

# Paediatric burn injuries in New England, USA

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*The authors analysed a subset of data from the New England Regional Burn Program (NERBP) to describe the epidemiology of burn injuries for children aged from birth to 19 years in the six-state New England area of the USA. The subset of the NERBP data analysed pertained to residents of the six New England states who were admitted to hospital for the treatment of a burn injury sustained between 1 July 1978 and 30 June 1979. Analysis of the data revealed that 1128 (41 per cent) of the 2742 hospitalized burns identified occurred to persons between the ages of birth and 19 years, yielding an overall burn incidence rate of 30.7 burns per 100 000 person-years. Children aged from birth to 2 years sustained a higher burn rate, 96.7 burns per 100 000 child-years, than did children in any other age category. The burn rate for males was higher than the rate for females in each age category, as were the rates for black children compared to white children. Children in Massachusetts experienced the highest overall burn rate among the six New England states; the lowest rate occurred in New Hampshire. Overall, 63 per cent of the burns occurred in a residential setting. The most common activities related to burn injury were food preparation and food consumption, which accounted for 471 (42 per cent) of the burn injuries.*

## Introduction

Burns are the fourth leading cause of injury death in the USA, accounting for approximately 6000 deaths each year. Of these victims, approximately 25 per cent, or 1500, are children under the age of 20 years. An additional 100 000 persons are hospitalized annually for the treatment of burns, of which approximately 40–45 per cent are children. An estimated 50 per cent of these persons sustain substantial temporary or permanent disabilities resulting from burn injury (Committee on Trauma Research, 1985).

The published literature on paediatric burn injury indicates that children between the ages of birth and 2 years are at increased risk of burn injury, particularly from scalds. Older children suffer from flame burns as well as from scalds. Overall, boys have higher burn rates than do girls (Iskrant, 1967; Smith, 1969; Barancik and Shapiro, 1975; Feck et al., 1977; Clark and Lerner, 1978; Feck and Baptiste, 1979; MacKay et al., 1979; Chatterjee et al., 1986; Rossignol et al., 1986). Although the general epidemiological patterns of burn injuries among children are known, few large-scale studies of burns in well-defined regional populations have been conducted.

The objective of this study was to extend the findings of previous analyses of data from the New England Regional

Burn Program (NERBP) to describe the epidemiology of burn injuries for children and young adults aged from birth to 19 years in the six-state New England area (Rossignol et al., 1986). The particular variables studied were age, sex, race, burn type, location where the burn occurred, geographical variation and aetiological factors. While the data collected by the NERBP (described in 'Materials and Methods') pertain to burn injuries which occurred in 1978 and 1979, these data still represent one of the largest available information files on hospitalized burn injuries occurring to residents of a defined geographical area. In addition, while mortality from burns has been decreasing over time, there is little indication that the aetiological epidemiology of burns has changed substantially (Committee on Trauma Research, 1985).

## Materials and methods

### New England Regional Burn Program

The New England Regional Burn Program (NERBP) was one of six projects within the National Burn Demonstration Project established under contractual agreements with the Division of Emergency Medical Services of the US Department of Health and Human Services (then the US Department of Health, Education and Welfare) to collect data on burn injuries occurring over a 26-month interval – May 1978 to June 1980 (Burke and Locke, 1980). The primary objective of the project was to collect data pertaining to the delivery of medical treatment to burned patients nationwide. It was hoped that these data would: (i) permit evaluation of the adequacy of existing treatment facilities, (ii) provide estimates of the relative effectiveness of different modes of burn care, and (iii) identify the cost of acute care and rehabilitation of burned patients.

Among the NERBP's data collection efforts was the identification of persons admitted to any of 240 of New England's 256 acute-care hospitals for treatment of a new burn injury. Patients were identified primarily by review of hospital inpatient records and emergency room logbooks. A secondary method of identifying burn victims was by review of newspapers and other news reports for mention of burn injuries. Types of injuries included in the review were scald, flame, flash, contact, electrical, chemical (ICD-8 codes 983.0, 983.1, 983.2 and phosphorus in code 983.9), and ultraviolet radiation burns. The present study is based on a subset of the NERBP's data. To assess the completeness of

the NERBP's case finding, two case-finding quality control procedures were implemented in a representative sample of participating hospitals. These intensive reviews indicated that the overall completeness of case finding was at least 90 per cent.

