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Fire Death Rate Trends: An International Perspective

These topical reports are designed to explore facets of the U.S. fire problem as depicted through data collected in the U.S. Fire Administration's (USFA's) National Fire Incident Reporting System (NFIRS). Each topical report briefly addresses the nature of the specific fire or fire-related topic, highlights important findings from the data, and may suggest other resources to consider for further information.

Findings

- From 1979 to 2007, fire death rates per million population have consistently fallen throughout the industrialized world. The North American and Eastern European regions' fire death rates have fallen faster than other regions.
- From 1979 to 2007, the fire death rate in the United States declined by 66 percent. Today, the United States still has one of the higher fire death rates in the industrialized world, however, its standing has greatly improved.
- Japan, a leader in fire safety, shows a slight worsening of fire death rates over the years studied.

Historically, the fire death rate in the United States has been higher than most of the industrialized world.[1] This has held true for both fire deaths and dollar-loss rates. The causes of the United States prominent standing in this area are not entirely clear and have been the subject of debate for some time. To compound the issue, the United States is comparatively safety conscious and one of the most technologically-advanced nations in the world. To have such high fire death rates is perplexing for a country that ranks so highly in those two areas. While today the United States still has one of the highest fire death rates in the industrialized world, its standing has greatly improved. Falling from among the top three nations in terms of the fire death rate two decades ago, the United States now has the tenth highest fire death rate per million people, putting the Nation in the upper half of the countries reviewed.[2]

This report explores the nature of the United States fire death problem and compares it to those of 23 other industrialized nations. The comparison reveals the magnitude of the fire death problem and differences between the nations. Trends in overall rates and disparities between countries are also explored.[3]

