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## Pediatric Homicides Related to Burn Injury: A Retrospective Review at the Medical University of South Carolina

**ABSTRACT:** Many burn injuries are mistakenly referred to as “accidents” because they occur suddenly and seem unpredictable and uncontrollable; however, injuries often occur in predictable patterns. We reviewed all pediatric forensic cases referred to the Medical University of South Carolina Forensic Pathology Section over a 28-year period from January 1975 to December 2002. There were 124 cases with 121 fire-related fatalities and three scald fatalities. Ninety of the burn victims were in the 0–5-year age group. The manner of deaths showed 108 accidents and 12 homicides (four undetermined). Eleven of 12 burn-related homicides occurred at the home with all of the victims in the 1–8-year age group. The perpetrator of the home fire homicides was the mother in five cases and the sister in one case (two undetermined). Homicide involved a vehicle fire in one case in which the father caused an explosion with an accelerant. The three scald death perpetrators were the father, mother’s boyfriend, and an aunt. This retrospective study and review of the literature may reveal patterns useful for evaluation of manner of death. By recognizing scene characteristics, potential perpetrators, and children at risk, we can better classify pediatric burn-related fatalities.

**KEYWORDS:** forensic science, pediatric, burns, fatal, homicide

Many injuries are mistakenly referred to as “accidents” because they occur suddenly and seem unpredictable and uncontrollable; however, injuries often occur in predictable patterns. During the last century, in the United States, injury surpassed disease as the leading cause of childhood morbidity and mortality. The top five causes of accidental-injury death and the top five since 1970 are motor-vehicle fatalities, falls, poisonings, drowning, and burns (1).

Whether accidental or inflicted, pediatric burns can be devastating with extensive morbidity or death. A recent study from 1986 to 1995 at the Medical University of South Carolina showed 10% of pediatric homicides were due to burns and/or carbon monoxide poisoning (2). Pediatric burn-related fatalities must be properly analyzed so that the suspected mode of injury can be compared with the given history, and the manner of death can be accurately assigned. This retrospective study and review of the literature may reveal patterns useful for evaluation of manner of death.

### Materials and Methods

We reviewed all forensic cases referred to the Medical University of South Carolina Forensic Pathology Section over a 28-year period from January 1975 to December 2002. All cases with victims 17 years of age and younger were analyzed and included in the study. We examined the age, sex, and race of the

victims; type of burn injury; reported location; time of year; cause and manner of death; scene history; perpetrator; injury–death time interval; and autopsy and toxicology findings.

### Results

Over 28 years, there were 124 cases of pediatric burn-related fatalities with 107 complete autopsies and 17 external examinations. The victims’ ages ranged from 6 months to 17 years. The majority of victims (90 cases) were in the 0–5-year age group, with a peak (29 cases) in the 2-year age group (see Fig. 1). The victims were 54 black males, 32 black females, 25 white males, and 13 white females.

Placing the burn deaths into categories, 121 were fire-related fatalities (one caused by high voltage electrocution) and three were scalds. No burn-related fatalities were from contact with hot objects, chemicals, or ultraviolet radiation.

With regards to incident location, the burn-related fatalities occurred at the home in 111 cases (108 home fires and three scalds), in vehicles in eight cases (five motor vehicle crashes), and outdoors in five cases. Whether homicidal or accidental, home fire-related fatalities occurred from October to March in 76% of total home fires, and from 21:00 hours to 10:00 hours in 68% of total home fires.

The cause of death was classified as thermal injury (20 cases, including three scalds), carbon monoxide (CO) toxicity with thermal injury (103 cases), or CO toxicity (one case house fire). When the percentage of carboxyhemoglobin (COHgb) saturation was analyzed, the following was noted: The range for COHgb saturation was 0–95%. The range for saturation for cases of death because of thermal injury was 0–14.3% with an average of 2%. For cases classified as CO toxicity with or without thermal injury, the range was 10.3–95% with an average of 66%. Of note, soot was present in the airway in 88.5% of CO toxicity deaths with or without thermal injury, and 30% of thermal injury deaths with no CO contribution.