Demographic data and information regarding the type and causes of the burn injury were obtained by review of the medical record for each case. A burn injury was considered to be caused by child neglect or abuse if a specific mention of neglect or abuse was present in the medical record.

### Analysis of data

The study is based on data for New England (USA) residents who were burned between 1 July 1978 and 30 June 1979, who were between the ages of birth and 19 years, and who were treated as hospital inpatients in any of the 240 hospitals participating in the NERBP. Residents of 12 Massachusetts cities and towns were not included in the analysis because three hospitals primarily serving these communities did not participate in the NERBP.

Crude and age- and sex-specific incidence rates of burns were estimated by relating the number of inpatients burns in each category of age or sex to the number of child-years during which the burns were observed to occur. The numbers of child-years used to calculate these rates were based on data reported in the 1980 US census for each of the six New England states, minus the data for Massachusetts communities not included in the study (Bureau of the Census, 1982, 1983). (The number of burn injuries treated at acute-care hospitals not participating in the NERBP was estimated to be small, and no adjustments for this under-reporting of burn cases were made.) The population of New England aged from birth to 19 years, adjusted for data from the 12 non-participating communities in Massachusetts, was approximately 3.5 million.

### Results

A total of 2742 New England (USA) residents were identified as being hospitalized for burn injuries occurring between 1 July 1978 and 30 June 1979. Of these persons, 1128 were children and young adults between the ages of birth and 19 years, yielding a burn incidence rate of 30.7 burns per 100 000 child-years for this age group. The overall burn rate for males aged 0–19 years was 2.2 times the overall burn rate for females (42.0 vs. 19.0 burns per 100 000 child-years).

Burn rates varied considerably by age and by state (*Table I*). Children between the ages of birth and 2 years experienced the highest burns rates for both males and females. Among males, the lowest burn rates occurred among children between the ages of 3 and 14 years; among females, the lowest rates occurred among children between the ages of 10 and 14 years. Burn rates were higher for males compared to females for each age category, ranging from a 1.6-fold increase for children between the ages of birth and 2 years to a 4.3-fold increase for children aged 10–14 years.

Children in Massachusetts experienced the highest overall burn rate among the six New England States. The lowest rate occurred in New Hampshire. Burn rates by age and sex varied considerably by state, although, in each state, the rate for children between the ages of birth and 2 years was higher than the rate for any other age group. In addition, with the exception of 10–14-year-old children in Vermont, the age-specific rates for males were higher than the corresponding rates for females within each state.

*Table II* shows burn rates by age and sex for white children and for black children. Black children had an overall burn rate 2.8 times the overall rate for white children. The difference in burn rates was apparent in each age category except ages 15–19 years, in which the rate for black children was only 1.1 times the burn rate for white children. The difference in burn rates for black children compared to white children was larger for females than for males in each age category.

*Table III* shows burn rates by age, sex, and location where burned. Sixty-three per cent of the burns for which location where the injury happened was known, occurred in a residential setting. Among children aged from birth to 2 years, 85 per cent of the burns occurred in a residential area. Overall, 8 per cent of the burns occurred in or around a motor vehicle, although 24 per cent of the burns to children and young adults between the ages of 15 and 19 years occurred near motor vehicles. Fifty-one (22 per cent) of the 231 burns to males aged 15–19 years were known to have occurred during paid employment.

*Table IV* shows the major aetiological types of burns for each age and sex group. The most common types of burns overall were scalds, flame burns and contact burns, accounting for 48, 28 and 11 per cent of all burns, respectively. These proportions varied considerably by age and sex. For example, 69 per cent of the burns to children between the ages of birth and 2 years were scalds, compared to only 26 and 30 per cent of the burns to 10–14 and 15–19 year olds, respectively. Flame burns, unusual among young children, accounted for 66 per cent of the burns to 10–14-year-old males, and 48 per cent of the burns to 15–19-year-old males. The majority of these flame burns involved ignition of a flammable liquid such as gasoline. Overall, 56 per cent of the burns to females were scalds, and 15 per cent were flame burns. The corresponding percentages for males were 45 per cent for scalds, and 33 per cent for flame burns.

