Child Protection Evidence Systematic review on Burns

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While the format of each review has been revised to fit the style of the College and amalgamated into a comprehensive document, the content remains unchanged until reviewed and new evidence is identified and added to the evidence-base. Updated content will be indicated on individual review pages.

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Summary

Scald burns remain the most common burn type in children who have been abused with the most common mechanism involving water. Scalds secondary to abuse are classically described as being distributed on the buttocks, perineum, and lower extremities, with clear upper limits and scald symmetry especially when present on the lower extremities. Contact burns are the most common non-scald causes of abusive burns. These burns tend to be distributed on the back, shoulders, and buttocks, with clearly demarcated edges and can present in the pattern of the object used.

The following systematic review evaluates the scientific literature on abusive and accidental burns in children published up until **October 2021**.

This update includes four new studies with evidence added to all current clinical questions.[1-4] One study profiled burn injuries associated with Child and Family service involvement, [1] whilst another investigated the differences in presentation for noninflicted, negligent and inflicted burns.[2] The characteristics of accidental versus abusive paediatric burn injuries in an urban burn centre over a 14-year period were described in a retrospective study,[4] and a systematic review discussed the incidence and characteristics of non-accidental burns in children.[3]

The review aimed to answer four questions:

- What are the clinical and social features that distinguish intentional and unintentional scalds in children?
- What are the features of intentional non-scald burns?
- What conditions mimic suspected intentional burns?*
- How do you identify a burn due to neglect?

*Ceased updating in 2009

Key findings:

- One study reported that apart from abusive head trauma, intentional burns are the most likely injury to cause death or long-term morbidity.
- The prevalence of abusive burns is estimated to be 5.3% – 14% of children admitted to burns units, highest for those aged 0 – 1 years.

- Scalds are the most common intentional burn injury. These injuries may occur as a consequence of running water, resulting in burns to the lower limbs with a symmetrical distribution. Contact burns are the second most common intentional burn injury.
- Features of non-intentional scalds include irregular margin, asymmetrical and anterior distribution. Agents are often hot beverages that have been spilt.
- Features in the history that are associated with intentional scalds include inconsistent history.
- A single comparative study noted a great proportion of occult injuries in those with intentional scalds.

Background

This systematic review evaluates the scientific literature on abusive and non-abusive burns in children published up until October 2021 and reflects the findings of eligible studies. The review aims to answer four clinical questions:

1. What are the clinical and social features that distinguish intentional and unintentional scalds in children?
2. What are the features of intentional non-scald burns?
3. What conditions mimic intentional burns?
4. How do you identify a burn due to neglect?

Methodology

A literature search was performed using a number of databases for all original articles and conference abstracts published since 1950. Supplementary search techniques were used to identify further relevant references. See Appendix 1 for full methodology including search strategy and inclusion criteria.

Potentially relevant studies underwent full text screening and critical appraisal. To ensure consistency, ranking was used to indicate the level of confidence that abuse had taken place and also for study types.

Findings of clinical question 1 What are the clinical and social features that distinguish intentional and accidental scalds in children?

Scalds are the most common intentional burn injury recorded.[1-7] However, a study which included all Emergency Department attendances recorded a higher prevalence of intentional contact burns.[8] Apart from abusive head trauma, intentional burns are the most likely injury to cause death or long term morbidity.[1]

Intentional and unintentional scalds

For this question, 34 studies were included.[4-7,9-40] The age ranged from 0 to 18 years.

There was no apparent difference in the frequency between boys and girls between abusive and unintentional scalds. However, significantly more boys sustained abusive scalds.[21,38] One study showed that boys sustained more unintentional non-tap water scalds than girls (61.5% boys to 38.5% girls (104 children included)).[25] No study addressed the diagnosis of intentional scalds in children with disability.

Influence of ethnicity and socio-economic group

A small, single centre, retrospective US study looked into how paediatric burn injuries are associated with Department of Children and Family Services (DCFS) investigations.[1]. It was found that children presenting with burn injuries who had DCFS involvement were more likely to be from communities with a lower median household income. It was also suggested an association that confirmed child maltreatment, detected by DCFS investigations, were more likely to be associated with non-Caucasian parents and an unemployed primary caretaker.

