Fire Victims: Medical Outcomes and Demographic Characteristics

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Abstract: The medical outcomes and demographic characteristics of all victims of fires identified by The Baltimore Fire Department during a 14-month period in Baltimore City were studied. Fifty-nine per cent of victims suffered minor injuries, 25 per cent required hospitalization and 16 per cent were fatalities. The majority of survivable injuries were due to burns, while the majority of deaths were due to pulmonary injury and carbon monoxide intoxication. Deaths occurring at the scene of the fire or during the first 24 hours were predominantly due to carbon monoxide. Exposure to fires was more likely to result in deaths in the very young and very old. Evidence from autopsy protocols suggests that alcohol was a contributory factor. (Am. J. Public Health 67:1077–1080, 1977)

Fires were responsible for 11,600 deaths and 123,000 injuries in the United States during 1974.[1] While serious burns occur frequently at fires, previous investigations[2–5] have indicated that the inhalation of toxic gases and particulates resulting from burning materials may be a more frequent cause of death and injury than the burns themselves. This information has usually been gathered by analysis of hospital records or autopsy data on burn victims. In order to further identify and document the extent and exact nature of the medical consequences of accidental exposure to fires, and to describe the demographic characteristics of the fire victims, we have traced the medical course of all persons initially identified by the Baltimore (Maryland) Fire Department as having been injured in fires during a 14-month period.

Methods

In the city of Baltimore, every interaction between the Fire Department and persons injured at fires is recorded on a "fire card". During the 14-month study period from January 1973 to March 1974, 414 such fire cards were completed. Twenty-five of the recorded injuries were due to causes other than fires (scalds from burning food, exploding steam boilers, etc.) leaving 389 persons identified as fire victims, of whom 14 refused medical care. Patients were treated at all 14 area hospitals. Multiple record searches failed to locate 29 hospital charts. Each of the remaining 346 medical records was carefully reviewed and pertinent information was extracted and entered on the computer. The confidentiality of these records was assured by the use of anonymous code numbers for patient identification and by compliance with the guidelines of hospital and university ethics committees. Data were collected for civilian casualties only and do not include injured fire fighters.

Post-mortem examinations were performed by the Baltimore Medical Examiner's Office on 46 of those 55 fire victims who did not survive the fire; four examinations were done by hospital pathology departments; in five cases a detailed post-mortem examination was not done. Autopsy protocols were reviewed in detail and attempts were made to describe the cause of death in the most specific manner possible. Thirty-four of these post-mortem examinations included measurement of blood alcohol, carboxyhemoglobin (COHb), and a toxicological screening for drugs. Sixteen of the autopsies were done in somewhat lesser degrees of detail depending upon the circumstances of the fire.

Results

During the 14-month period of this study 17,942 fires were attended by the Baltimore Fire Department, resulting in 389 civilian fire victims of whom 346 were traceable. Fires which resulted in casualties were most often (40 per cent) due to careless smoking as determined by the fire investiga-

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tor's office and fires due to careless smoking also accounted for the greater percentage of fatalities (65 per cent), as shown in Table 1; The improper use of flammable liquids (gasoline, heating and cooking oils, etc.) was the next most common cause of victim-related fires (22.5 per cent), while children playing with matches was third (14 per cent). The majority of victim-related fires (83 percent) occurred in residential buildings with only 3 per cent occurring in commercial buildings. Fourteen per cent were vehicle or outdoor fires.

Attempts to quantify the activities and the prevalence of prior smoking and consumption of alcohol among the victims of fires were precluded by the incomplete recording of such information on hospital charts. Over 50 per cent of the medical histories made no mention of either smoking or alcohol use. Autopsy examination, however, revealed that eleven cases (20 per cent of fatalities and 32 per cent of all deaths whose alcohol levels were tested) had elevated blood alcohol levels.*

Fifty-five of the traceable fire victims were fatalities (16 per cent) and 87 (25 per cent) required hospitalization for treatment of their injuries. The remaining 204 persons (59 per cent) were treated and released from hospital emergency rooms with minor injuries (Table 2).

The majority (62 per cent) of the 55 fatalities were either dead at the scene of the fire or pronounced dead on arrival at the hospital. Eight (14.5 per cent) of the fatalities who received treatment survived for less than one day, and 13 (23.5 per cent) received extended hospital treatment, in some cases surviving for as long as several months prior to succumbing to their injurites (Table 2).