Fifty-eight per cent of the flame burns involved clothing ignition. This proportion was 15 per cent for children less than 3 years old and 61 per cent for children aged 3 years or older.

The most common activity related to burn injury was food preparation and food consumption, which accounted for 471 (42 per cent) of the burn injuries (*Table V*). Seventy-nine per cent of the food-related burns were scalds. Among children aged from birth to 2 years, 63 per cent of the burns were food related. This proportion decreased to 44 per cent for 3–9 year olds, 20 per cent for 10–14 year olds and 21 per cent for 15–19 year olds. One hundred and forty-seven (47 per cent) of the food-related scald burns to children between the ages of birth and 9 years were caused by hot liquids spilled from coffee pots or tea kettles. Over 90 per cent of the food-related flame and contact burns to all children were caused by contact with stoves, ovens and grills. A larger proportion of the burns to females than to males were food related in each age category, although the difference was small for children less than 3 years of age. While this is true overall, males experienced a larger number of food-related burns than did females (297 food-related burns to males versus 174 such burns to females).

Forty of the scald burns occurred in bathroom showers and tubs. Of these burns, 23 occurred to children less than 3 years of age (13 to males and 10 to females), and nine occurred to children between the ages of 3 and 9 years (seven to males and two to females).

Child neglect or abuse was stated in the medical record as a contributing cause in 57 (5 per cent) of all burns. Forty-one

**Table 1.** Burn injuries among persons aged 19 years or younger by age category, sex and state: inpatients – New England Residents, 1 July 1978 to 30 June 1979

| Age category (yr) | Connecticut          |             | Maine                |             | Massachusetts        |             | New Hampshire        |             | Rhode Island         |             | Vermont              |             | Total                |             |
|-------------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|
|                   | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) |
| 0-2               |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |
| M                 | 116.6                | (67)        | 105.7                | (26)        | 125.5                | (123)       | 76.9                 | (15)        | 135.3                | (24)        | 124.2                | (14)        | 117.7                | (269)       |
| F                 | 85.4                 | (47)        | 51.4                 | (12)        | 89.4                 | (85)        | 37.2                 | (7)         | 58.4                 | (10)        | 37.4                 | (4)         | 75.0                 | (165)       |
| Both sexes        | 101.3                | (114)       | 79.2                 | (38)        | 107.7                | (208)       | 57.4                 | (22)        | 97.5                 | (34)        | 81.9                 | (18)        | 96.7                 | (434)       |
| 3-9               |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |
| M                 | 26.7                 | (38)        | 20.4                 | (12)        | 44.6                 | (73)        | 17.2                 | (8)         | 32.9                 | (14)        | 15.0                 | (4)         | 26.4                 | (149)       |
| F                 | 14.0                 | (19)        | 19.7                 | (11)        | 23.8                 | (37)        | 4.4                  | (2)         | 19.7                 | (8)         | 11.9                 | (3)         | 14.9                 | (80)        |
| Both sexes        | 20.5                 | (57)        | 20.0                 | (23)        | 34.5                 | (110)       | 10.8                 | (10)        | 26.4                 | (22)        | 13.5                 | (7)         | 20.8                 | (229)       |
| 10-14             |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |
| M                 | 22.2                 | (29)        | 20.7                 | (10)        | 31.0                 | (70)        | 42.8                 | (17)        | 18.4                 | (7)         | 18.2                 | (4)         | 27.4                 | (137)       |
| F                 | 5.6                  | (7)         | 2.2                  | (1)         | 4.7                  | (10)        | 8.1                  | (3)         | 11.0                 | (4)         | 24.1                 | (5)         | 6.3                  | (30)        |
| Both sexes        | 14.0                 | (36)        | 11.7                 | (11)        | 18.4                 | (80)        | 26.1                 | (20)        | 14.8                 | (11)        | 21.1                 | (9)         | 17.0                 | (167)       |
| 15-19             |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |
| M                 | 36.9                 | (54)        | 47.5                 | (26)        | 42.9                 | (112)       | 38.4                 | (17)        | 22.3                 | (10)        | 47.0                 | (12)        | 39.5                 | (231)       |
| F                 | 12.0                 | (17)        | 17.1                 | (9)         | 10.4                 | (27)        | 23.0                 | (10)        | 2.2                  | (1)         | 11.7                 | (3)         | 11.7                 | (67)        |
| Both sexes        | 24.6                 | (71)        | 32.6                 | (35)        | 26.7                 | (139)       | 30.8                 | (27)        | 12.3                 | (11)        | 29.2                 | (15)        | 25.7                 | (298)       |
| Total (0-19)      |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |
| M                 | 39.4                 | (188)       | 39.7                 | (74)        | 46.6                 | (378)       | 37.9                 | (57)        | 38.4                 | (55)        | 39.8                 | (34)        | 42.0                 | (786)       |
| F                 | 19.6                 | (90)        | 18.5                 | (33)        | 19.8                 | (159)       | 15.2                 | (22)        | 16.5                 | (23)        | 18.2                 | (15)        | 19.0                 | (342)       |
| Both sexes        | 29.7                 | (278)       | 29.4                 | (107)       | 33.3                 | (537)       | 26.8                 | (79)        | 27.6                 | (78)        | 29.2                 | (49)        | 30.7                 | (1128)      |