Details of comparative studies

Of the included studies, 10 compared unintentional and intentional scalds.[4-7,11,13,18,22,25,28,30,39] The majority of these studies were highly ranked for definition of abuse (1 or 2), with the age ranging from 0 to 18 years.

Please see Appendix 1 for ranking of abuse and for defining unintentional causes (A or B).

Details of non-comparative studies

24 included studies addressed either unintentional [35,37] or intentional scalds.[6,9,10,12,14-17,19-21,23,24,26,27,29,31-34,36,40] The age ranged from 0 to 18 years.

Scald injuries may be defined by

Agent (e.g., tap water, hot liquids); mechanism (spill, flow, immersion); pattern (depth, outline) and distribution (affected body part, Total Body Surface Area (TBSA)).

1.1 Physical features of unintentional scalds

Agents of unintentional scalds

The majority of unintentional scald agents are non-tap water.[7,11,13,18,22,25,28,30,38] They are caused by; hot beverages/liquids pulled off a tabletop/stove or opening the microwave and pulling beverages/liquids out or the preparation of convenience foods.

Mechanisms of unintentional scalds

Unintentional scalds are predominantly spill injuries.[5,7,11,13,22,25,30,38] Few unintentional scalds are caused by immersion.[5,7,11,13,22,25,30,38] Unintentional scalds can often occur when children remove hot substances from the microwave.[25] One study highlighted scalds involving children aged seven to 14 years old, in which scalds were sustained either by the older child supervising the younger child or by them spilling the substance on the younger child whilst cooking or carrying the scalding substance.[25] There is also a case report of unintentional scalds caused by flowing water.[37]

Distribution of unintentional scalds

Key areas which are vulnerable to unintentional scalds[6,22,35] are the head, neck, trunk, face and upper body.

Patterns of unintentional scalds

The patterns of unintentional scalds include; a lack of circumferential (glove or stocking) distribution,[37,39] irregular margin,[37,39] irregular burn depth[37,39] and asymmetric involvement.[18,30,37,39] Injuries were more likely to be unilateral on the anterior surface of their body and asymmetric.[18]

Features of unintentional flowing water injuries

A single high ranked study recreated the scene of the accident and confirmed the clinical features found when a child accidentally turns on a hot tap scalding themselves.[37]

This study noted a lack of circumferential (stocking) distribution, irregular margin, irregular burn depth, and a lack of splash marks. However, a comparative study did not show any difference in splash marks between intentional and unintentional scalds.[38] The distribution was asymmetric involvement of lower limbs.

1.2 Physical features of intentional scalds

Agents of intentional scalds

The majority of intentional scald injuries are caused by hot tap water.[5,7,10,11,18-20,22,25,27,28,30,32,38,40]

Mechanisms of intentional scalds

Forced immersion scald injuries are the most common.[9,11,12,14-17,19-21,26,27,29,32-34,36,40] Bath related immersion injuries were significantly more common in intentional injury.[7]

Distribution of intentional scalds

Intentional scalds usually occur on the lower limbs,[7,10,11,15,18-21,26,28,31-33,40] especially the feet.[4,7] Bilateral lower extremity scalds are also common.[7,11,21,30,32,40] A multivariate analysis identified that in children less than five years old, hot tap water scalds, bilateral scalds and posterior location were significant indicators of intentional burns.[18] Lower extremities may also be unilateral.[7,28] Intentional scalds have been found to occur on the buttock and perineum [6,7,11,19-21,26,31,32,36,40] and the back.[7] A combination of buttock/perineal and bilateral lower extremity scalds[6,7,10,11,15,19-21,26,31-33,36,40] are also characteristics of intentional scalds. The posterior location of the burn is significantly associated with abuse (OR 2.6, 95% CI 1.3, 4.16)[18] and this was supported by another comparative study.[7]

