Burn injuries among children from a region-wide paediatric burns unit

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Abstract
Burns are known to be a cause of the most severe childhood injuries. The purpose of this retrospective study was to investigate socio-demographic and other factors involved in children being presented to a burns unit for treatment. This is the first reported comprehensive audit of burns admissions highlighting factors that may relate to the occurrence of burns in children. Raw data was obtained from the data service unit (DSU) and the ward registers of a paediatric burns unit. Of 1249 admissions, 1156 cases (92.5%) had clearly specified causes. The number of annual admissions ranged from 225 to 281 with a mean of 250 ± 25 per year. Eighty-eight percent of burns were superficial and covered less than 10% of body surface area. The majority of cases were males (744 cases; 60%). The mean age of cases was 4 years ± 1.8 years. The major causes of burns were ‘spill’ (765 cases; 61%) and ‘contact’ (150 cases; 12%). The largest group was white British (787 cases; 63%) followed by Asian (353 cases; 28%). Mixed and African population groups made up the remaining 9%. The risk of burns injuries is higher among younger children, during the early evening, and is disproportionately high in the Asian/Asian British groups. It is suggested that there is a need to increase injury prevention towards those at greatest risk.

Key words: Burns ■ Children ■ Incidences ■ Gender ■ Ethnicity ■ Demographics

Intentional and unintentional injuries account for one of the major causes of loss of life and long-term disability among children. This was highlighted by Turner et al (2006), who showed that worldwide, burn injuries are responsible for more years of life lost than other causes. Unintentional injury has now become the leading killer of children, and unfortunately, can leave its physical and psychological effects well into adulthood. It is typified by a traumatic injury to the skin causing varying degrees of superficial and deep tissue damage. The main causative agents are hot liquids, metals, gases, radiation, electricity, chemicals and extreme cold (Ghosh et al, 1996). In addition, children are much more likely to sustain a burn injury after contact with an open fire or flame, electrical items, and/or other hot surfaces (Royal Society for the Prevention of Accidents (RoSPA), 2007). The main causative factor in childhood burns, identified by RoSPA (2007), is hot bath water. Hot bath water is responsible for the highest number of fatal and severe scalding injuries among young children (RoSPA, 2007).

Previous studies highlight that the majority of fatal and non-fatal medically-attended burn injuries occur in the home (Office for National Statistics (ONS), 2005). The risk of burn injuries is greater among younger children, with the relationship between injury risk and age varying with the mechanism of burns (Kendrick et al, 2005). Many of the unintentional burn injuries occur in the home, where children are presumably being supervised. These home injuries account for 40% of medically attended burns in 5–9-year-olds and 25% in 10–14-year-olds (Edelman, 2007).

Aims and objectives
The purpose of this retrospective study was to explore and investigate the factors that may be responsible for children being presented to a burns unit for treatment, with a view to assessing any possible socio-demographic and additional factors that may be involved. The objectives of the audit were to:

■ Identify the reported causes and frequency of burns
■ Explore the relationship between burn injuries and gender and age
■ Explore the relationships between burn injuries, social deprivation, time of injury, and any seasonal incidences.

Methods and data analysis
As this was a retrospective audit involving no clinical involvement of patients and/or staff, the authors were
advised that no IRAS application to local NHS Research Ethics Committee would be required.

Birmingham Children’s Hospital became a major burns centre in 2004, and a retrospective data retrieval process was applied to the years 2004 and 2008 inclusive, concerning burn admissions. All admissions data to the burns department resulting from burn injury (whether cases were discharged on the same day or stayed longer) were included. Raw data was obtained from two sources; the data service unit (input computer system)—patients notes were not accessed—and a burn ward registry was inspected for completeness of missing data from the previous tool. These two tools for data collection are valid and reliable for the accuracy and availability of data for professional use when needed, and for future research.

The data contained children’s gender, age, ethnicity and postcode. Additional information included the causes, mechanisms and frequency of burns, body surface area (BSA) covered by burns, the season, and time of day of the injury.