\*Number of burns per 100 000 person-years.

**Table II.** Burn injuries among persons aged 19 years or younger by age and sex for the white and black populations; New England residents 1 July 1978 to 30 June 1979

| Age category (yr) | White                |             |                      |             |                      |             | Black                |             |                      |             |                      |             |
|-------------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|----------------------|-------------|
|                   | Male                 |             | Female               |             | Both sexes           |             | Male                 |             | Female               |             | Both sexes           |             |
|                   | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) | Burn incidence rate* | Burns (no.) |
| 0-2               | 98.8                 | (205)       | 57.5                 | (114)       | 78.6                 | (319)       | 275.9                | (35)        | 253.7                | (31)        | 265.0                | (66)        |
| 3-9               | 30.1                 | (106)       | 15.0                 | (50)        | 22.8                 | (156)       | 90.1                 | (18)        | 67.2                 | (13)        | 78.8                 | (31)        |
| 10-14             | 23.4                 | (108)       | 5.0                  | (22)        | 14.4                 | (130)       | 54.8                 | (14)        | 23.6                 | (6)         | 39.2                 | (20)        |
| 15-19             | 33.8                 | (181)       | 10.7                 | (57)        | 22.3                 | (238)       | 37.1                 | (10)        | 14.3                 | (4)         | 25.5                 | (14)        |
| Total             |                      |             |                      |             |                      |             |                      |             |                      |             |                      |             |
| 0-19              | 38.5                 | (600)       | 16.2                 | (243)       | 27.5                 | (843)       | 90.4                 | (77)        | 63.6                 | (54)        | 77.0                 | (131)       |

\*Number of burns per 100 000 person-years.

**Table III.** Burn injuries among persons aged 19 years or younger by age, sex and location where injured: inpatients, New England residents, 1 July 1978 to 30 June 1979