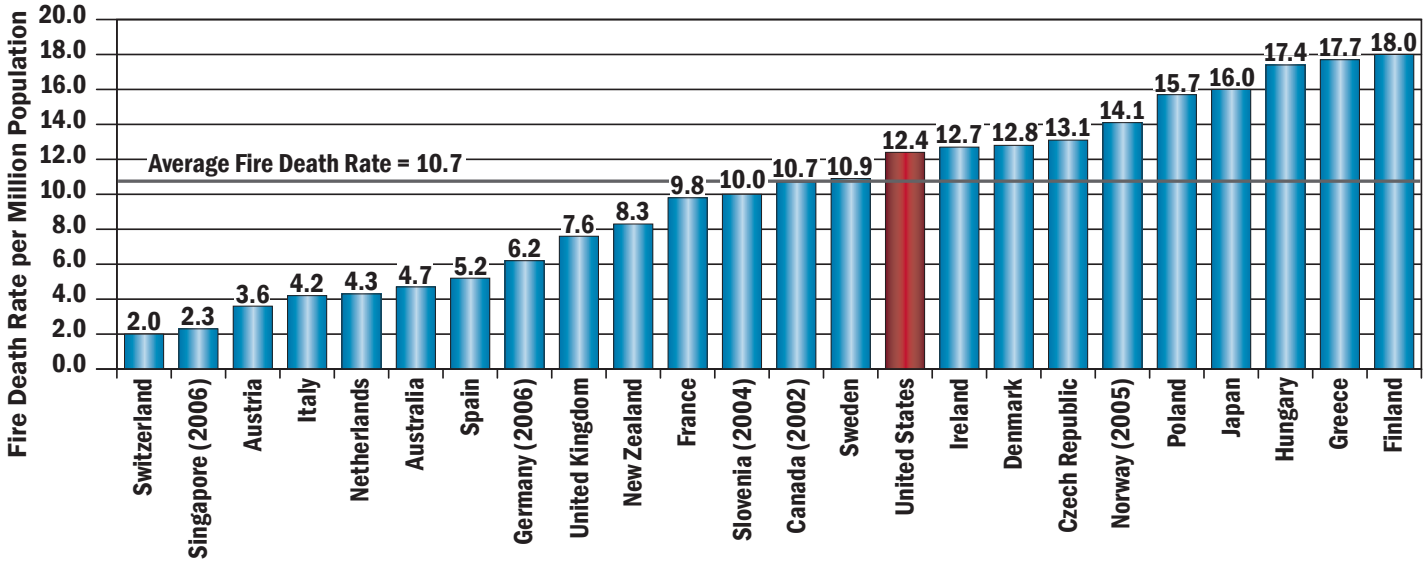
The International Fire Picture

Although reliable statistics are available for fire incidence and fire loss rates in the United States, diverse recordkeeping and fire classification practices in different countries preclude reliable international comparisons of these rates. Loss estimates can even vary within a country, depending on the source of the information. This variation is especially true for data regarding monetary loss. The monetary loss reported by a fire department can vary significantly from that assessed by an insurance company. And both of these estimates may differ from the monetary loss as perceived by the owner or occupant. Fire deaths, however, are generally less controversial as they are more readily identified and consistently counted, although they too have reporting problems. In the United States, for example, data on fire deaths can come from estimates derived from a statistical sample of fire departments[4] or from data collected from death certificates, coded and collated by proximate cause of death.[5] Nonetheless, these two sources, more often than not, provide relatively similar numbers. Because of these and similar considerations, the following analyses comparing the United States to other industrialized countries are limited to fire deaths.[6]

Figure 1 depicts the fire death rates per million population for 24 industrialized nations. As this figure demonstrates, in 2007, the United States had the 10th highest death rate of the 24 nations studied, putting it at the bottom of the top half. With 12.4 deaths per million population, the United States rate of fire deaths was much smaller than that of Finland, the nation with the highest death rate, recording 18.0 deaths per million population.[7] In spite of this, the United States fire death rate is still at least double that of eight of the nations included: Switzerland, Singapore, Austria, Italy, the Netherlands, Australia, Spain, and Germany. In addition, the United States death rate is over six times that of Switzerland, the nation with the lowest rate of all the countries considered; only two deaths per million population. Further research may reveal the source of these differences. They could be due to a number of factors, including differences in lifestyle, cultural attitudes towards fire, fire prevention practices and education, and building practices and regulations.

It is impossible to determine, however, whether any difference in fire deaths between countries is due to the number of fires experienced in each or if the fires experienced in one country are deadlier than those of another. The data are not available to make a determination on this point.

