Fire Fatalities Among Children: An Analysis Across Philadelphia's Census Tracts

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SYNOPSIS

Objectives. This study investigates the possible causes of high levels of residential fire deaths to children younger than 15 years of age in Philadelphia from 1989 to 2000.

Methods. The authors analyzed 246 deaths from 146 residential fires by census tract in Philadelphia using both individual level data and aggregate level data drawn from the records of the Fire Marshal's Office. Death rates by age and sex were calculated using the 1990 Census. Data on fires from official records were combined with aggregate level data by census tract from the 1990 Census and analyzed using logistic regression. Newspaper articles on the fires analyzed were used to identify residences with possible fire code violations. The authors used data from the Philadelphia Bureau of Licenses and Inspections to provide evidence of code violations.

Results. The statistically significant variables that resulted from the logistic regression were census tracts in the highest quartile for low income households, census tracts in the highest quartile for single-parent households with children younger than age 18, census tracts in the highest quartile for houses built before 1939, and the number of children younger than 15 years of age in a census tract.

Conclusions. Population characteristics by census tract are useful in identifying risk factors for residential fire deaths of children. Census tracts identified as at highest risk can provide fire prevention units with opportunities to take preventative measures such as the distribution of smoke detectors, and the education of residents about the dangers of careless smoking and planning for the rescue of children in the event of a fire.

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Nationwide, the United States has made progress in reducing death rates from fires since the mid-1960s.[1] This progress is generally attributed to the widespread use of smoke detectors, fire sprinkler systems, stricter fire codes and changes in lifestyle, including decreased smoking.[2] Despite these improvements, the United States has one of the highest per capita death rates from fires in the developed world,[3] twice as high as those of Western Europe and Japan.[4] Among the groups with the highest fatality rates are children, particularly those under the age of 5,[5] but this cause has received less attention than other causes of fatal injury among children,[6] despite the fact that many fires are preventable and a result of human behavior.[4]

The reasons why children are at high risk for fire deaths have not been clearly established.[7] Environmental conditions, the presence of adults as supervisors and rescuers, and children's changing ability to both create and escape from danger are all relevant factors. It is estimated that in 1998 children playing with fire caused 232 civilian deaths and 1,805 civilian injuries in the United States.[8]

In some local communities, child death rates from fires may deviate sharply from the national trends. Nationally, death rates for motor vehicle accidents exceed those for accidental fire deaths at all ages.[9] However, in Philadelphia from 1996 to 2000, accidental fire death rates were higher than those for motor vehicle accidents for children younger than ten years of age. (Unpublished data, Pennsylvania Department of Health, Bureau of Health Statistics; 2002. The Department specifically disclaims responsibility for any analyses, interpretations, or conclusions.) In a study of 199 U.S. counties with a population greater than 250,000 from 1988 to 1992, Philadelphia had the second highest crude death rate from fires (3.7 per 100,000 population), even after adjusting for county variation in age structure.[10]

The relatively large proportion of fire deaths in Philadelphia and the special case of child fatalities have rarely been addressed in academic research and constitute the central focus of this paper. We examine both unintentional fire deaths and arson deaths together for children younger than age 15 in Philadelphia from 1989 to 2000. In urban areas such as Philadelphia, arson deaths are grounded in family violence and drug dealing, while unintentional fire deaths are grounded in poverty. However, the new emphasis of public health in injury mortality is on the mechanism of death, e.g., fire, rather than the intent or manner of death, e.g., homicide,[11] since the primary prevention strategy is the same—smoke detectors. To test the advisability of including both unintentional and arson deaths in the study, we performed an analysis on the complete data set and another analysis on a partial data set that did not include the arson deaths. Both analyses led to exactly the same results. Therefore, we will focus on the results that stemmed from the complete data set.

We use the term *residential fires* to indicate that the fires took place in houses, apartments, and other residential dwellings. The project is intended to investigate the possible causes of this unusually high level of mortality by using two kinds of data, individual and aggregate level, the latter through logistic regression.

BACKGROUND

Fire and burns are the leading cause of death in the home for children.[4] Children may not respond appropriately to fire—hiding or not telling adults about the situation. Even in the presence of working smoke detectors, children may not react properly and usually need adult rescuers to help them get out of a burning building.[12] Very young children cannot escape fires by themselves. From ages 3 to 5, children are better at escaping but are more likely to play with matches, lighters, or candles and start fires if left unsupervised.[5,13,14] Nationally, among children younger than age six who die in residential fires, one-third are due to children playing with matches or fire.[15] The following account documents the importance of adult supervision of small children at all times:

> A woman left two of her children, ages 5 and 3, alone in their apartment while she walked her three older children to school. Within 15 minutes, the fire department was notified of a fire in the apartment. The 3-year-old boy apparently had ignited the couch . . . with a lighter and then had retreated to a third-floor bedroom with his sister. His body was found on the bed . . . . His sister's body was on the floor.[15]