| Age category (yr) | Residential |    | Motor vehicle |    | Other |    | Unknown |      | Total |     |
|-------------------|-------------|----|---------------|----|-------|----|---------|------|-------|-----|
|                   | No.         | %  | No.           | %  | No.   | %  | No.     | %    | No.   | %   |
| 0-2               |             |    |               |    |       |    |         |      |       |     |
| M                 | 224         | 87 | 0             | 0  | 32    | 13 | 13      | n.a. | 269   | 100 |
| F                 | 127         | 82 | 0             | 0  | 28    | 18 | 10      | n.a. | 165   | 100 |
| M & F             | 351         | 85 | 0             | 0  | 60    | 15 | 23      | n.a. | 434   | 100 |
| 3-9               |             |    |               |    |       |    |         |      |       |     |
| M                 | 105         | 74 | 0             | 0  | 37    | 26 | 7       | n.a. | 149   | 100 |
| F                 | 58          | 79 | 3             | 4  | 12    | 16 | 7       | n.a. | 80    | 100 |
| M & F             | 163         | 76 | 3             | 1  | 49    | 23 | 14      | n.a. | 229   | 100 |
| 10-14             |             |    |               |    |       |    |         |      |       |     |
| M                 | 60          | 53 | 14            | 12 | 39    | 35 | 24      | n.a. | 137   | 100 |
| F                 | 16          | 62 | 2             | 8  | 8     | 31 | 4       | n.a. | 30    | 100 |
| M & F             | 76          | 55 | 16            | 12 | 47    | 34 | 28      | n.a. | 167   | 100 |
| 15-19             |             |    |               |    |       |    |         |      |       |     |
| M                 | 48          | 21 | 55            | 24 | 124*  | 55 | 4       | n.a. | 231   | 100 |
| F                 | 22          | 35 | 15            | 24 | 26    | 41 | 4       | n.a. | 67    | 100 |
| M & F             | 70          | 24 | 70            | 24 | 150   | 52 | 8       | n.a. | 298   | 100 |
| Total             |             |    |               |    |       |    |         |      |       |     |
| 0-19              |             |    |               |    |       |    |         |      |       |     |
| M                 | 437         | 56 | 69            | 9  | 232   | 31 | 48      | n.a. | 786   | 100 |
| F                 | 223         | 65 | 20            | 6  | 74    | 23 | 25      | n.a. | 342   | 100 |
| M & F             | 660         | 59 | 89            | 8  | 306   | 29 | 73      | n.a. | 1128  | 100 |

Percentage results based on persons for whom location where burned is known (= 94 per cent of patients).

n.a., Not applicable.

\*Includes 51 males who were burned at work.

of these burns occurred to children less than 3 years old (24 males and 17 females), accounting for 9 per cent of the burns to these children. An additional 13 such burns occurred to children between 3 and 9 years old (seven males and six females). Fifty-six per cent of the burns involving child neglect or abuse were scalds, and 32 per cent were contact burns. Burn rates associated with child neglect or abuse were 10 times higher among black children aged from birth to 14 years than among their white counterparts (15.6 vs. 1.5 burns per 100 000 child-years).

The presence of a physical or mental handicap was a contributing factor in causing the burn injury in only 13 (1 per cent) of the burns.

## Discussion

The results of this study are consistent with the findings of other studies with respect to the high burn rates for children under 3 years old, for males, and for black children compared

to their older, female, and white counterparts, respectively. Also consistent with other studies is the high proportion of scalds among the burns to young children, and the increasing proportion of flame burns among older children, particularly among males. The factors which cause the high burn rates among black children are not clear, but do not appear to involve differences in age-associated developmental behaviour or sex-associated behaviour.

Notable among the study results is the fact that burn rates varied considerably from state to state, with some rates differing by as much as two- to three-fold within age categories. For example, among children less than 3 years of age, the burn rates varied from 107.7 burns per 100 000 child-years in Massachusetts to 57.4 burns per 100 000 child-years in New Hampshire. The corresponding rates for children aged 3-9 years in these states were 34.5 and 10.8 burns per 100 000 child-years. The reasons for these large differences in rates are not clear. Part of the difference may be attributable to random variation in burn

Table IV. Burn injuries among persons aged 19 years or younger by age, sex and burn type: inpatients, New England residents, 1 July 1978 to 30 June 1979