The sample size for the audit was 1249 patients between the year 2004 and 2008. All patients registered in the computer within this period were included in the study, while excluding the second registration of patients.

Postcodes were used to obtain the Index of Multiple Deprivations (IMD), which combines a number of indicators (income, employment, health and disability, crime, living environment, economics, social aspects, housing issues and education) into a single deprivation score for each area in England and Wales. This has been produced at Lower Super Output Area (LSOA) level, resulting in IMD scores for 32 482 areas in the UK. As a result, IMD allows each area to be ranked relative to others according to their level of deprivation, and identify areas that would benefit from special initiatives or programmes (Indices of Deprivation, 2007). Group comparisons of categorical factors were made using Chi-square (χ²) tests and as implemented by Minitab v15 and SPSS v16 packages. Comparisons of burns cases with West Midlands regional characteristics as measured by the 2007 census were also made by χ² tests.

### Results

#### Admissions and presentation

Inspection of data from 2004–2008 resulted in 1249 burns patients presenting to the burns ward at the Children’s Hospital. Annual variation in presentation was small, varying between 225 and 281 cases per year, with no obvious year-on-year trends emerging, with the mean number of admissions equalling 250 ± 25 per year. Burn admissions across the 5 years of the study were:

- **2004, n=226 (18.1%)**
- **2005, n=281 (22.5%)**
- **2006, n=247 (19.8%)**
- **2007, n=224 (17.9%)**
- **2008, n=271 (21.7%).**

Of 1249 cases, 1156 cases (92.5%) had clearly specified causes, with 93 cases providing no unique cause. Of all admissions, 1156 (92.6%) did not result in fatality, and four (0.3%) resulted in fatality, with the outcome unrecorded for 89 (7.1%).

Admissions for the years 2004–2008 were grouped into four different categories (0–11 months; 1–6 years; 7–11 years; 12–16 years). Burn admission patients had a mean of 4 years (± 1.8 years). There were more males than females in each of the four age groups, and in total, males accounted for 744 cases (59.6%) and females for 504 cases (40.4%). Of all cases, the mean burn surface area percentage was not significantly different between males (5.6 ± 9.2; n=656) and females (5.0 ± 6.7; n=448) (F=1.4; P=0.04). The mean age of all female cases was significantly younger than for males (3.7 years ± 3.7; n=503) and 4.2 years ± 4.3 (n=742) respectively (F=4.1; P=0.04). In the West Midlands, statistics showed that the average number of children is 497 170, of which 254 644 were male, accounting for 51.2% of regional childhood population.

In this regard, there was a disproportionately higher than expected presentation rate by males. The odds ratios of boys presenting relative to girls across all groups are shown in Table 1.

#### Causes and sources of burn injury

For the purpose of this article, ‘cause’ of burn relates to mechanism (e.g. scald, contact, flame, or electrical), whereas ‘source’ of burn relates to the equipment or device involved (e.g. kettle, gas fire, or iron). The main causes of the 1249 burn cases included:

- **Scalds (n=835; 66.9%)**
- **Contact (n=202; 16.2%)**
- **Flames (n=118; 9.4%)**
- **Flashes (n=30; 2.4%).**

Causes were unknown for 28 cases (2.2%). The remainder of cases involved less frequent causes, such as chemicals (n=12), electrical appliances (n=10), friction (n=7), radiation (n=4), and others (n=3).