Other causes of fatal fires are careless smoking, arson, heating equipment, and cooking left unattended.[2,13,14,16,17] Nationally, residential fires usually start in the kitchen, with the bedroom the second most common site.[18] Fire-related deaths are lowest in the summer and highest during the winter, due to increased use of heating and ignition sources,[19] particularly portable space heaters and wood-burning stoves.[20] Fatal fires usually occur at night or early in the morning, when victims may be sleeping and unaware that a fire is taking place or too confused to respond in time to escape.[4] Substandard and unsafe dwellings, whether in rural or urban areas, are less likely to have fire warning systems and exits[7] and, according to Greenberg

and Schneider,[21] as marginal environments, elevate the risk of fire deaths by arson. African-Americans have the highest residential fire-related death rate.[13,19] Poor children are also at a greater risk of dying in a residential fire.[22] Smoke detectors are considered to be among the most important intervention strategies to decrease deaths from fires.[13,17]

METHODS

The Philadelphia Fire Department supplied data on 146 residential fires that were fatal to children younger than 15 years of age during 1989–2000. Information included the address, census tract, date, age, sex, and race of the 246 decedents, as well as the cause, room in the residence where the fire began, time of day, the presence or absence of a working smoke detector, and whether children were left unsupervised. The 1990 Census[23] was used to calculate death rates by age and sex. Death rates are based on 12-year averages of deaths and expressed per 100,000 population.

The exceptions to the 1990 Census are the estimated death rates by race/ethnicity and the associated rate ratios. The 1990 Census race and Hispanic origin categories include "Black," "Asian or Pacific Islander," "Hispanic origin (of any race)" and "White, not of Hispanic origin." Therefore, the "Black" category can include Hispanics. The 2000 Census revised the race and ethnicity categories into "Black or African American alone, not Hispanic or Latino,"[24] "Asian alone, not Hispanic or Latino,"[25] "Hispanic or Latino,"[26] and "White alone, not Hispanic or Latino."[27] These categories permit a more accurate estimate of death rates by race and ethnicity, since the fire department grouped decedents into "Black," "Asian," "Hispanic," and "White" designations (see Table 2).

The 1990 Census summary tape file 3A was used to determine characteristics of census tracts which may influence the risk of fatal fires and to construct independent variables for the logistic regression analysis, including age of housing, single-parent households, income, education, ability to speak English, access to a telephone, unemployment, the ratio of children to adults, and the population younger than age 15.[28] The aggregate-level data were analyzed using logistic regression. The research problem was to find the main determinants of fires fatal to children in Philadelphia by census tract.

There are 367 census tracts in Philadelphia; 40 of these were eliminated because they had a population of less than 500. These 40 tracts included 1,398 children or 0.4% of the population younger than age 15. There was one child fire fatality among these eliminated census tracts. An additional three tracts were eliminated that had a population of 500 or more but no or few children: tract 50.99 (Philadelphia Navy Yard, no children), tract 328 (Philadelphia Prison Complex, no children), and tract 364 (Byberry: group quarters, institutionalized individuals, two children). Tract 364 constituted an outlier, with only two children. There were no child fire fatalities from tract 364. The next largest child population among census tracts with a total population of 500 or more was 42 children. Three hundred and twenty-four tracts remained. These tracts were divided according to whether there had been at least one child fire fatality or none in the years studied. Ninety-four tracts had at least one child death due to residential fire.

The first author interviewed officials of the Fire Prevention Unit of the Philadelphia Fire Department and representatives of the local insurance industry to obtain information from individuals that dealt with the consequences of fires on a day-to-day basis. The goal was to make an optimum selection of variables to be tested in the study. The interviews with the Philadelphia Fire Department covered the topics of causes of fires (including children playing with matches, careless smoking, the high flammability of synthetics used in furniture) and prevention programs. The interviews with insurance agents centered on the dangers of Philadelphia's aging housing stock, the row house construction where fire and smoke can easily spread from one house to another, outmoded electrical systems, overloaded electrical outlets, and frayed wiring. The lack of regulation of homeowners was also discussed.

In addition, 301 newspaper articles from the online archives of the three major daily newspapers, *The Philadelphia Inquirer*, *The Philadelphia Daily News*, and *The Philadelphia Tribune*, were matched to the fires. Research using newspaper accounts of injuries has shown that fires involving child injury have a high degree of news coverage.[29] Of the 146 fires under consideration in our study, 134 could be linked to newspaper accounts. For 26 fires included in our analysis, newspaper articles indicated the possibility of substandard housing conditions. This is likely to be an under-count, since many articles gave only a brief account of the fire. An official from the Philadelphia Bureau of Licenses and Inspections (L & I), which is responsible for inspecting and enforcing fire, electric, and other code violations, searched the 26 addresses for outstanding violations on those properties. A second official reviewed abstracts from the newspaper accounts of the fires for possible violations of fire and electrical codes.

RESULTS

Individual-level data

Males had higher death rates per 100,000 from fires than did females in our study, in keeping with a well-established finding in fire research of the higher risk for males in general.[30] Death rates decreased with age. Children younger than age 5 had the highest death rate from fires. Children ages 5 to 9 had a lower rate, and children ages 10 to 14 had the lowest death rate (see Table 1).

Among the racial and ethnic groups examined, non-Hispanic whites had the lowest death rate, with higher rates among the other groups studied. The highest death rate was among blacks. The second highest rate, among Asians, must be interpreted with caution since it is based on only 13 deaths. This uncertainty can be seen in the wide confidence interval for this rate (see Table 2). Rate ratios were used to illustrate the comparative risk of different race and ethnic minority groups. Using the fire death rate of non-Hispanic whites as the denominator, blacks have nearly four times the risk of fire deaths, Hispanics nearly three times the risk, and Asians more than three and a half times the risk. Again, caution must be taken with the small numbers of Asian decedents (see Table 2).