Figure 1. 2007 International Fire Death Rates per Million Population

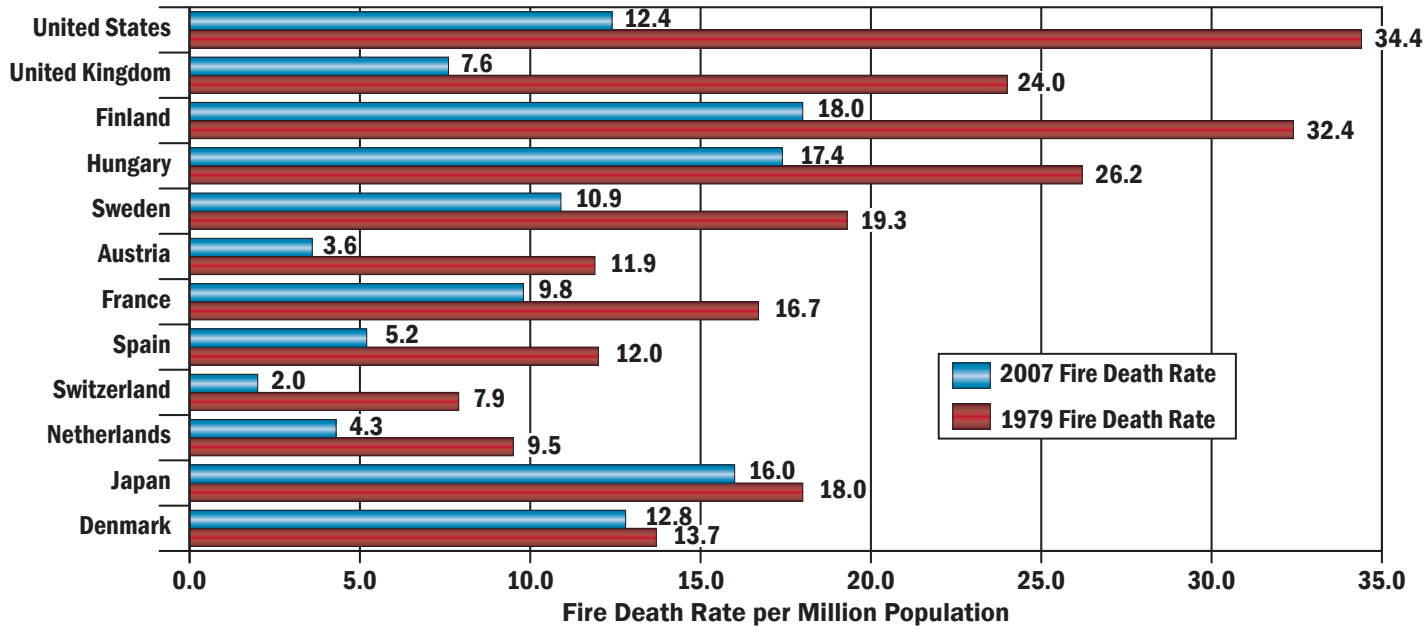


Sources: World Fire Statistics Centre fire death data and the United Nations (U.N.) Demographic Yearbook population estimate data.
Note: Where 2007 data were unavailable, the death rate for the most recent year available is shown.

The United States Improves

In absolute and relative terms, the situation in the United States improved greatly from 1979 to 2007. The United States accomplished 50 percent of its improvement in the first 10 years of that period and halved its death rate in the first two decades. Only five other nations for which data were available for both years (1979 and 2007) halved their death rates: the United Kingdom, Austria, Spain, Switzerland, and the Netherlands. Figure 2 shows the 1979 and 2007 fire death rates for the 12 countries where data were available for both years. In terms of absolute decrease, the United States had the largest decrease: the fire death rate fell from 34.4 fire deaths per million population in 1979 to 12.4 fire deaths per million population in 2007. The United Kingdom had the next largest drop from 24 deaths per million population in 1979 to 7.6 fire deaths per million population in 2007.[8]

Figure 2. Comparison of Fire Death Rates per Million Population, 2007 versus 1979 (by Absolute Improvement)



Sources: World Fire Statistics Centre fire death data and the U.N. Demographic Yearbook population estimate data.
Note: These nations were chosen for comparison because data for both 1979 and 2007 were available.

The United States Compared to Other Nations

Overall Fire Death Rate Trends

Table 1 is a trend comparison of the available international fire death rates. Data were not available for all of the years in question for every country and the resulting trends do not always reflect the full 29 years between 1979 and 2007. However, fire death rate trends in 13 of the 23 nations reflect 23 or more years of data. Six nations, the United Kingdom, the United States, Hungary, Sweden, Denmark, and Japan, have data for all 29 years.

The data demonstrate that, in general, fire death rates per million population have been decreasing over the past decades. Of the countries studied, only Denmark, Japan, and the Czech Republic recorded increases in their fire death rates per million population; all other countries lowered their fire death rates and many by substantial margins.

Table 1. Trend Comparison of Fire Death Rates per Million Population (1979–2007)