Of the 1249 cases, the single main source was ‘spill’ burns, (765 cases; 61.2%). Sources of spill burns included:

- **Hot drinks (n=395)**
- **Kettles (n=152)**
- **Hot water bottles (n=78)**
- **Boiling water in a bowl (n=45)**

| Table 1. Distributions of genders between the different age groups and their percentages in the West Midlands |
|---|---|---|---|---|---|
| 0–11 months | 1–6 years | 7–11 years | 12–15+ | Total |
| West Midlands population | | | | |
| Male | 18 709 | 86 981 | 81 022 | 67 782 | 254 644 |
| Female | 17 743 | 81 795 | 77 551 | 65 437 | 242 526 |
| Burns | | | | |
| Male | 88 | 506 | 57 | 93 | 744 |
| Female | 63 | 358 | 44 | 39 | 504 |
| Male/female odds ratio (95% CI) | 1.32 | 1.33 | 1.24 | 2.30 | 1.41 |
| (0.95–1.84) | (1.16–1.53) | (0.83–1.85) | (1.57–3.37) | (1.25–1.58) |
Saucepans (n=35)
Soup and food (n=30)
Hot milk (n=21)
Hot water taps (n=9).

Table 2 shows types of burn injuries and the varying sources involved.

Burn severity
Burns resulting from spills covered less than 4% of BSA in 382 of 765 cases (50%), while bathing burns covered more than 12% of BSA in 26 of 103 cases (25%). The maximum recorded percentage of BSA was with contacts burns (96%), while the minimum recorded percentage of BSA was with spills burns (0%) when there was no need for treatment. The mean burn severity BSA percentage was 5.3 (n=1105). Table 3 shows the severity of burn injuries by varying burn type.

Ethnicity
The distribution of the total number of burns across four major ethnic groups (British/white; Asian/Asian British; African/African British; and mixed origin) was significantly different from the census distribution of ethnic groups (P<0.001). The Asian/Asian British and African/African British groups presented with burns disproportionately more than should be expected, and the British/white groups presented less than was expected. The source of burns across all ethnic groups is shown in Table 4.

Asian/Asian British cases were significantly younger on average than white/white British cases (F=23.9; P<0.0001) (n=352; 3.1 years ± 3.2; n=787; 4.4 years ± 4.4 respectively). The mean severity of burn cases (measured by burn surface area percentage) across the four ethnic groups did not vary significantly (F=1.2; P=0.2), although white/white British cases had a slightly higher severity than cases from the other ethnic groups. Mean BSA ratings were:

- White/white British (n=706; 5.7 ± 9.0)
- Asian/Asian British (n=309; 4.7 ± 7.3)
- African/African British (n=62; 4.8 ± 5.6)
- Mixed origin (n=28; 4.2 ± 3.8).

Duration of hospital stay after admission also failed to vary significantly across ethnic groups (F=0.4; P=0.7):

- White/white British (n=692; 5.1 days ± 26.3)
- Asian/Asian British (n=300; 3.8 days ± 21.9)
- African/African British (n=62; 2.3 days ± 3.9)
- Mixed origin (n=32; 2.9 days ± 4.2).

There was no significant difference (χ²=0.5; P=0.4) in the number of cases admitted to stay in hospital between white/white British and Asian/Asian British cases (59.1% compared with 56.6% respectively).

Social deprivation
Postcode matching for the burns cases allowed IMD scores to be ascertained for each type of burn injury, and for each

Table 2. Causes and the sources of burn injuries

<table>
<thead>
<tr>
<th>Causes</th>
<th>Cases (%)</th>
<th>Sources (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spill</td>
<td>765 (61.2)</td>
<td>Tea and coffee cup and pots (395); kettle (152); hot water bottle (78); boiling bowl (45); saucepan (35); soup and food (30); milk (21); tap splash/spill (9)</td>
</tr>
<tr>
<td>Contact</td>
<td>150 (12)</td>
<td>Ignitions (36); gas fires (27); other flammable objects (27); barbecue (13); electric hob (21); solid fuel cooker (7); gas hob (6); oven (6); fireworks (5); grill (2)</td>
</tr>
<tr>
<td>Iron</td>
<td>125 (10)</td>
<td></td>
</tr>
<tr>
<td>Bathing</td>
<td>103 (8.4)</td>
<td></td>
</tr>
<tr>
<td>Unspecified causes</td>
<td>93 (7.4)</td>
<td>Scalded skin syndrome (3); toxic epidermal necrosis (1); sunburn (1)</td>
</tr>
<tr>
<td>Building on fire</td>
<td>8 (0.6)</td>
<td></td>
</tr>
<tr>
<td>Diseases</td>
<td>5 (0.4)</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Body surface area affected by cause