Table 1. Age-specific fire death rates per 100,000 population for children younger than age 15, by sex and five-year age groups: Philadelphia County, 1989–2000.

Sex	*Rate*	n	*95% Confidence Interval*
Males	7.42	145	6.22, 8.64
Females	5.33	101	4.29, 6.37
Age group (years)			
0–4	10.28	143	8.60, 11.97
5–9	6.00	75	4.64, 7.36
10–14	2.32	28	1.46, 3.18

NOTE: Population data are from the 1990 Census for Philadelphia County; deaths are from the Philadelphia Fire Department, Fire Marshal's Office. Census data are based on residents of Philadelphia, while the Fire Department data are comprised of occurrences of deaths in Philadelphia. For accuracy, the population in the numerator should match the population at-risk in the denominator. To check if the child fire deaths had occurred largely to residents, we examined child fire deaths in Philadelphia from the website of the Centers for Disease Control (cdc.wonder.gov) which are based on medical examiner data on Philadelphia residents for 1989 to 1999. When we calculated the death rates by age and sex, the results differed from the death rates above by only one-half of a percentage point. Therefore, the decedents in the Fire Department data are likely to be Philadelphia residents.

Table 2. Age-specific fire death rates per 100,000 population for children younger than age 15, by race/ethnicity: Philadelphia County, 1989–2000.

Race/ethnicity	*Rate*	n	*95% Confidence Interval*
Non-Hispanic white	2.28	25	1.39, 3.18
Non-Hispanic black	8.61	174	7.33, 9.89
Hispanic	6.78	34	4.31, 8.87
Asian	8.27	13	3.78, 12.78

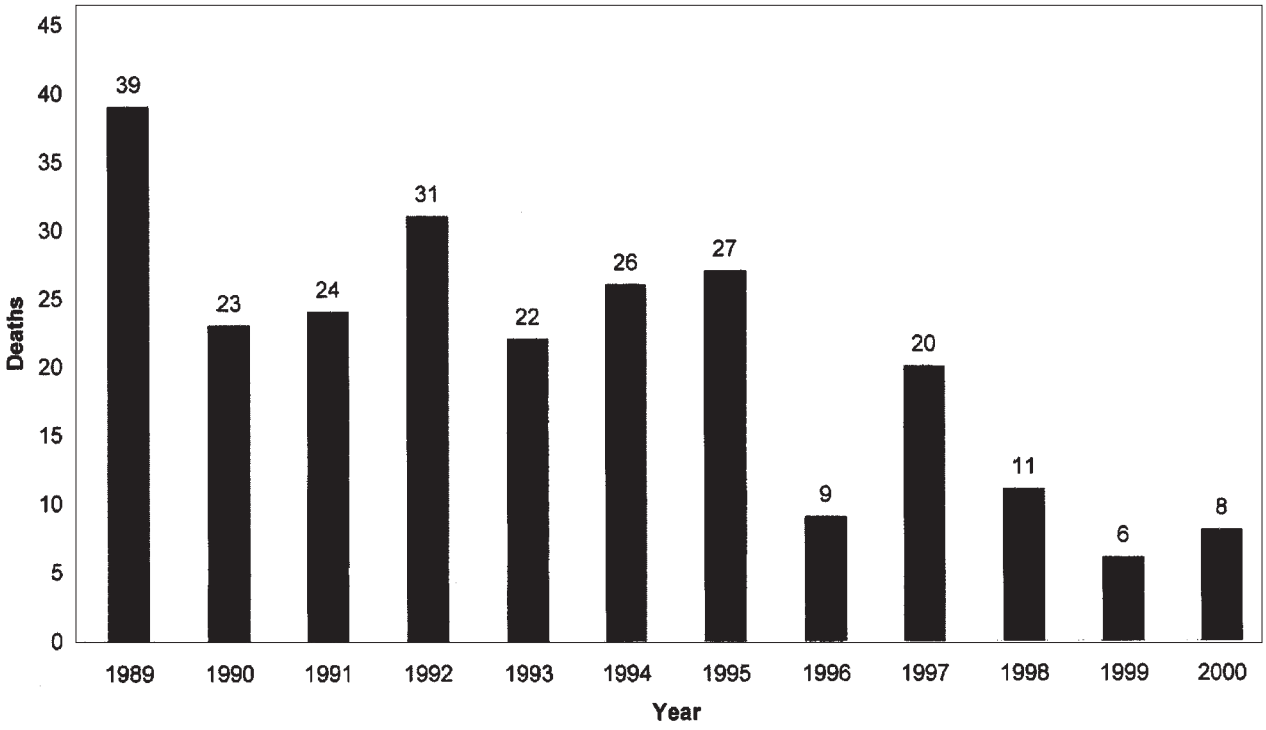
	Rate ratio
Non-Hispanic black/Non-Hispanic white	3.78
Hispanic/Non-Hispanic white	2.97
Asian/Non-Hispanic white	3.63

NOTE: Population data are from the 2000 Census (100% data); deaths are from the Philadelphia Fire Department, Fire Marshal's Office.