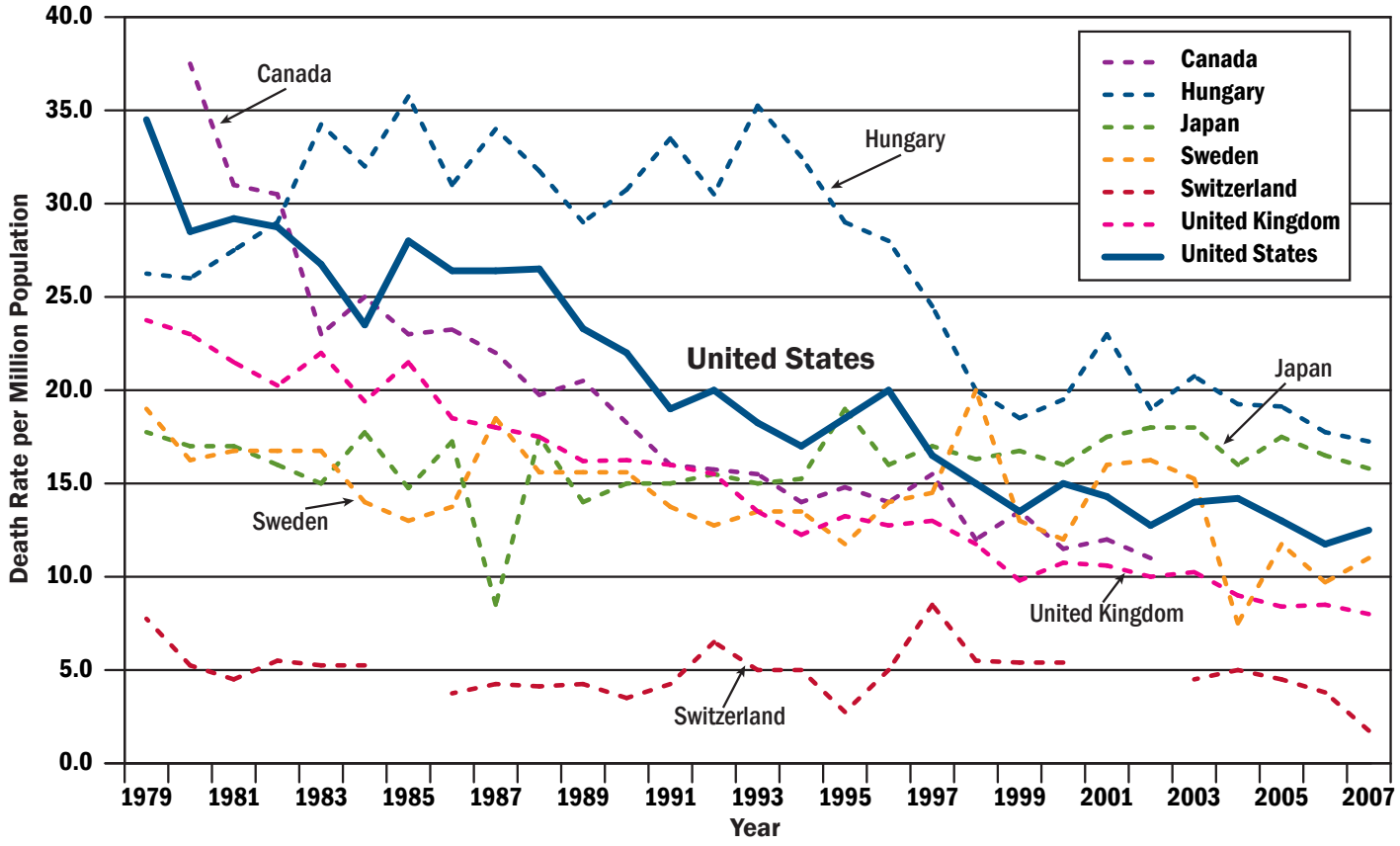
Country	Trend (percent)	Year Range	Years of Data
United Kingdom	-69.5	1979–2007	29
United States	-66.1	1979–2007	29
Hungary	-42.6	1979–2007	29
Sweden	-29.0	1979–2007	29
Denmark	3.6	1979–2007	29
Japan	7.1	1979–2007	29
Finland	-22.8	1979–2007	28
France	-49.1	1979–2007	27
Norway	-35.8	1979–2005	27
Austria	-50.9	1979–2007	26
Switzerland	-20.7	1979–2007	26
New Zealand	-42.2	1982–2007	23
Canada	-70.7	1980–2002	23
Spain	-54.6	1979–2007	21
Netherlands	-14.8	1979–1996	18
Australia	-44.6	1991–2007	17
Czech Republic	18.9	1991–2007	17
Greece	-19.4	1992–2007	16
Poland	-9.6	1992–2007	16
Germany	-52.6	1990–2006	16
Slovenia	-13.8	1994–2004	11
Ireland	-54.4	1997–2007	11
Italy	-51.6	1995–2007	9

Sources: World Fire Statistics Centre fire death data and the U.N. Demographic Yearbook population estimate data.
Notes: The fire death rates are presented by the number of years of available data, then by the trend change. The Netherlands fire death data were not reported between 1997 and 2005; trend calculations are based on 1979 through 1996 data. Singapore is not included as the small number of fire deaths resulted in a poor trend fit.