Patterns of intentional scalds

In intentional scalds, scald margins may have clear upper limits, [9,11,29,36,38-40] and tend to be symmetrical..[6,16,26,32,39,40] Skin fold sparing is also found, e.g. in the popliteal area.[11,12,29,31,36,40] Central sparing of buttocks, sometimes referred to as “doughnut ring” pattern, may be found in immersion injuries.[31,32] Scalds are often circumferential (glove or stocking distribution) on upper

or lower limbs.[10,16,20,32,34,40] Stocking distribution scald involving just one limb has also been noted in studies of intentional burns alone.[19,32,34] Uniform scald depth was found in studies of intentional burns alone.[9,16,34]

Associated features

Associated features were confirmed in studies of intentional scalds, and in some cases, associated features were found in non-abusive data.

In studies of intentional scalds alone,[11,19,23,24,31,32,34] it was found that children are likely to have sustained previous burns, this was supported in one comparative study.[30]

Neglect or faltering growth were shown to be associated in studies of intentional burns.[12,16,17,19,33,34] Other associated features included the child's development being inconsistent with the history of the injury, this was shown in studies of intentional burns alone.[12,16] Furthermore, history which was incompatible with the physical examination was reported in comparative studies. [5,11,22,38] and non-comparative studies of intentional or unintentional burns alone.[9,11,12,16,19,26,31,34,37,40]

Co-existing fractures found on skeletal survey were shown in comparative studies [4,5,18,39] and non-comparative studies of intentional or unintentional studies.[17,21,26] A retrospective cohort study found that children in the abusive group were more likely to have internal injuries, including fractures, subdural haemorrhage and abdominal injuries . This was compared to no children in the accidental injuries group.[4] Associated injury at the time of the scald was noted on examination by both comparative studies[5,11,39] and non-comparative studies of intentional or unintentional burns.[9,11,17,19,20,26,31-34]

It was noted that a child being passive or fearful on examination was reported in both comparative studies[5] and non-comparative studies of either intentional burns or unintentional burns.[12,17,26,31,35]

Hair sample testing for illicit drug use (cocaine, benzoylecgonine, cannabinoids and methamphetamine) were more commonly positive in abused than unintentionally injured children.[18,38]

Historical and social features of intentional scalds

A lack of parental concern was found in studies of intentional scalds alone.[17,31] Furthermore, an unrelated adult presenting the child for medical attention was only reported in studies of

intentional burns.[9] Differing accounts of the cause of the injury was reported by studies of intentional scalds alone.[11,16,36]

The presence of domestic violence was reported by two comparative studies[5,30] and a history of prior abuse of the child was reported by both comparative [5] and non-comparative studies of intentional scalds.[11,23] A trigger event such as soiling, enuresis or minor misbehaviour by the child was frequently recorded immediately prior to the scald both in comparative[6] and non-comparative studies of intentional burns alone.[11,17,20,23,26,29,33,34] A child or family who were already known to social services was reported in one comparative study,[6] and in two non-comparative studies of intentional and unintentional scalds respectively.[17,37]

Intentional scalds were commonly attributed to a sibling in comparative studies[22,39] and studies of intentional scalds alone.[11,16,19,36] Numerous prior accidental injuries noted in the intentionally scalded child in one comparative study[5] and non-comparative studies of intentional and unintentional scalds.[11,19,24,26,31] One comparative study found no difference in prior injuries in maltreated and non-maltreated children.[38]

1.3 Key evidence statements

A detailed history of the events including the mechanism, timing and agent involved must be taken for all children with scalds. In evaluating the plausibility of the burn mechanism, it is essential to determine if the burn pattern and mechanism are compatible with the child's developmental stage. A top to toe examination is vital in all children presenting with burn injuries to enhance detection of other injuries.