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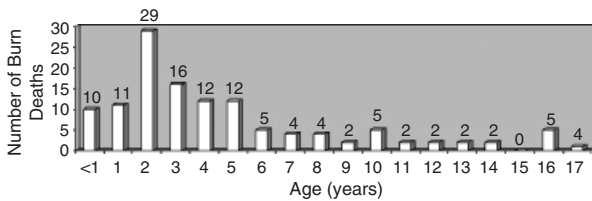


FIG. 1—Burn victims by age.

The burn-related fatality injury–death time interval was classified as follows: seconds–minutes (rapid) in 79 cases including seven of nine fire-related homicides (40% of thermal injury cases, and 68% of CO toxicity cases with or without thermal injury); and hours–months (postponed) in 15 cases (10 thermal injury cases including three scalds, and five CO toxicity with or without thermal-injury cases). The remaining cases were unclassified. Sixty percent of the cases with a postponed death had  $\leq 50\%$  TBSA burns.

The cases were also analyzed with regards to manner of death. Of the 124 cases, 108 were classified as accidents, 12 as homicides, and four as undetermined. No cases were classified as suicides. The four undetermined cases were fire-related fatalities by home fires. The accidental deaths were further examined: 75 of 108 accidents were in the 0–5-year age group, 96 of 108 were home fires. Accidental home fire deaths steadily declined from a 2-year-old peak, becoming one to two cases for each age from 11 to 17 years. Seven of the eight vehicle fires were accidental: five motor vehicle crashes (one driver, four passengers); one fire involved no adult supervision and a child playing with a lighter; and one fire involved an electrical malfunction.

The 12 homicides consisted of nine fire-related fatalities and three scald deaths. All homicides were in the 1–8-year age group with a peak of five cases at 2 years of age. The incident location of homicidal burns showed 11 occurring at home (eight fires, three scalds) and one vehicle fire. The victims were five black males, four black females, and three white females. Other than thermal injuries, no other evidence of abuse or neglect was noted.

When examining the nine homicidal fire deaths, the following scenarios were noted. The one vehicle fire homicide victim was a 2-year-old white female whose father caused an explosion using an accelerant resulting in charring of the entire body; soot was in the airway with a COHgb of 29.6%.

The perpetrator of the eight home fire homicides was the mother in five cases, the sister in one case, and undetermined in two cases. The sister confessed she was upset with the grandparents and started the fire at their home where the victims were staying. Two incidents involved multiple simultaneous victims. All home fire homicides were classified as CO toxicity with or without thermal injury: six had  $\geq 50\%$  TBSA burns,  $\geq 63\%$  COHgb, and a rapid death noted, five with soot in the airway; two cases had a postponed death with 12–30% TBSA burns, 27–30% COHgb with and without soot noted in the airway. The homicidal home fires occurred from October to March and from 23:00 to 6:30 hours with one case at 17:00 hours.

The three homicidal scalds occurred in the 1–2-year age group. Scald victims were a 2-year-old black male, a 2-year-old black female, and a 1-year-old white female. Perpetrators were the father, mother's boyfriend, and aunt. The scald histories were as follows: the father reports he immersed the child in scalding water; the mother's boyfriend reported the victim had burned himself in the bathtub, but the child reported being put into the bathtub (temperature of the faucet water was recorded at 140°F);

and an aunt who reported the child stepped into a tub of soap and hot water prepared for washing clothes. Two scald deaths occurred at the victim's home, and one at the aunt's home. All scald deaths occurred by immersion of the lower body into hot water with 30–45% TBSA burns and a classic pattern characteristic of lower body immersion: burns spared areas of flexion and the upper torso with approximate bilateral burn symmetry, stocking and glove distribution of burns on the distal extremities, and an immersion burn line at the level of the hot liquid. Second- and third-degree burns or scars were noted over the hands and distal forearms, lower abdomen, lower extremities, back, buttocks, and genital areas. No other evidence of trauma was found. All scald victims had postponed deaths (1–6 months) secondary to sepsis (two victims) and tracheostomy complication (one victim).