<table>
<thead>
<tr>
<th>Causes</th>
<th>Cases (%)</th>
<th>Minimum BSA %</th>
<th>Lower quartile</th>
<th>Median</th>
<th>Upper quartile</th>
<th>Maximum BSA %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spill</td>
<td>765 (61.2)</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>93</td>
</tr>
<tr>
<td>Contact</td>
<td>150 (12)</td>
<td>0.2</td>
<td>1</td>
<td>1.5</td>
<td>5</td>
<td>96</td>
</tr>
<tr>
<td>Iron</td>
<td>125 (10)</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Bathing</td>
<td>103 (8.4)</td>
<td>0.5</td>
<td>2.5</td>
<td>6.5</td>
<td>12</td>
<td>53</td>
</tr>
<tr>
<td>Disease</td>
<td>5 (0.4)</td>
<td>0.5</td>
<td>2</td>
<td>7</td>
<td>12</td>
<td>50</td>
</tr>
<tr>
<td>Building fire</td>
<td>8 (0.6)</td>
<td>3</td>
<td>3.6</td>
<td>6.7</td>
<td>12.5</td>
<td>14</td>
</tr>
<tr>
<td>Unspecified causes</td>
<td>93 (7.4)</td>
<td>0</td>
<td>1</td>
<td>2.5</td>
<td>5.7</td>
<td>60</td>
</tr>
</tbody>
</table>

Table 4. Source of burn injuries by ethnic group

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Spills</th>
<th>Contacts</th>
<th>Iron</th>
<th>Bathing</th>
<th>Diseases</th>
<th>Non-specified</th>
<th>Total n (%)</th>
<th>2009 census age 0–15 in West Midlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>British/white</td>
<td>60%</td>
<td>69%</td>
<td>62%</td>
<td>75%</td>
<td>70%</td>
<td>68%</td>
<td>787 (63%)</td>
<td>345 495 (69.5%)</td>
</tr>
<tr>
<td>Asian/Asian British</td>
<td>30%</td>
<td>25%</td>
<td>32%</td>
<td>17%</td>
<td>30%</td>
<td>29%</td>
<td>353 (28.3%)</td>
<td>99 846 (20.1%)</td>
</tr>
<tr>
<td>African/African British</td>
<td>8%</td>
<td>5%</td>
<td>3%</td>
<td>8%</td>
<td>0%</td>
<td>2%</td>
<td>75 (6.0%)</td>
<td>20 628 (4.1%)</td>
</tr>
<tr>
<td>Mixed origin</td>
<td>2%</td>
<td>1%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>1%</td>
<td>34 (2.7%)</td>
<td>31 177 (6.3%)</td>
</tr>
</tbody>
</table>
of the four ethnic groups. The median UK national IMD value is 32.4, and the IMD values for burn cases across the four ethnic groups are shown in Figure 1, relative to this median value. IMD scores for each type of cause of burn injury are shown in Figure 2. Causes of burns and spills are notably worse because the median of spill is close to 37.31 IMD, but other major causes have a median IMD close to the UK median (Figure 2).

**Temporality**

The distribution of time of burn injury for 994 of cases (for 255 cases time was unknown) is shown in Figure 3, and can be seen to be bi-modal. The major peak for burn injuries occurs between 6 pm and 9 pm, and continues to decrease steadily hour-on-hour until 11 pm. This significant hour-long peak accounts for approximately 11% of cases (when time was recorded). A second minor peak can be observed between 10 am and 11 am, which is the climax of an increasing injury rate that starts to build from 7 am. The 10–11 am peak accounts for approximately 6% of cases (when time was recorded). Figure 4 shows the number of cases per month across the 5 years of data, with a slight trend increasing as the year progresses, undergoing a small dip in the traditional summer months. There was no correlation between month of burn injury and the severity of burn injury as measured by burn surface area percentage ($r$=0.02; $P=0.5$). In terms of seasonal variation of admissions across the 5 years, the following breakdown of cases was observed:

- Winter ($n=296; 23.7\%$)
- Summer ($n=307; 24.6\%$)
- Spring ($n=316; 25.3\%$)
- Autumn ($n=330; 26.4\%$).