| Age category | Flame                     |      |     |      |            |      |             |      |             |      |         |      | Total all burns |          |    |           |    |            |    |         |      |       |
|--------------|---------------------------|------|-----|------|------------|------|-------------|------|-------------|------|---------|------|-----------------|----------|----|-----------|----|------------|----|---------|------|-------|
|              | Flammable liquid involved |      |     |      | House fire |      | Other flame |      | Total flame |      | Contact |      |                 | Chemical |    | Radiation |    | Electrical |    | Unknown |      |       |
|              | No.                       | %    | No. | %    | No.        | %    | No.         | %    | No.         | %    | No.     | %    |                 | No.      | %  | No.       | %  | No.        | %  | No.     | %    |       |
| 0-2          | 187                       | (70) | 3   | (1)  | 5          | (2)  | 5           | (2)  | 13          | (5)  | 44      | (16) | 5               | (2)      | 6  | (2)       | 13 | (5)        | 1  | (0)     | 269  | (100) |
|              | 112                       | (68) | 0   | (0)  | 5          | (3)  | 3           | (2)  | 8           | (5)  | 27      | (16) | 2               | (1)      | 0  | (0)       | 9  | (5)        | 9  | (5)     | 165  | (100) |
|              | 299                       | (69) | 3   | (1)  | 10         | (2)  | 8           | (2)  | 21          | (5)  | 71      | (16) | 7               | (2)      | 6  | (1)       | 22 | (5)        | 10 | (2)     | 434  | (100) |
| 3-9          | 71                        | (48) | 27  | (18) | 3          | (2)  | 14          | (9)  | 44          | (30) | 13      | (9)  | 3               | (2)      | 3  | (2)       | 13 | (9)        | 2  | (1)     | 149  | (100) |
|              | 44                        | (55) | 5   | (6)  | 2          | (3)  | 15          | (19) | 22          | (28) | 6       | (8)  | 3               | (4)      | 1  | (1)       | 3  | (4)        | 3  | (4)     | 80   | (100) |
|              | 115                       | (50) | 32  | (14) | 5          | (2)  | 29          | (13) | 66          | (29) | 19      | (8)  | 6               | (3)      | 4  | (2)       | 16 | (7)        | 5  | (2)     | 229  | (100) |
| 10-14        | 31                        | (23) | 69  | (50) | 6          | (4)  | 16          | (12) | 91          | (66) | 5       | (4)  | 1               | (1)      | 0  | (0)       | 6  | (4)        | 3  | (2)     | 137  | (100) |
|              | 12                        | (40) | 3   | (10) | 0          | (0)  | 2           | (7)  | 5           | (17) | 3       | (10) | 2               | (7)      | 2  | (7)       | 4  | (13)       | 4  | (13)    | 30   | (100) |
|              | 43                        | (26) | 72  | (43) | 6          | (4)  | 18          | (11) | 96          | (57) | 8       | (5)  | 3               | (2)      | 2  | (1)       | 10 | (6)        | 7  | (4)     | 167  | (100) |
| 15-19        | 64                        | (28) | 63  | (27) | 18         | (8)  | 29          | (13) | 110         | (48) | 14      | (6)  | 19              | (8)      | 1  | (0)       | 16 | (7)        | 7  | (3)     | 231  | (100) |
|              | 24                        | (36) | 5   | (7)  | 8          | (12) | 5           | (7)  | 18          | (27) | 13      | (19) | 3               | (4)      | 9  | (13)      | 0  | (0)        | 0  | (0)     | 67   | (100) |
|              | 88                        | (30) | 68  | (23) | 26         | (9)  | 34          | (11) | 128         | (43) | 27      | (9)  | 22              | (7)      | 10 | (3)       | 16 | (5)        | 7  | (2)     | 298  | (100) |
| Total: 0-19  | 353                       | (45) | 162 | (21) | 32         | (4)  | 64          | (8)  | 258         | (33) | 76      | (10) | 28              | (4)      | 10 | (1)       | 48 | (6)        | 13 | (2)     | 786  | (100) |
|              | 192                       | (56) | 13  | (4)  | 15         | (4)  | 25          | (7)  | 53          | (15) | 49      | (14) | 10              | (3)      | 12 | (4)       | 16 | (5)        | 16 | (5)     | 342  | (100) |
|              | 545                       | (48) | 175 | (16) | 47         | (4)  | 89          | (8)  | 311         | (28) | 125     | (11) | 38              | (3)      | 22 | (2)       | 64 | (6)        | 29 | (3)     | 1128 | (100) |