Time Series Fire Death Rate Trends

Overall, the United States has been successful in reducing fire deaths. Figure 3 depicts a time-series comparison of the fire death rates per million population of the United States and several industrialized nations studied. These nations present a range of fire death rates: high, medium, and low European rates, our Canadian neighbors, and Japan. As Figure 3 indicates, with the exception of Japan, the general trend in these fire death rates has been downward. Japan has long been considered a leader in fire safety. Even with its burgeoning elderly population, an age group known to be at a higher fire death risk[9], Japan's fire death rate per million population is still moderate. (The relationship between population age and fire death rates is addressed in the section "Other Influencing Factors.") The United States rate has decreased at a somewhat faster rate than the majority of the other countries.

Figure 3. Fire Death Rates per Million Population by Selected Countries



Sources: World Fire Statistics Centre fire death data and the U.N. Demographic Yearbook population estimate data.

Death Rate Trends by Region

The changes in fire death rates by region are shown in Table 2. Six regions, one of which is a single country, are identified as follows:

- Western Europe: Switzerland, Netherlands, Austria, Spain, France, United Kingdom, Italy, Germany, and Ireland;
- Eastern Europe: Slovenia, Hungary, Czech Republic, Poland, and Greece;
- Oceania: Australia and New Zealand;
- Japan;
- North America: Canada and the United States; and
- Scandinavia: Norway, Finland, Sweden, and Denmark.

The fit ratio (R^2) shown in the table indicates the amount of variability between the data and the linear trend line, which estimates the change in the death rate from 1979 to 2007. A higher fit ratio indicates less variance in actual fire death rates compared to values predicted by the trend line. Fit ratios vary from 0.0 to 1.0, with 0.0 indicating no fit and 1.0 indicating a perfect fit. It is important to note that fluctuations evident in the regional fire death rates reflect both actual changes in fire death rates and changes in the quality of fire data collected.

Table 2. Percent Change Across Regions (1979–2007)