**Discussion**

The 5-year audit showed a number of interesting details about childhood burn injuries in the West Midlands. Childhood burns are a significant cause of admission to the Children’s Hospital in this region. The hospital serves a relatively large catchment area, which to some extent explains these numbers. However, in terms of prevalence, burns accounted for a significant proportion of admissions, and this seems to have been more or less the same over the 5 years with little variation. The proportion of the West Midlands was 5,040,000 (ONS, 2007), and the West Midlands (with the exception of London) has the lowest proportion of people identifying themselves as white – 88.8% (4,450,000 people) compared with 90.9% for England as a whole. As a result, the West Midlands has above average proportions of white Irish, mixed white and African–Caribbean, Indian, Pakistani, Bangladeshi and African-Caribbean people. The 5.6% per cent to 7.3%, and the new ‘mixed’ group formed 1.4% (70,000) of the 2001 population (ONS, 2003).

Results showed the Asian/Asian British group to have a higher percentage of burn admissions, and Asian/Asian British cases being significantly younger on admission than white/white British cases. Istre et al (2002) stated that non-whites were at a greater risk of burn injury, were more likely to be burn patients, and had higher age-specific death rates (Ballard et al, 1992; Shai and Lupinacci, 2003). This may be because home practices in some activities differ between cultures (such as communal cooking or eating), and perhaps other cultural factors could have a bearing on this observation, such as level of parents’ education, income, overcrowding, catering and entertaining.

Official statistics show the number of female and male children in the region to be similar, in that there were 254,644 boys and 242,526 females. This study found that 59.6% burns cases were male, and although this is disproportionately higher than the general male–female child split for the region, this is in line with what other researchers have found (Delgado et al, 2002; Peleg et al, 2005). In addition, other studies investigating the relationship between gender and burns showed that boys are more likely to have burns accidents than girls (Department for Education and Skills, 2002) and were consistently found to be at a higher risk of injury than girls. The reasons cited for this difference included younger boys being more likely to exhibit showing-off and high risk-taking behaviours among their friends, and occasionally over-reaching their abilities (Kendrick et al, 2005).

The incidence of burns in children is believed to be highest in the winter months (Van Niekerk et al, 2004). However, this study found that the traditional winter months were not fully in line with this previous finding; November and December had the highest burn frequencies,
while January and February were the lowest. The results of this study suggest that the mechanisms underlying burn injury admissions are therefore more complex than merely being related to climatic seasonal effects alone.

The IMD for each case in this study was based on postcode, and consequently this resulted in the mean deprivation scores for African/African British and Asian/Asian British being above the national average of deprivation (32.48). Swart and Seedat (2001) stated that the socioeconomic status of the burns cases is known to play a significant role in predisposing children to accidental injuries. This finding is also supported by Delgado et al (2002), who demonstrated that low income and overcrowding were associated with an increased risk of burn injury. It is therefore posited that healthcare prevention programmes are urgently required in these identified and discreet geographical areas.

The largest number of burns sustained by children in this study was 61.2%, deriving from scalds from hot water in the preparation of beverages or food (with a small number involving hot water bottles). This finding is supported by Edelman (2007), who highlighted that burns were a common occurrence in young children while they are at home. Petridou and Tursz (2001) alluded to this in their article and in this context cannot be overstated in the need to minimize such injuries in children. The authors’ estimates suggest that approximately 40% of burn accidents occurred between the hours of 9 am and 5 pm, when parents are traditionally working, and when some children are no doubt left in the care of older siblings—especially after school—and may not have been as closely supervised. The authors estimate that 11% of burn cases were injured between 5 pm and 6 pm, and a further 18% between 7 am and 11 am. The high frequency of, and increase in, early morning injuries may be reflective of parents rushing to get to work, and perhaps being more distracted in the morning, and the early evening peak may be owing to arrival home from work and preparation of evening meals, bathtimes and domestic responsibilities. This is also supported by Affeltranger and Thomasson (2005).