The year with the greatest number of deaths was 1989, with 39. Since then, deaths have generally been decreasing; 1999 was the lowest year with six deaths (see Figure 1). While fatal fires occurred around the clock, the greatest number occurred between midnight and 6:00 a.m., the hours when most people are asleep; this is very similar to the findings for all fire fatalities nationwide.[30] The number of occurrences is smaller as the day progresses (see Figure 2). The period of the year with the highest frequency of fatal fires was January to March, the coldest months, when space heaters are most likely to be used. While summer months have the smallest number of fires, partly because of decreased use of all heat sources, it is likely that the few fires for June are also due to the fluctuation of small numbers (see Figure 3). The most common cause of fire deaths was children playing with matches, substantiating the views of the firefighters interviewed. Cigarettes or careless smoking was the second leading cause, with arson almost as important (see Figure 4). The two most frequent locations for the fires were the bedroom and the living room, areas where children are likely to be sleeping or playing (see Figure 5).

An activated smoke alarm was found in only 18.9% of the residences. Children had been left alone in three cases, according to the Fire Department records. The National Fire Protection Agency defines "left alone" or "unattended" as children younger than ten years of age who are "left alone at home during the day, children under 15 who were alone during the night, and children who were under the care of other children under the age of 12."[15]

Figure 1. Child fire deaths by year: Philadelphia County, 1989–2000



Of the 26 properties submitted to the clerical division of the Bureau of Licenses and Inspections, 23 had outstanding fire, electrical, and/or property code citations. In five cases, the properties were cited for fire and electrical code violations and described as constituting health and safety hazards or "unfit for human habitation." The remaining 18 properties were considered "unsafe" or a "public nuisance" due to being unlicensed, and having unsafe exits and/or the accumulation of rubbish, garbage, rodents, and weeds. The review of conditions cited in the newpaper articles by the coding department found violations of the Fire Prevention Code in the way kerosene heaters were used (three properties), the misuse of extension cords (two properties), faulty wiring as an electrical hazard (five properties with two additional ones as possible hazards), unsafe exit doors and windows (two properties), and reducing the effectiveness of required alarms by removing the batteries or disconnecting the system (two properties). Many of these causes are risk factors that had been cited by the insurance agents interviewed. Finally, as an illustration of the possibilities of multiple problems in a single residential unit, one of the properties was a single-family dwelling illegally made into a makeshift apartment house with one bathroom for eight families (15 people). The fire, which killed four children, involved the use of an electrical heater in a faulty outlet. The property had exposed electrical wires, leaky pipes, and rainwater coming through the walls. It lacked fire extinguishers, heat, and hot water.

Aggregate-level analysis: logistic regression

Initially, we intended to model the number of fire deaths in a census tract using Poisson regression. However, census tract 21 with 10 deaths and census tract 279 with 9 deaths were extreme outliers. A model that would adequately fit the data that included these two outliers could not be found. We did not want to eliminate these two census tracts, with their large number of deaths. Therefore, we were forced to use an alternative method of analysis. Even though we were losing information by treating numbers of deaths as a dichotomous variable (none or one or more deaths), we felt that this was the best way to handle the outliers in our data set. It was hypothesized that the relationship between child mortality by fire and a set of independent variables is not homogeneous across census tracts,