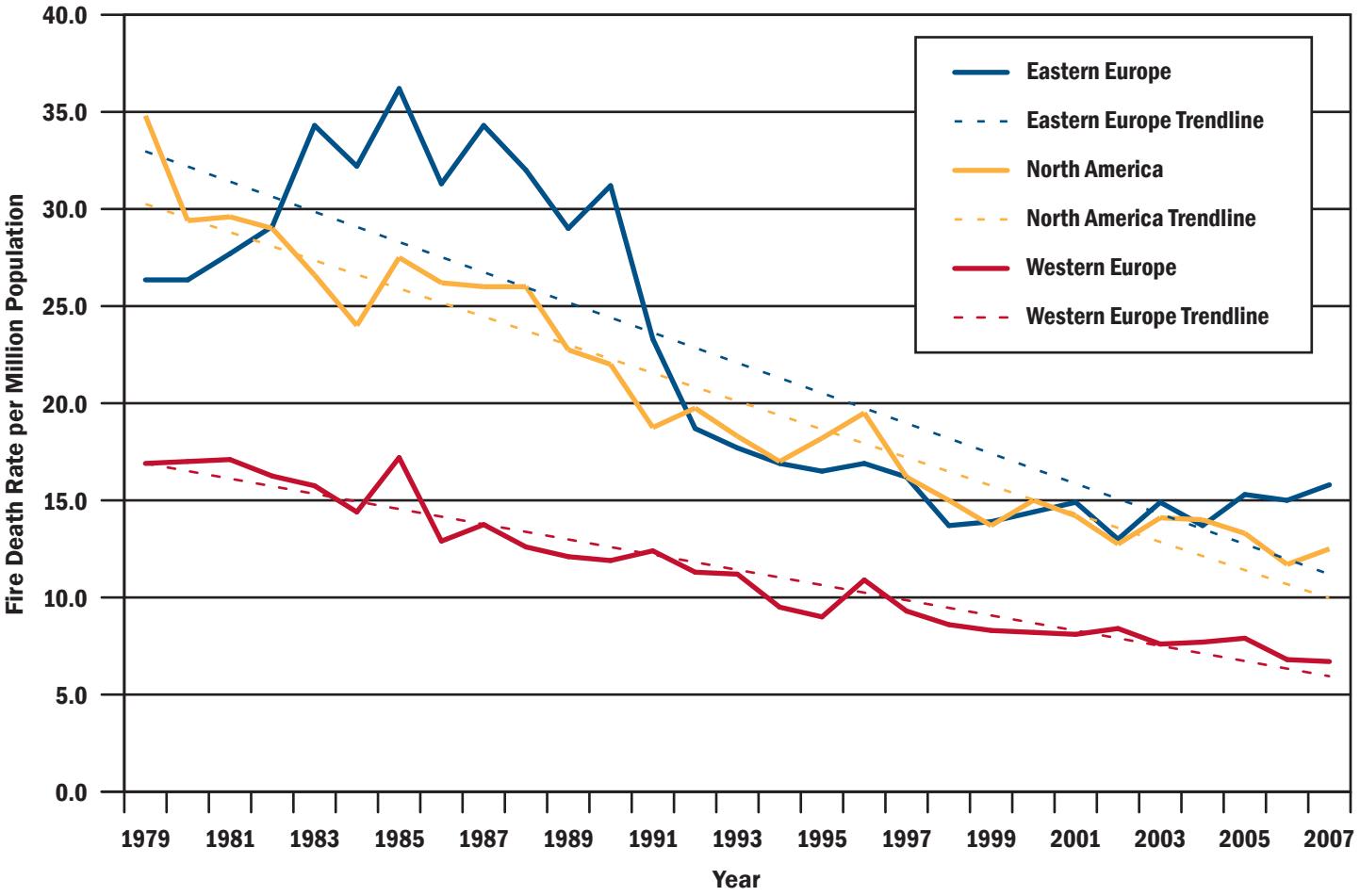
Region	Fire Death Rate Reduction(-) or Gain(+) Percent Change (Linear)	Fit Ratio[10] (R^2)
Western Europe	-64.5	0.94
North America	-66.7	0.93
Eastern Europe	-66.3	0.71
Oceania	-54.9	0.59
Scandinavia	-22.4	0.49
Japan	+7.1	0.03

Sources: World Fire Statistics Centre fire death data and the U.N. Demographic Yearbook population estimate data.
Notes: Countries within regions may have data for differing year ranges as noted in Table 1. Singapore is not included as the small number of fire deaths resulted in a poor trend fit.

The trend shown in Table 2 for Japan can be said to have no fit at all. The lack of correlation for the Japanese trend line is an indication of the variability of the fire death rate (and the underlying data) and reductions (or gains) derived from the trend data must be viewed with caution. The Oceania and Scandinavian trends can also be said to have a moderate fit.

Figure 4 presents a comparison of the fire death rate trends from 1979 to 2007 of the remaining three regions with strong trend fit ratios: Western Europe, Eastern Europe, and North America. Eastern Europe and North America have steep trend lines, starting with very high fire fatality rates and ending in the moderate range. In fact, North America and Eastern Europe experienced 67 and 66 percent overall annual reductions in their fire death rates, respectively, comparing favorably to the 65 percent reduction for Western Europe.

Figure 4. Trends in Fire Death Rates per Million Population by Region, 1979–2007



Sources: World Fire Statistics Centre fire death data and the U.N. Demographic Yearbook population estimate data.