Review of autopsy reports revealed that 19 (34.5 per cent) of all deaths and 55 per cent of deaths whose COHb levels were tested had blood COHb levels greater than 50 per cent and were therefore felt to have expired due to carbon monoxide intoxication. Burns and their complications accounted for 14 (25.5 per cent) of the fatal cases, while a combination of burns, lesser degrees of carbon monoxide exposure (COHb 20 per cent–40 per cent) and pre-existing disease accounted for eight of the deaths (14.5 per cent) (Table 3).

Forty-two of the 55 fatalities died during the first 24 hours, and all 19 deaths due to carbon monoxide intoxication were recorded as D.O.A. or died shortly after arrival at the hospital. Burns and their complications, pulmonary problems and other medical problems such as arteriosclerotic cardiovascular disease and diabetes accounted for the delayed deaths.

Eight-seven (30 per cent) of those 291 victims who survived the fire required some hospitalization for treatment of their injuries. The majortiy of the survivors (204 or 70 per cent) suffered only relatively minor injuries, but 25 (8.6 per cent) remained hospitalized for one month or more (Table 2).

Major burns (third degree or greater than 10 per cent of the body surface) and minor burns accounted for 56 per cent of hospitalizations (Table 3). Major pulmonary problems (including pneuomonitis) occurred in 19.5 per cent of hospitalized patients (Table 3). No cases of frank pulmonary edema were recorded and blood carboxyhemoglobin levels (COHb) were recorded on only two of the surviviors' hospital charts.

The diagnosis in those patients who were treated and released from the emergency rooms was minor burns in 46 per cent of the cases and pulmonary difficulties (cought or irritation due to smoke and soot inhalation) in 33 per cent of the cases (Table 3).

A slight excess of males was noted among fire victims (54 per cent as compared to 56 per cent males in the population of Baltimore City, $P = < .05$). No difference from the Baltimore population was noted in racial make-up nor in age distribution (using the Chi square goodness-of-fit for 10-year age groupings).

The percentage of those fire victims in each age group who did not survive the fire varied markedly according to

*"Elevated" levels were all over 0.15 per cent and most of them were 0.20–0.30 per cent. One level was 0.41 per cent.

TABLE 2—Outcomes and Duration of Treatment of Fire Victims

		Survivors	
	Fatalities	Hospitalized	Treated/Released
DOA at Fire Scene	5	—	—
DOA at Hospital	29	—	—
Treated and Released	—	—	204
Hospitalized			
< 1 Day	8	11	—
1 Day–1 Week	5	16	—
1 Week–1 Month	6	35	—
> 1 Month	2	25	—
TOTAL	55	87	204

TABLE 1—Cause of Fires Resulting in Casualties

			Survivors	
Cause of Fire	Total	Fatalities	Hospitalized	Treated/Released
Careless Smoking	140 (40%)	36 (65%)	30 (34%)	74 (36%)
Children Playing with Matches	48 (14%)	5 (9%)	14 (16%)	29 (14%)
Flammable Liquids	78 (23%)	2 (4%)	25 (29%)	51 (25%)
Arson	28 (8%)	3 (5%)	13 (15%)	12 (6%)
Other	28 (8%)	5 (9%)	5 (6%)	18 (9%)
Unknown	24 (7%)	4 (7%)	—	20 (10%)
TOTAL	346 (100%)	55 (100%)	87 (100%)	204 (100%)

TABLE 3—Major Diagnosis or Cause of Death of Fire Victims

Primary Diagnosis	Fatalities	Survivors	
		Hospitalized	Treated/Released
Carbon Monoxide (CO) Intoxication > 50%	19	—	—
Major Pulmonary	7	17	—
Minor Pulmonary	—	7	67
Major Burns	14	34	—
Burns and CO Intoxication (20%-40%)	8	—	—
Minor Burns	—	15	94
Fracture/Laceration	—	8	23
Shock and Anxiety	—	—	14
Other	7	6	6
TOTAL	55	87	204

age group, with the highest proportion of deaths to total fire victims occurring in the younger and older age groups. (A comparison of a sub-set of those fire victims less than two years of age who did not survive did not vary significantly from the total age group under 10 years old.) (Figure 1).