**Table V.** Food-related burns to children aged 19 years or younger by age, sex and type of burn – New England Residents, 1 July 1978 to 30 June 1979

| Age category (yr) | Scald |                | Flame |                | Contact |                | All food-related burns |                |
|-------------------|-------|----------------|-------|----------------|---------|----------------|------------------------|----------------|
|                   | No.   | % of all burns | No.   | % of all burns | No.     | % of all burns | No.                    | % of all burns |
| 0–2               |       |                |       |                |         |                |                        |                |
| M                 | 138   | 74             | 1     | 1              | 28      | 64             | 167                    | 62             |
| F                 | 85    | 76             | 2     | 25             | 19      | 70             | 106                    | 64             |
| M & F             | 223   | 75             | 3     | 14             | 47      | 66             | 273                    | 63             |
| 3–9               |       |                |       |                |         |                |                        |                |
| M                 | 53    | 75             | 2     | 5              | 8       | 62             | 63                     | 42             |
| F                 | 31    | 70             | 5     | 23             | 2       | 33             | 38                     | 48             |
| M & F             | 84    | 73             | 7     | 11             | 10      | 53             | 101                    | 44             |
| 10–14             |       |                |       |                |         |                |                        |                |
| M                 | 18    | 58             | 5     | 5              | 2       | 40             | 25                     | 18             |
| F                 | 7     | 58             | 2     | 40             | 0       | 0              | 9                      | 30             |
| M & F             | 25    | 58             | 7     | 7              | 2       | 25             | 34                     | 20             |
| 15–19             |       |                |       |                |         |                |                        |                |
| M                 | 26    | 41             | 14    | 13             | 2       | 14             | 42                     | 18             |
| F                 | 14    | 58             | 4     | 22             | 3       | 23             | 21                     | 31             |
| M & F             | 40    | 45             | 18    | 14             | 5       | 19             | 63                     | 21             |
| Total: 0–19       |       |                |       |                |         |                |                        |                |
| M                 | 235   | 67             | 22    | 9              | 40      | 53             | 297                    | 38             |
| F                 | 137   | 71             | 13    | 25             | 24      | 49             | 174                    | 51             |
| M & F             | 372   | 68             | 35    | 11             | 64      | 51             | 471                    | 42             |

rates due to the small number of burns identified in New Hampshire. This possible source of error, however, is an unlikely explanation for all of the difference. Other possible explanations include different probabilities of being hospitalized for comparably sized burn injuries in the New England states due to varying hospital policies regarding admission, and differences among the states in environmental factors such as housing or population density that modify the risk of burn injury. The proportionately larger black populations (who experience higher burn rates than do white populations) in Massachusetts, Connecticut and Rhode Island compared to the other New England states cannot explain the differences in burn rates because the proportion of the population that is black is low even in the southern New England states (an average of 5 per cent of the population is black in the southern New England states compared to an average of 0.3 per cent for the northern New England states).

Burn injuries which were not severe enough to require in-hospital care, and burn injuries which were fatal prior to in-hospital care were not considered in the present study. Previous investigations suggest that burns to 0–2 year olds, and burns to 15–19 year olds, are overrepresented among burn injuries which do not require in-hospital care (Barancik and Shapiro, 1975; MacKay et al., 1979), and that burn injuries associated with house fires are the leading cause of burn fatalities (Baker et al., 1984). According to these same investigations, the aetiological patterns of both less severe burns and fatal burns are similar to the patterns found among burn injuries which require hospital care.

One possible source of error in this study warrants discussion. The data on which the study is based pertain to burn injuries which occurred during the 1-year period beginning 1 July 1978, over ten years ago. Several changes in the epidemiological profile of paediatric burn injuries have occurred since 1978. These changes include the fact that burns involving clothing ignition from point sources (e.g. from stove burners) have decreased substantially since that time. The reasons for the decrease include the fact that

clothing fashions dictate the wearing of tighter fitting clothing; such clothing is less apt to come into contact with an ignition source. In addition, following the removal of the flame retardant TRIS (2,3 dibromopropyl) phosphate, from the market, the flammability standards for children's sleepwear resulted in the use of materials for all children's clothing which were inherently more flame resistant. Other changes in the epidemiological profile of burns since 1978 include a reduction in fatal burns (and hence more inpatient burns) due to improved emergency care and in-hospital care for large burns, and a reduction in scald burns from home showers and bathtubs due to a greater public awareness of the need to keep the temperature of tap water below 120°F (49°C) to prevent scalds. With respect to food-related burns, there now are more burns associated with microwave cooking and foods prepared in a microwave oven than there were in 1978 due to the increased availability and use of these ovens. There also have been more burns from contact with wood-burning stoves because of the use of these auxiliary heating devices following the 'energy crisis' precipitated in the mid-1970s.