Other Influencing Factors

Further research is needed to reveal the source of the differences in the death rates of the nations studied. The differences could be due to a number of factors, including fire prevention practices and education, building practices and regulations, differences in lifestyle, and cultural attitudes. For example, Japan has an acute problem with incendiary suicide, which pushes up the number of fire deaths considerably.[11]

The proportion of seniors in a country could also be a possible factor in the difference between fire death rates in countries. In the United States, the fire death rate from that segment is much higher than that of the general population.[12] Older adults face a greater risk of fire death than most people,[13] as they may have impaired mobility or senses, and have a greater chance to have reduced mental faculties due largely to Alzheimer's Disease.[14] Japanese data suggest that the increase in their fire death rate is at least partially due to their aging population.[15] Whether age distribution has a strong effect on fire death rates requires further investigation.

One of the difficulties in determining the cause of different fire death rates internationally is the lack of data available. Nations do not share very much or very specific data with other countries, making indepth examination more difficult. Increased cooperation between nations in the future could shed more light into the causes of fire deaths and effective preventative measures.

Summary

By the end of the 20th century, dramatic improvements put the United States in a more comparable position to the rest of the industrialized world. In spite of these gains, the 2007 United States fire death rate of 12.4 deaths per million population was still the 10th highest of 24 nations. This fire death rate does show large improvements against almost every country investigated, but eight nations still have half or less than half of the fire death rate of the United States including Switzerland, with two deaths per million population, less than a sixth of the United States rate. Overall, while the United States continues to have fire death rates that are higher in absolute numbers in comparison to other industrialized countries, the country has improved significantly in terms of relative decreases in fire deaths.

To request additional information or to comment on this report, visit http://www.usfa.dhs.gov/applications/feedback/index.jsp

Resources

There have been numerous studies published on the international fire picture and many of them give valuable insight on the United States situation. The list below presents a range of reports that provides insights into the issues and practices of fire protection and prevention internationally.

Fire Death Rate Trends: An International Perspective, U.S. Fire Administration, prepared by TriData Corporation, 1997.

Fire in the U.S. and Canada, National Fire Protection Association, April 2005.

Fire in the U.S. and Japan, National Fire Protection Association, August 2003.

Fire in the U.S. and Sweden, National Fire Protection Association, April 2004.

Fire in the U.S. and United Kingdom, National Fire Protection Association, April 2005.

Global Concepts in Residential Fire Safety: Part 3 - Canada, Puerto Rico, Mexico, and Dominican Republic, Centers for Disease Control and Prevention, prepared by TriData Corporation, July 2009.

Global Concepts in Residential Fire Safety: Part 2 - Australia, New Zealand, and Japan, Centers for Disease Control and Prevention, prepared by TriData Corporation, 2008.

Global Concepts in Residential Fire Safety: Part 1 - Best Practices from England, Scotland, Sweden, and Norway, Centers for Disease Control and Prevention, prepared by TriData Corporation, 2007.

International Concepts in Fire Protection: New Ideas from Europe, Philip Schaenman, TriData Corporation,1993.

International Concepts in Fire Protection: Practices from Japan, Hong Kong, Australia, and New Zealand, Philip Schaenman, TriData Corporation, 1985.

International Concepts in Fire Protection: Ideas From Europe That Could Improve U.S. Fire Safety, Philip Schaenman, TriData Corporation, 1982.

The Geneva Association, through its World Fire Statistics Centre (WFSC), produces an annual Bulletin on international fire comparisons. These yearly Bulletins report current fire statistics on fire deaths, fire death rates, direct fire losses, and expenditures on fire protection for many of the nations studied in this paper.

Notes:

[1] Fire death rates are determined by the number of deaths occurring to a specific population group divided by the total population for that group. This ratio is then multiplied by a common population size. For the purposes of this report, fire death rates are measured per 1 million persons. For example, the 2007 fire death rate per million population for the United States is computed from the total number of fire deaths (3,750) divided by the total U.S. population (301,621,000) multiplied by 1,000,000 persons. This rate is equivalent to 12.4 deaths per 1 million population.

[2] Of the 27 countries whose fire-related data are presented in the World Fire Statistics Centre (WFSC) yearly Bulletins, 24 industrialized nations were reviewed. The relative standing of the United States is given in terms of this sample. Countries reviewed were the United States, Australia, Austria, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Poland, Singapore, Slovenia, Spain, Sweden, Switzerland, the United Kingdom. Belgium, West Germany, and Czechoslovakia were excluded because of limited pre-1992 data and because the latter two countries no longer exist.