Figure 2. Child fire deaths by time of day: Philadelphia County, 1989–2000

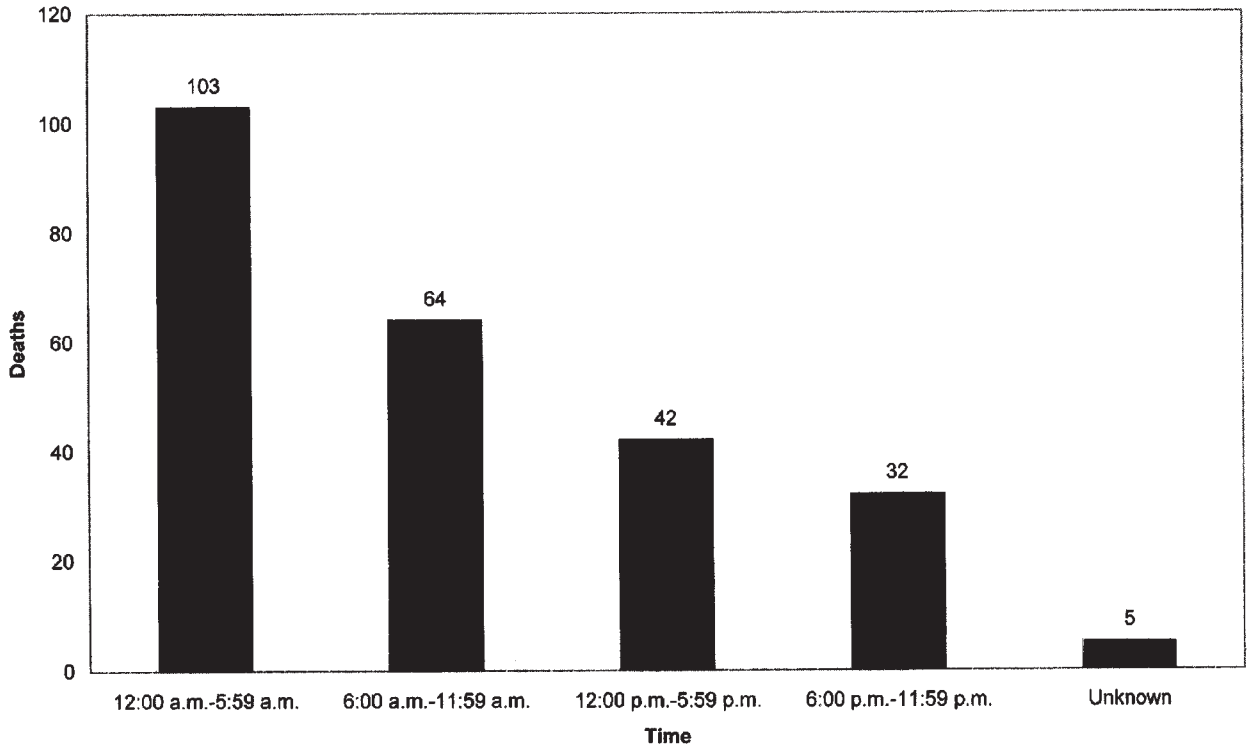