## Discussion

The literature reports the most common types of pediatric burns overall are scalds 48%, flame burns 28%, and contact burns 11% (3); however, the majority of fatal pediatric burn injuries are fire-related. Males have a slightly higher death rate than females, and black children are at greater risk than white (4). Statistics show for South Carolina in 1996, 37% of the population under 18 years of age was black (5) with roughly males and females of equal numbers in the general population. Recent pediatric burn injury data shows children age 1–5 years of age comprise the peak category of burn victims. In one study of 1461 fire/burn deaths for ages 0–19 years in the United States, 84% were due to home fires, and 56% were in the 0–4-year age group, with the primary cause of death as smoke inhalation rather than tissue damage from burns (4). We found 90 of 124 total burn-related deaths in the 0–5-year age group. The majority of all of our cases of fire-related death involved black children, and males were overly represented in burn related fatalities. The majority of our fire-related deaths were due to CO toxicity, with airway soot in the airway prevalent whether accident or homicide.

A 1998 study indicated that a child 3 years of age or less from a single-parent impoverished home with a scald or thermal-contact burn were at the highest risk of abuse (6). Several studies report a child burn abuse rate of approximately 4–10% of hospital burn admissions, with the majority of victims scalded, male, less than 4 years old, and with no black or white race predominance (3,7,8). Although males and females are about equal in number in the general population, males are generally reported to comprise a slightly higher percentage of children killed because of abuse or neglect (5). In contrast, another burn abuse study of children age 0–18 years did not support the assertion that males outnumbered females (9). Our study of homicidal burns showed young black children, especially males, are at a higher risk but females predominated overall (1–8 years of age, peak at 2 years of age, five black males, four black females, and three white females). Burn abuse is noted to be a highly lethal injury with many of the victims dying of their injury (7). Reported mortalities for burn-abused children are up to 40%, most due to immersion scalds and generally in the very young. In contrast, death occurs in only about 2% of accidentally burned children (10). Our study indicated the primary method of homicidal burns (75%) was fire related.

As for location, 70–90% of burn-related injuries occur in the home (11). The 1994 statistics show accidental deaths because of fire were 87% conflagrations (large disastrous fires) (1). Conflagrations can injure people of any age, but the circumstances causing burns differ as a child develops. Scalds predominate in

hospitalized preschoolers, and fire-related burns predominate for older children (4). House fires are responsible for the great majority of fire and burn deaths across all ages, with children under five at the highest risk (12). The majority of house fire deaths are noted to occur during December–March (13). Indeed the vast majority of burn-related deaths in our study occurred in the home (108 home fires), during the colder months, and during normal sleeping hours, whether accidental or homicidal.

Classifying the manner of death in burn fatalities can be extremely challenging. Accidental burn injuries and death are more common than homicidal in the general and pediatric populations. In one fire/burn study of victims 0–19 years of age, the manner of death was considered 92.3% accident and 5.2% intentional (homicide or suicide) (4). Our review showed 87% cases were accidents and 10% were homicides. Most accidental burn deaths were home fires but most homicidal deaths are also home fires, as shown in our study. Although burns are often reported to be a component of physical abuse and even a cause of pediatric death, we found no other evidence of prior abuse.

