteristic only of the oversampled regions or community sizes.

Note that this approach also means that the NFPA survey results for detailed property-use classes (e.g., fires in storage structures) may not match the national estimates of the same value.

Calculating National Estimates of Particular Types of Fires

Most analyses of interest involve the calculation of the estimated number of fires not only within a particular occupancy but also of a particular type. The types that are mostly frequently of interest are those defined by some ignition-cause characteristic. The six cause-related characteristics most commonly used to describe fires are: form of the heat that caused the ignition, equipment involved in ignition, form or type of material first ignited, the ignition factor that brought heat source and ignited material together, and area of origin. Other characteristics of interest are victim characteristics, such as ages of persons killed or injured in fire.

For any characteristic of interest in NFIRS, some reported fires have that characteristic unknown or not reported. If the unknowns are not taken into account, then the propensity to report or not report a characteristic may influence the results far more than the actual patterns on that characteristic. For example, suppose the number of fires remained the same for several consecutive years, but the percentage of fires with cause unreported steadily declined over those years. If the unknown-cause fires were ignored, it would appear as if fires due to every specific cause increased over time while total fires remained unchanged. This, of course, does not make sense.

Consequently, most national estimates analyses allocate unknowns. This is done by using scaling ratios defined by NFPA survey estimates of totals divided by only those NFIRS fires for which the dimension in question was known and reported. This approach is equivalent to assuming that the fires with unreported characteristics, if known, would show the same proportions as the fires with known characteristics. For example, it assumes that the fires with unknown ignition factor contain the same relative shares of child-playing fires, incendiary-cause fires, short circuit fires, and so forth, as are found in the fires where ignition factor was reported.

Rounding Errors

The possibility of rounding errors exists in all our calculations. One of the notes on each table indicates the extent of rounding for that table, e.g., deaths rounded to the nearest one, fires rounded to the nearest hundred, property damage rounded to the nearest hundred thousand dollars. In rounding to the nearest one, functional values of 0.5 or more are rounded up and functional values less than 0.5 are rounded down. For example, 2.5 would round to 3, and 3.4 would round to 3. In rounding to the nearest one, a stated estimate of 1 could be any number from 0.5 to 1.49, a roughly threefold range.

The impact of rounding is greatest when the stated number is small relative to the degree of rounding. As noted, rounding to the nearest one means that stated values of 1 may vary by a factor of three. Similarly, the cumulative impact of rounding error - the potential gap between the estimated total and the sum of the estimated values as rounded - is greatest when there are a large number of values and the total is small relative to the extent of rounding.

Suppose a table presented 5-year averages of estimated deaths by item first ignited, all rounded to the nearest one. Suppose there were a total of 30 deaths in the 5 years, so the total average would be $30/5 = 6$.

In case 1, suppose 10 of the possible items first ignited each accounted for 3 deaths in 5 years. Then there would be 10 entries of $3/5 = 0.6$, rounded to 1, and the sum would be 10, compared to the true total of 6.

In case 2, suppose 15 of the possible items first ignited each accounted for 2 deaths in 5 years. Then there would be 15 entries of $2/5 = 0.4$, rounded to 0, and the sum would be 0, compared to the true total of 6.

Here is another example: Suppose there were an estimate of 7 deaths total in 1992 through 1996. The 5-year average would be 1.4, which would round to 1, the number we would show as the total. Each death would represent a 5-year average of 0.2.

If those 7 deaths split as 4 deaths in one category (e.g., smoking) and 3 deaths in a second category (e.g., heating), then we would show $4 \times 0.2 = 0.8$ deaths per year for smoking and $3 \times 0.2 = 0.6$ deaths per year for heating. Both would round to 1, there would be two entries of 1, and the sum would be 2, higher than the actual rounded total.

If those 7 deaths split as 1 death in each of 7 categories (quite possible since there are 12 major cause categories), then we would show 0.2 in each category, always rounding to 0, and the sum would be 0, lower than the actual rounded total. The more categories there are, the farther apart the sum and total can -- and often do -- get.

Note that percentages are calculated from unrounded values, and so it is quite possible to have a percentage entry of up to 100%, even if the rounded number entry is zero.