Discussion

When we include minor injuries as well as those fatalities who died after prolonged treatment, we find that fatalities occurred at the same rate in our study population (5.2/100,000) as has been reported nationally[1] However, we observed only 6.3 survivors per fatality compared with 11.2 survivors per fatality nationally. (Our data do not include deaths and injuries to fire fighters.) Variations in urban and rural mortality experience have been discussed by Beryl and Halpin.[6]

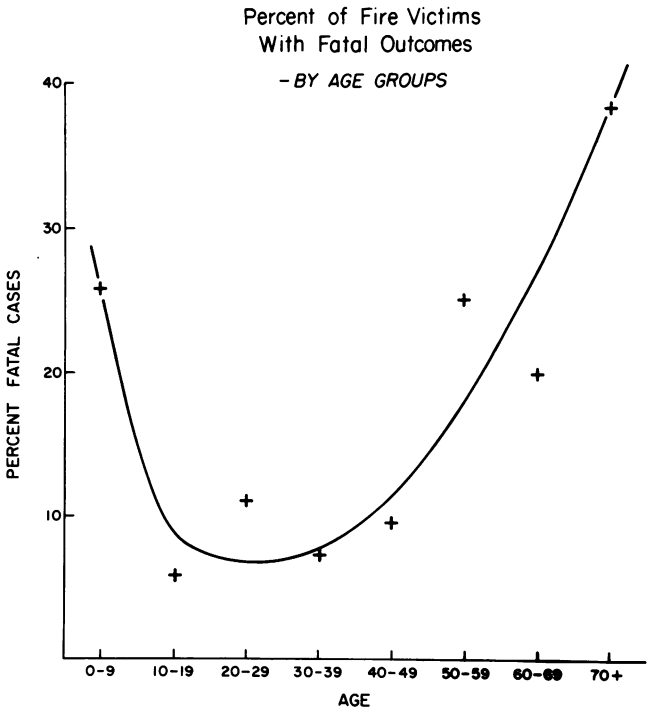

FIGURE 1—Per Cent of Fire Victims with Fatal Outcomes, by Age Groups.

Although the race, sex, and age distributions of fire victims did not indicate serious discrepancies from that of the reference population, survivability was age-dependent, with a greater percentage of deaths to injuries occurring in the very young and very old.

The vast majority of victim-related fires occurred in residential buildings and 54 per cent of these fires were caused by careless smoking or children playing with matches. Thus the major contribution of cigarette smoking to the toll of fires is emphasized.

Thirty-two per cent of those autopsy examinations, which included blood alcohol testing, revealed elevated blood alcohol levels. However, the contribution of personal habits such as drinking and of pre-existing diseases to the cause, or the survivability of fires could not be determined from the survivors' medical records.

Survivable injuries were due to burns in approximately one-half of the cases, while pulmonary problems accounted for less than one-third. Fatalities, however, were due to pulmonary injury, to the inhalation of toxic gases (CO), and to burns in combination with CO in 62 per cent of our cases. Thus burns were more frequently reponsible for injuries while inhalation of toxic gases (CO) and pulmonary problems were more frequently responsible for deaths.

A very striking difference is apparent in the cause of death for fatalities who survived for different periods of time. Seventy-six per cent of the fatalities survived for less than one day, and all 19 deaths due to carbon monoxide intoxication occurred during this early period. Those 24 per cent fatalities who survived and received treatment for prolonged periods eventually succumbed to major burns or to other medical problems. This agrees with autopsy studies of New York City fire victims in which 60 per cent of the fatalities survived for less than six hours and all deaths due to CO intoxication occurred during this early period.[2] In our experience, fatalities due to carbon monoxide comprised 34.5 per cent of all fatalities as compared to 17.5 per cent in the New York study.

The frequency of carbon monoxide intoxication as a cause of death in fire victims, and the evidence of a synergistic contribution of minimally elevated COHb levels in those fatalities which are due to compromised coronary artery circulation[5] and in the precipitation of angina[7] emphasizes the importance of the early treatment of this common complication.

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Second National Home Sewage Treatment Symposium Set

The Second National Home Sewage Treatment Symposium, co-sponsored by the American Society of Agricultural Engineers, the American Public Health Association, and a number of related organizations, will be held December 12–13, 1977 at the Palmer House in Chicago, preceding ASAE's winter meeting.

This symposium is centered around 11 invited papers, all written with multiple authorships, in the following subject areas:

- Site evaluations
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- Effluent quality
- Septic tanks
- Sewage treatment by septic tank
- Effluent distribution
- Standard drainfield trenches and beds
- Sewage treatment mounds
- Reduced area systems
- Aerobic tanks
- Septage disposal systems.

These papers are designed to help develop new domestic waste disposal standards, which will replace the confusing design criteria now used in various areas of the country. Additionally, 14 other papers covering present research associated with the subject matter of the above invited papers will be presented.

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