Figure 3. Child fire deaths by month: Philadelphia County, 1989–2000

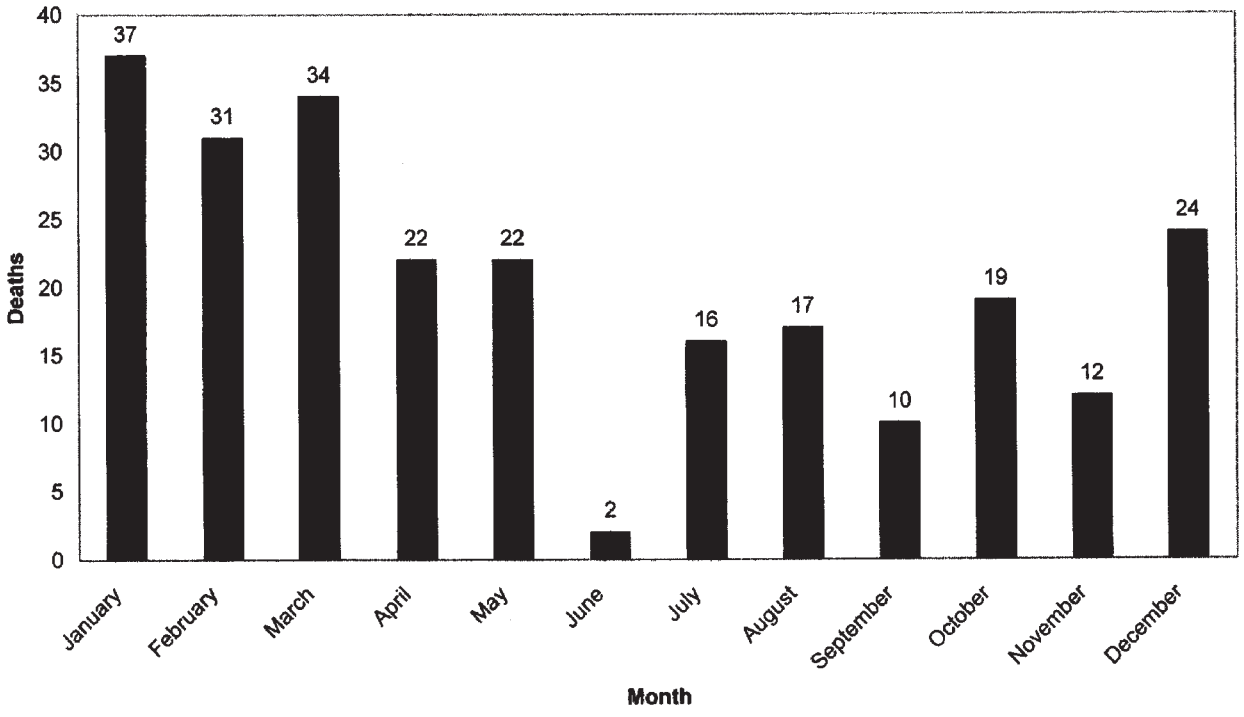
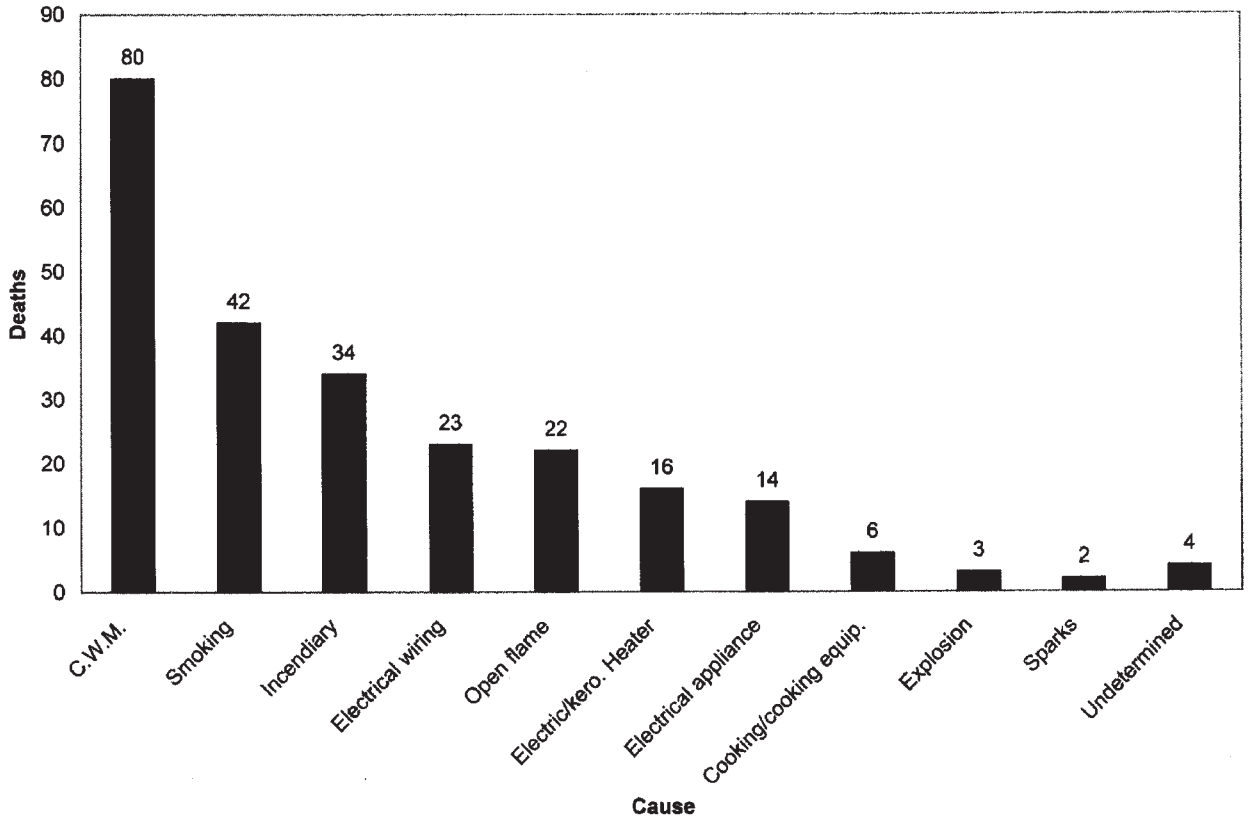