Notwithstanding these changes in the epidemiological profile of paediatric burn injuries since 1978, the implications of the study results for burn injury control include the following observations. Sixty-three per cent of the burns to children occurred in a residential setting. For children less than 3 years old, the proportion was 85 per cent. Often these burns occurred in the kitchen and were associated with food preparation and food consumption. Although burn hazards associated with food-related activities are well documented (Sorensen, 1976; Feck et al., 1981; Langley and Silva, 1981), many potentially effective controls to prevent these burns have not been implemented (Rossignol et al., 1989). Such controls include the use of cups, pots, and other cookware that resist spilling, and stoves that are designed to prevent contact between hot surfaces and clothing or body parts. Supervision of young children during meal preparation and the physical separation of children from areas of potential danger in the kitchen and dining area need to be

emphasized to adult and teenage caretakers.

Twenty-four per cent of the burns to young persons between the ages of 15 and 19 years occurred near motor vehicles. These burns included scald burns from radiator fluid, flame burns associated with petrol (e.g. from priming carburettors with petrol), flame burns from postcrash fires, and contact burns from hot engine parts or exhaust system components. The contribution of motor vehicles to the risk of burn injury among 15–19 year olds has been noted previously (Barancik and Shapiro, 1975; Feck et al., 1978; Rossignol et al., 1985). In New England, the majority of these burns occur during the months May to August, with the seasonal peak occurring in mid July. Educational efforts to prevent motor vehicle-related burns might successfully take advantage of this seasonal variation by emphasizing prevention during the summer months, particularly in geographical areas that have weather patterns that are similar to the patterns in New England. Other prevention strategies include placing unambiguous warning labels on or near carburettors and designing petrol tanks that resist petrol spillage in a vehicle crash.

At least 22 per cent of the burns to 15–19-year-old males occurred during paid employment. The majority of these burns were associated with food preparation activities or with motor vehicle service. Prevention of these burns involves the participation of the Occupational Safety and Health Administration which is responsible for protecting workers from occupational hazards. Control approaches which are appropriate for occupational burns resemble the approaches that are recommended for burns that occur outside the work setting.

Flame burns, which were uncommon among young children, accounted for 66 per cent of the burns to 10–14-year-old males, and 48 per cent of the burns to 15–19-year-old males. The majority of these burns involved the ignition of a flammable liquid, particularly petrol. The general availability of petrol, for example, from containers stored in residential areas, hinders effective control of these burns. It seems imperative to teach children at a young age about the flammability of petrol and other organic liquids. In addition, the mass media might be persuaded to address society values which suggest that fire and explosions are exciting and glamorous.

Clothing ignition was involved in 58 per cent of all flame burns. Ignition of clothing is the strongest predictor of the size of a flame burn resulting from a point ignition source (that is, excluding structural fires) (Oglesbay, 1969). Strategies to prevent clothing ignition include not only the selection of material for clothing that is naturally flame resistant but also the selection of tighter fitting clothing which is less likely to come into contact with ignition sources such as stove burners. Clothing ignition following ignition of a flammable liquid can be addressed as part of the educational messages directed toward the hazards of flammable liquids. In addition, programmes to encourage the safe storing of matches and lighters and to prevent young children playing with matches could prevent some of the flame burns involving clothing ignition.

Forty scald burns occurred in bathroom showers or bathtubs. Although these burns account for only a small proportion of all scalds (7 per cent), they tend to be large, and in some instances, fatal occurrences. These burns are almost entirely preventable by reducing the temperature of tapwater to below 120°F (49°C) (Consumer Reports, 1978; Baptiste and Feck, 1980).

In this study, 5 per cent of the burns were associated with

child abuse or neglect. Prevention of these burns involves the input of social service agencies and of adult support groups.

In summary, it seems clear that control strategies are available to prevent the majority of burn injuries that occur to children. A co-ordinated approach utilizing existing local, state and federal agencies to set and enforce standards for consumer and industrial products, and residential and occupational building design, seems necessary. This approach should be complemented by effective educational interventions which encourage safe behaviour and which are directed towards children who are at increased risk of burn injury, and their family members.

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