1.4 Research implications

Further research is needed in the following areas:

- The scalds triage tool will require validation in all clinical settings where children present with scalds
- There remains a need for high quality comparative studies of intentional and unintentional scalds presenting to all clinical settings. There is bias towards burns presenting to hospital setting.
- Large multicentre prospective studies would be helpful to identify further key characteristics between abusive and accidental burn injuries

1.5 Limitations of review findings

- The majority of studies were based on hospital or burns unit admissions. This biases the data towards the severe end of the spectrum. Generally the studies included are retrospective rather than prospective
- The included studies span a wide time period (dates of included studies range from 1960 onwards) therefore definitions of abuse have varied
- Many studies lack clinical detail as to the pattern of burn injury or co-existent clinical features in abused children
- Lack of definitive gold standard diagnostic criteria to decipher abusive versus accidental scalds

1.6 Current clinical criteria not substantiated by this review

Distinguishing features of intentional scalds

- There are no studies addressing the ageing of burns by clinical examination. For this reason, defining the burn as older than described cannot be supported by published evidence
- Delay in seeking medical attention for scald injuries may be due to effective first aid masking the severity of the injury

Findings of clinical question 2
Features of intentional non-scald burns

This category includes contact burns (e.g., cigarettes, domestic irons, etc.), caustic burns, radiation burns, flame burns and microwave burns, all of which have been intentionally inflicted upon children. By far the most common intentional non-scald burns are contact burns which may not warrant hospital admission; unfortunately to date, the literature relating to intentional non-scald burns is predominantly non-comparative and only four new studies have been identified since 2011.[7,30,38,41]

Intentional non-scald burns

For this question, 35 studies were included,[7,10,17,20-22,26,27,30,38,41-65] the age ranged from 0 to 14 years.

There were no large-scale epidemiological studies that determined the gender break-down for intentional non-scald burns.

One study included two children with a physical disability and learning impairment.[60]

Influence of ethnicity and socio-economic group

None of the included studies addressed this issue.

2.1 Contact burns

There were no **comparative studies** that specifically set out to identify features that differentiate between intentional and unintentional non-scald burns.

The following data is taken from studies of intentional non-scald burns or studies that described cases of both intentional and unintentional non-scald burns (studies of unintentional cases alone were not analysed).[7,10,20-22,26,27,38,41,44-46,48,49,51,53,56,58-62]

- Contact burns were the most commonly described non-scald burns
- Intentional burns were most commonly reported on the back, shoulders and/or buttocks
- Intentional burns had sharply demarcated edges which could be matched to the specific implement in many cases
- In contrast to other physical injuries, intentional non-scald burns occurred throughout childhood.

Due to the paucity of literature, the inclusion criteria were lowered to include single case reports.

Three comparative studies confirmed that contact burns were the most common non-scald burns in maltreated and non-maltreated children.[7,30,38] One study showed that 5% of abusive burns in children <10 years old were contact burns compared to 10% in the non-abused group.[7]

Intentional burns from domestic irons

Location of intentional iron burns, where provided[20-22,41,48,58,60] were on the leg, back of hand, shoulder/upper arm, back and crest of pelvis. A burn to the palm of the hand was often a

punishment. Burn **characteristics** of **intentional** iron burns (where provided) showed there were clear demarcation of burn margins. The age range was from 0 to 14 years.

Unintentional burns from domestic irons

Location of unintentional iron burns (total: two cases)[22] were found to be on the palm of hand (one case)and back of hand (one case), these were categorised by rank of accident: C.

Intentional burns from hairdryers

The location of intentional hairdryer burns (total: eight cases)[21,44,59,60,62] tended to be on both buttocks, the face, the soles of fee, the back and abdomen

All intentional burns had clear demarcation of burn margins.[21,44,59,60,62] Some cases had precise imprints of the grid on the face of the dryer, enabling the exact matching of the implement used. Intentional hairdryer burns tended to be superficial to partial thickness burns or full thickness burns. The age ranged from 0 to 6 years old.

Unintentional burns from hairdryers

One case noted the location and characteristics of unintentional hairdryer burns,[59] in which the burns were on the shoulder, back of neck and edge of ear. The burns were clearly demarcated. The rank of accident for this case was B.

Intentional burns from cigarettes

No studies defined the characteristics of a nonintentional cigarette burn. Although many studies mentioned intentional cigarette burns,[20,22,49,51,58,60,61] and six studies recorded the characteristics of these.