Figure 4. Child fire deaths by cause of fire: Philadelphia County, 1989–2000



C.W.M. = children with matches

and that economic deprivation, decreased ability to notify and communicate with emergency personnel, aging housing stock, and single-parent households will increase the risk of fire victimization.

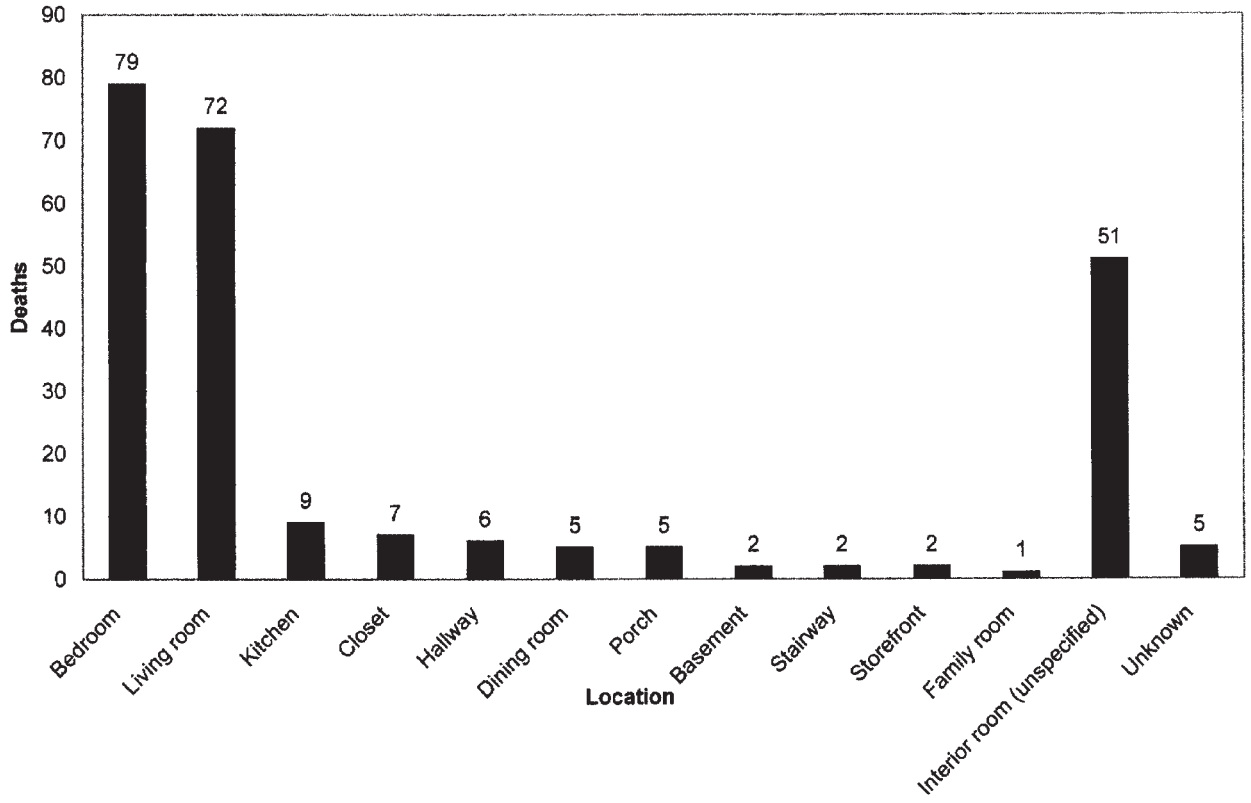
Explanation of independent variables

The age of housing has long been suspected as a factor in fatal fires. Runyan et al., in a study of fatal fires in North Carolina in 1988-89, found that buildings twenty years old and older had twice the likelihood of fatal fires than newer houses.[31] Istre et al., in a study of fire injuries and deaths in Dallas (1991–1997), found that the oldest houses did not have the highest rates of injury, with houses built in the 1950s and 1960s more likely to burn than those built earlier or later.[13] Differential findings may be related to the age and architecture of a city. Philadelphia was incorporated as a city in 1701, Dallas in 1871. Older neighborhoods in Philadelphia have a distinctive residential pattern of row houses, characteristic of only a few areas in the northeast of the United States (e.g., Baltimore), which may contribute to the high fire fatality rates in both.[10] When poor people are unable to maintain their older residences or landlords are unwilling to bring buildings up to code for fire safety, the results are dilapidated and deteriorated housing.[21] Philadelphia officials have estimated that approximately one quarter of the city's 300,000 rental units lack the proper certificates of occupancy, leading to possible unsafe conditions.[32] The review of cases by the Philadelphia Bureau of Licenses and Inspections showed that many properties had outstanding violations.

It has been well established that fire mortality is more common in economically disadvantaged groups.[6,10,13,33–36] Therefore, two variables were used to tap this cause—unemployment and low income.

The lack of education, and particularly maternal education, has been noted as a factor strongly related to fire rates.[33,37] Hussey[38] found that a low level of education of the head of the household was associated with increased unintentional injury mortality, including fire mortality, in children and young adults.[38] Al-

Figure 5. Child fire deaths by location of fire: Philadelphia County, 1989–2000



though the relationship between education and fire deaths is not well understood, it is likely that low-education parents living in hazardous living conditions are less knowledgeable about injury prevention.[38]

Homes without a telephone have been found to present a higher risk of fatal injury by fire.[31,36] Since Philadelphia has a large immigrant population, the ability to speak English was also included in the present study.

The proportion of female-headed households in a census tract has been found to increase the mortality risk in that tract;[39] specifically, unmarried mothers are at higher risk of fatal fire events involving young children.[37,40] It has been found that children living with a single parent, on the average, have less supervison and fewer resources.[38] In addition, in the event of a fire, there may be fewer adults present to rescue children.

Another variable included to tap the presence of potential rescuers was the ratio of children to adults. Research has found that high-vulnerability groups such as the elderly or the very young are most likely to survive a fire if a potential rescuer is present[3] or if the number of children in a family is small.[37] Therefore, we speculated that the higher the proportion of children to adults in the census tract, the fewer the potential rescuers in the case of fire.

We anticipated that the number of children younger than 15 years of age would be significant, since the greater the number of children, the more likely it is that the census tract would experience a fatal fire involving children. Therefore, the variable UNDER15 was used as a covariate to adjust the responses due to this fact (see Figure 6).

Logistic regression was used to determine how the nine variables and possible interactions between them (cross-products of a pair) affected the dependent variable of the risk of a fatal fire in a census tract. The purpose was to select those variables and interactions that were most related to the risk of a fatal fire. The analysis was performed using SAS version 8.01.[41]

Figure 6. Variables and measures

Covariates	*Description*
Dependent variable	
FIRE	A binary variable coded 1 if one or more fires fatal to a child or children younger than 15 years of age had occurred in a given census tract in the years 1989-2000; otherwise 0.
Independent variables	
HOUSE	A binary variable coded 1 if the percentage of houses built prior to 1939 in a given census tract falls into the highest quartile, 74.60% or higher; otherwise 0.
INCOME	A binary variable coded 1 if the percentage of households with an income less than $15,000 in a given census tract falls into the highest quartile, 43.80% or higher; otherwise 0.
LESS9	A binary variable coded 1 if the percentage of individuals with less than nine years of education in a given census tract falls into the highest quartile, 13.27% or higher; otherwise 0.
ENGLISH	A binary variable coded 1 if the percentage of individuals who speak English "not very well" or "not at all" in a given census tract falls into the highest quartile, 2.60% or higher; otherwise 0.
PHONE	A binary variable coded 1 if the percentage of housing units without a telephone in a given census tract falls into the highest quartile, 7.01% or higher; otherwise 0.
SINGLE	A binary variable coded 1 if the percentage of single-parent households with own children younger than 18 years of age in a given census tract falls into the highest quartile, 15.77% or higher; otherwise 0.
RATIO	A binary variable coded 1 if the ratio of children younger than 15 years of age to adults in a given census tract falls into the highest quartile, 34 or higher; otherwise 0.
UNEMPLOY	A binary variable coded 1 if the percentage of individuals 16 years of age or older in a given census tract who were unemployed falls into the highest quartile, 7.93% or higher; otherwise 0.
Control variable	
UNDER15	A continuous variable indicating the number of children younger than 15 years of age in a given census tract.

RESULTS

Of the nine independent variables, only four were statistically significant: UNDER15, as expected, as well as HOUSE, INCOME, and SINGLE. We will call this model our main effects model. Various models containing interaction terms were fit to the data; however, they did not contribute significant information to the model. We determined this by comparing the difference in the log-likelihood values between the main effects model and the model containing the interactions to an appropriate chi-square distribution. For each of the interaction models tested, the difference in log-likelihood values was not significant. Therefore, we decided to focus on the main effects model.