Inflicted burns usually have a characteristic pattern, which must be correlated with the given history. The inflicted lower body immersion scald type of burn has a distribution usually simultaneously of the buttocks and distal limbs, perineum and both feet with some sparing of the areas of flexion. Accidental immersion scald injuries are more common and do not have this pattern (14). Abusive burns tend to be more severe, deeper and larger than accidental burns (10). Our review showed the classic pattern of immersion burn of the lower body in all three scald deaths. Frequent clues indicative of abuse were a discrepancy between the history offered by the child's caretaker and the burn pattern, type, or symmetry (10). Two of our homicidal scald cases noted characteristic inflicted lower body burn pattern with an initial discrepant history of the victims producing the burn themselves. A scalded 2½-year-old black male was reported to have "burned himself in the bathtub" by the mother's boyfriend, who was home with the child. Third-degree immersion burns involved 30% of his body: the lower back, buttocks, thighs, and lower extremities. The child told the mother that he was put in the water. A social worker noted the bathroom faucet water to reach 140° within seconds and the hot water heater thermostat at the maximum setting. A second homicidal scald case described a 2½-year-old black female who was reported to have "stepped into a tub of soap and hot water that had been prepared for washing clothes" by the child's aunt at the aunt's home where the child resided. Second- and third-degree burns were of the feet, legs, hands, perineum, and lower trunk involving 45% of the body. A detective's interview of the aunt after the autopsy reported the decedent and her 2-year-old son played in shoe polish. The aunt sat the children in the bathroom and filled the bathtub with water, but did not realize only hot water ran. After the aunt left the bathroom and returned, the child was in the bathtub. Our last homicidal scald case of a 21-month-old white female was only reported to have been immersed in scalding water by her father. She was admitted to the hospital with second- and third-degree burns of 35–40% of her body and at autopsy had extensive scarring of the lower abdomen, genitalia, buttocks, lower extremities, distal right forearm, and hand. The victim died after 6 months from tracheostomy complications and had classic bilateral popliteal sparing outlined by the surrounding dense scar tissue of the lower extremities.

The remaining nine homicidal burn deaths involved vehicle fire and home fires. No discrepant histories emerged concerning how the victims were burned. The vehicle fire homicide of a 2-year-old

white female occurred in a van occupied by her and her father. The father set himself and the van on fire, which subsequently exploded and was consumed by flames. The events may have stemmed from domestic difficulties of the divorced parents. The remaining eight cases were homicidal home fires: A decedent's sister was angry with her grandparents and started a home fire allegedly unaware the 3½-year-old black male decedent was at the grandparent's home; arson of an adjoining apartment resulted in the death of a 1-year-old black male; an assailant at home started a home fire after a 20-month-old white female's parents were stabbed to death, with the child dying of CO toxicity and thermal burns; a grandmother burned her 3-year-old black male grandson and her 8-year-old black daughter after locking them in a room with a fire started elsewhere in the home; and the mother of a 5-year-old black female, 4-year-old black male, and a 2-year-old black female confessed to starting a home fire that killed the three children.

Although mothers have been reported to be the most frequent perpetrators of abuse, men constitute more than one half of the abusers, and men are more likely to injure children fatally (15). A disproportionate number (70%) of burn perpetrators are female, which is a factor seldom found in other types of physical abuse (9). In a 1999 study, 85.5% of perpetrators of abuse were parents, other caregiver relatives, or other household members (5). Another study further categorized the perpetrators as the mother 25.8%, father 24.6%, mother's boyfriend 8.6%, female babysitter 6.3%, and stepfathers 4.1% (15). We found the mother as the perpetrator in five of eight fire-related homicides, but in none of the three homicidal scalds. The current study also showed known perpetrators of all burn-related homicides were 58% females. Furthermore, 58% of the known perpetrators were the parents (the mother in five deaths, mother's boyfriend in one death, father in two deaths, sister in one death, an aunt in one death, and undetermined in two deaths).

Accidental and homicidal cases identify specific groups of children who are at greatest risk of dying from burn injury, and the types of injuries these children are most likely to sustain, making it possible to better classify cases. With homicides, the typical scenario, victim, method, and perpetrator are important to understand. The following conclusions were drawn from this review and study:

- Young children (1–8-year-age group, peak at 2 years of age) are at greatest risk of burn-related homicides, with scald victims at the youngest ages (1–2 years of age).
- The majority of homicidal burns were fire related and resulted in rapid death.
- Scald deaths were homicides and involved the lower half of the body with a classic immersion burn pattern, a postponed death, and an initial history discrepancy.
- All fatal scalds were homicides.
- Although burns are often reported to be a component of child abuse and neglect, no other evidence of prior abuse or neglect was found in our cases.
- The majority of the perpetrators were female.
- The majority of the perpetrators were family members.
- Black homicide burn victims predominate.
- Female homicide burn victims predominate.
- The vast majority of homicidal burn related deaths occur in the home.
- Whether homicidal or accidental, the majority of home fire related fatalities occurred from October to March and from 21:00 to 10:00 hours.

- The majority of burn-related homicides have a rapid injury-to-death interval.

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