Three types of burns are well documented and classified as:

- First degree or a superficial burn—the skin appears red, painful, and dry
- Second degree burn—the skin appears red, blistered, and painful, with possible swelling
- Third degree burn—the burn is serious and damages the underlying bones, muscles, and tendons and in this case, the burn site appears white or charred black.

Most of the burn injuries reported in this study were of a superficial nature and were less than 10% of BSA; however, 25% of the burns were serious and accounted for over 10% of BSA.

On a grander scale, these results have a financial cost for the hospital. However, on an individual basis there are emotional consequences that can be short- or long-term for the parents involved. The immediate emotions expressed by parents range from feelings of extreme guilt to high levels of emotional distress. The following authors all recognize the importance of prevention programmes, rather than primary care restoration (Sie et al, 2004; Affeltranger and Thomasson, 2005; Drago, 2005). The programmes promulgated by the above authors focuses on socially deprived families living in identified geographical locations and suggest a range of interventions including distributing posters, home visiting, lectures, and visiting children in school to increase their awareness of dangerous situations.

**Limitations**

A limitation of the study was the timeframe taken in accessing the data from the hospital computer system, a process which took longer than expected. This was primarily because the Burns Unit was in the process of moving to a new centre and the transition period took longer than anticipated. As a result, all the previous data had to be moved onto a new system, thus creating a few electronic glitches with regard to data compatibility and transferability. This required training of the computer administration team and held data collection of this study back.

**Conclusions**

The results of this study suggest that the mechanisms underlying burn injury admissions are more complex than merely being related to climatic seasonal effects alone. It is therefore posited that simple preventive measures can help to reduce selective burn injuries. The most effective way may be via education, focusing on parents with preschool children.

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**Figure 3. Time of burn injury across cases**

**Figure 4. Month of burn injury across five years of data**
(Tarim et al, 2005) and/or targeting local TV or radio broadcasts. The messages issued via the media could include highlighting risk situations in general and more specifically, household accident hotspots, presenting epidemiological data on burn accidents, and drawing attention to preventive measures against burns can be useful. It has also been recommended by Rossi et al (1998) that illustrations presented in a range of formats showing hypothetical accidents may have an impact on the prevention of accidents. There is little doubt that health education programmes which inform and warn people about the causes of all types of burn injury should be offered (Anlatici et al, 2002). Peleg et al (2005) reported a statistically significant reduction in the rate of hospitalizations of burn injuries in infants and toddlers where intervention programmes have been implemented. This illustrates that intervention programmes may have a direct effect on the reduction of burn injuries among children. These programmes may also be modified to take into account cultural and ethnic features of a target population, which may increase the efficacy of such programmes.

Further research is now required to thoroughly investigate the other socioeconomic factors, which might include:

■ Level of parents’ education
■ Household income
■ Geographical location
■ Housing tenure and number of family members in a household.

This may help to uncover whether there are relationships between the different variables responsible for the occurrence of burns in children, and also to develop a contextual model of burn injuries in children with a view to informing future healthcare policy and health promotion programmes.

**KEY POINTS**

- Asian/Asian British children have a higher percentage of burn admissions than expected for the population size
- The largest number of burns sustained by children in this study was 61.2%, deriving from scalds from hot water in the preparation of beverages or food
- Asian/Asian British burn cases were significantly younger on admission than white/white British burn cases
- The results of this study suggest that the mechanisms underlying burn injury admissions are therefore more complex than merely being related to climatic seasonal effects alone

**Conflicts of interest: none**