Before interpreting the parameter estimates from the model, we wanted to make sure that there was no apparent lack of fit for our model. One criterion for assessing goodness of fit in a logistic regression model is the Pearson chi-square statistic. For this model, the Pearson chi-square statistic is 289.71, which is based on 319 degrees of freedom. The *p*-value for this statistic is 0.8791. This *p*-value is not significant at the 5% level of significance, indicating that there is no significant lack of fit for our model. Another method of determining lack of fit is to observe the standardized residuals. Only seven of 324 (2.2%) standardized residuals have a magnitude greater than two, and all seven have a magnitude less than 2.5. Since there are no abnormally large standardized residuals, and since the Pearson chi-square statistic did not detect lack of fit, we feel comfortable that our model is fitting the data well.

Table 3 lists the parameter estimates for the significant variables from the logistic regression analysis, along with their *p*-values, corresponding estimates of the odds of a child younger than age 15 experiencing a fatal fire, and confidence intervals for the estimated odds.

Table 3. Parameter estimates and estimated odds (with confidence intervals) of a census tract experiencing at least one fatal fire to a child younger than age 15

Variable	Parameter estimate	Estimated odds	95% confidence interval of the odds
UNDER15	0.0013	1.001	1.0009, 1.0018
INCOME	1.1578	3.183	1.551, 6.531
HOUSE	1.0444	2.842	1.504, 5.369
SINGLE	1.0306	2.803	1.380, 5.692

To interpret these results, we must consider a change in one explanatory variable while holding all other variables fixed at a given level. If all other variables are held at the same level, the odds of experiencing a fatal fire are multiplied by:

- 3.183 for those census tracts in the highest quartile of low-income households;
- 2.842 for those census tracts in the highest quartile of percentages of houses built before 1939;
- 2.803 for census tracts in the quartile with the highest percentage of single mothers with children younger than age 18;
- 1.001 for every additional child younger than 15 years of age in a census tract (for an *n* child increase, the estimated odds are multiplied by 1.001 to the *n*th power).

DISCUSSION

Our findings from the individual-level data point to the high-risk status of children in minority groups and to the high percentage of deaths of children caused by playing with matches. Efforts to teach match and lighter safety to children, child-resistant lighters, redesigned matches or match containers, warning labels on matches and lighters, and parental education concerning child supervision would be worthwhile in preventing deaths from fire.[8] Programs to discourage careless smoking and to develop and promote cigarettes that are less likely to ignite fires are also important.

The logistic regression findings support the hypothesis that the relation between child mortality by fire and a set of independent variables is not homogeneous across census tracts. Of the nine independent variables, only four were significant: the age of housing, income, single-parent households, and the number of children under the age of 15.

Philadelphia is one of the oldest cities in the United States and its housing stock is aging. As the original furnaces age, they can become less efficient and space heaters are used to provide heat, presenting a higher risk of fire.[30] Older buildings also have outmoded electrical systems, which can contribute to the risk of fire through overloaded outlets, the use of extension cords, and frayed wires within walls. Our findings point to the importance of inspections for violations of fire codes in older residences where possible. The importance of low income supports the finding of other researchers that a disproportionate percentage of child fire victims come from the lowest socioeconomic level,[6,7,22,34] and that poor households have greater difficulty providing safe environments for children. The finding that areas with large proportions of single mothers have a greater risk of experiencing a fatal fire points to the problems of one parent in a household, where unsupervised and unattended children may play with fire and start a fatal conflagration, supporting the findings of Fahy,[15] Greenberg,[40] and Hussey.[38] A second problem is that, in the case of a fire, there is only one parent to rescue children, as has been pointed out in other studies.[3,37]

The logistic regression technique can be useful, not only from a theoretical perspective, but in indicating to fire departments which are the areas of greatest risk and in which neighborhoods preventative measures are likely to be needed, such as distributing smoke detectors and educating families about escape measures in the event of a fire. In Philadelphia, six census tracts fall into the highest quartile for the three significant dichotomous independent variables, and therefore are at greatest risk (tracts 137, 161, 167, 169, 177 and 195). All are located in North Philadelphia. Four of these tracts had three deaths, one had four, and one had five.

It is necessary to add a number of caveats about the ability to generalize from our data. While our research shows that housing characteristics are associated with child residential fire deaths, the housing conditions in Philadelphia are distinctive to certain areas of the northeast United States and may not be representative of housing in other areas. Secondly, as in all child mortality studies, the numbers of deaths are small compared with mortality studies of the adult population. Therefore, caution must be taken, especially in the interpretation of age-specific death rates, particularly in regard to race and ethnicity, where some of the groups had very few deaths. The higher death rates from fire for black children are an issue of concern. The main purpose of this paper is to raise issues and to suggest areas of further research.

The topic of fire mortality among children is an important one because it touches on one of the central concerns of demography and sociology—the profound inequities that exist in society and how they relate to differential mortality, especially among the most vulnerable. Since residential fires are largely preventable, with smoke detectors the primary prevention strategy along with education and the development of safer lighters, matches and cigarettes, it is hoped that these findings will point to new directions for prevention and intervention locally, as well as the theoretical and practical implications for other urban areas.

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