[3] Analyses are based on fire death data from the WFSC yearly Bulletins and population estimate data from the United Nations (U.N.) Demographic Yearbook. Fire deaths, as presented by the WFSC, include firefighter deaths and an adjustment "for deaths unknown to fire brigades and/or hospitals, and for rounding." United States fire death estimates from WFSC vary from year-to-year from those based on the U.S. Fire Administration's (USFA's) analysis of mortality data from the National Center for Health Statistics (NCHS) and from the National Fire Protection Association (NFPA) estimates. Analyses of the differences in these estimates from 1999 to 2007 (since the use of the International Classification of Diseases (ICD)-10 codes for United States mortality data) show that the differences in the WFSC estimates and USFA's analysis of the NCHS data average less than 1 percent. The differences between the WFSC and the NFPA survey estimate of fire deaths, including firefighter deaths, average 6 percent, with the WFSC estimates consistently higher.

[4] NFPA conducts an annual survey of fire departments. The survey sample is chosen from a statistically random selection of United States fire departments. The NFPA estimates are created using stratified sampling techniques.

[5] The U.S. Centers for Disease Control and Prevention (CDC), NCHS, collects and disseminates United States vital statistics data. These data are provided through contracts between NCHS and vital registration systems operated in the various jurisdictions legally responsible for the registration of vital events. The NCHS mortality data from the National Vital Statistics System (NVSS) are based on data collected from death certificates. Coding of medical information on the death certificate follows World Health Organization rules specified in the ICD. As "fire" is not a specific disease classification in the ICD, the counting of fire deaths can be subject to some interpretation.

[6] Fire deaths, as presented by the WFSC, include firefighter deaths and an adjustment "for deaths unknown to fire brigades and/or hospitals, and for rounding." United States fire death estimates from WFSC vary from year-to-year from those based on USFA's analysis of NCHS mortality data and NFPA estimates. Analyses of the differences in these estimates from 1999 to 2007 (since the use of the ICD-10 for United States mortality data) show that the differences in the WFSC estimates and USFA's analysis of the NCHS data average less than 1 percent. The differences between the WFSC and the NFPA survey estimate of fire deaths, including firefighter deaths, average 6 percent, with the WFSC estimates consistently higher.

[7] As a result of unusually high numbers of fires deaths from wildfires, the total reported deaths for Greece made it the country with the highest fire death rate per million population of 23.7. After removing the 67 deaths due to the catastrophic 2007 wildfires, the adjusted fire death rate is 17.7 deaths per million population. The number of deaths from the wildfires was taken from the article "Greek volunteers replant fire-ravaged forest," AFP (http://afp.google.com/article/ALeqM5ho4R6U6QfmZNZZlFF4a4lWyihAxQ).

[8] In terms of improvement, Canada, which had a 71 percent improvement, experienced a drop of 26.4 deaths per million population. Data for Canada for 1979 and from 2002 to 2007, however, were unavailable and as such Canada was not included in Figure 2.

[9] *Fire Risk to Older Adults in 2007*, Topical Fire Report Series (Volume 11, Issue 10), USFA, February 2011.

[10] R^2 provides a measure of how well the data are likely to be explained by the model (in this case, the trend line). There is no standard of what is a "good" R^2. In the case of a simple linear regression such as the ones present here, in general, the closer R^2 is to 1, the better the trend line fits the data series and possibly predicts future results.

[11] *Fire in the U.S. and Japan*, NFPA, August 2003.

[12] *Trends in Older Adult Fire Death Rates* (2003-2007), http://www.usfa.dhs.gov/statistics/estimates/trend_older.shtm.

[13] *Fire Risk to Older Adults in 2007*, Topical Fire Report Series (Volume 11, Issue 10), USFA, February 2011.

[14] *Fire and the Older Adult*, USFA, prepared by TriData Corporation, January 2006.

[15] *Global Concepts in Residential Fire Safety: Part 2 - Australia, New Zealand, and Japan*, CDC, prepared by TriData Corporation, 2008.