The location of intentional cigarette burns tended to be on the fingers,[49] base of thumb,[51] palm of hand,[22] back of the hand, back[58] and trunk.[61]

Burn characteristics of intentional cigarette burns included a circular punched out burn, which was one cm in diameter[51] and deep circular burns.[22,49] These burns covered small areas, were often in groups[20] and produced small rounded scars.[58] One study containing detailed images described multiple cigarette burns, all regular in size and round, some with a vesicular appearance and others that were raised.[61] The age range of these cases were between 2 to 13 years.

Intentional burns from cigarette lighters

Two studies described intentional burns from cigarette lighters, the age range was from 3 to 13 years.[53,60] There was one fatal case with burns caused by a hot cigarette lighter pressed against the child's body.[53] The characteristics showed clearly demarcated lesions matching the top of the cigarette lighter. The location of the intentional burns were on the face, chest, abdomen, back and forearms.[53]

Intentional burns from grease/oil

Three studies described **intentional** burns from the application of hot grease/oil.[10,26,41,56] In two cases, the location of the burns were not given.[10] In one case the child was burnt on the back and shoulder.[26] In another case the child was burnt on the thighs and arms.[56] In one case the mother admitted burning the child with a metal spatula dipped in boiling oil leaving 30 circular/oval shaped burns.[56] The age range was from 0 to 14 years.

Intentional burns from unidentified objects

Nine cases detailed the location of intentional burns,[10] the trunk and buttocks were most frequent. The age range was from one month to 12 years.

Intentional burns from other objects

Multiple studies noted intentional single cases of intentional burns from other objects.[21,22,27,41,45,46,58,60] These included, a stun gun injury to the chest, abdomen and thighs,[45] two cases of frostbite to the feet,[21,46] four cases of stove or radiator burns,[21,46] a light bulb burn,[21] a burn due to melted plastic,[21] curling tong burn to leg,[21,22] radiator burns to back of the hand/wrists,[22] car bonnet,[27] burning of cloth to the calf of the leg,[58] electric water heater (kettle) to the leg [41] and one case of a glowing knife burn.[60] The age range was from 0 to 14 years.

2.2 Flame burns

Intentional flame burns

House fires were **excluded** from this review which encompasses the majority of flame burns. Flame burns were responsible for 3% of abusive burns vs 30% on non-abusive burns in children <10 years. [7]

Cases of **intentional** flame burns included [7,17,21,26,27,38,46] two attempted incinerations, one cigarette thrown in baby's incubator and two fire burns and flame burns however, no details were provided.

The location of intentional flame burn/incineration[17,21,26,27,46] were typically extensive and were all over the body. All extensive burns were fatal and were consistent with the history. One study described ten cases of a burning match held to the face or thigh of the child.[41] The age range was from 0 to 10 years.

Unintentional flame burns

There was one case of a child with mental disabilities, aged seven years and nine months, who had her nappy unintentionally set alight by a sibling.[52]

2.3 Microwave burns

Intentional microwave burns

One study described two cases of two children who were placed in a microwave.[42] The five-week-old baby had burns on their left hand and wrist, thorax, right foot and left thigh. The 14 month old received burns to their mid-back.[42]

One case displayed a full thickness burn and the other case had 2nd and 3rd degree burns.[42] Both cases had sharply demarcated burns. One case was biopsied and showed characteristic sparing of the subcutaneous fat beneath burned epidermis and dermis, and below the fat significantly burned muscle with no nuclear streaming.

2.4 Caustic burns

Intentional caustic burns

Seven studies describe international caustic burns.[7,21,41,46,47,54,58] Caustic burns were rare in either abuse (1.4%) or non-abusive burns (0.9%) in children less than 10 years old.[7]

Intentional caustic burns described by the studies included acidic liquid in the ear,[54] acid dripped on the head,[58] forced drinking of caustic cleaner which burnt the mouth and pharynx[46] and acid thrown on the face or in the eyes.[47] In one case the location of the injury was not recorded.[21] Three adolescents had caustic burns to exposed body parts as a punishment by their employers.[41]

Unintentional caustic burns

Several studies described the characteristics of unintentional caustic burns that were initially mistaken for abusive burns.[43,50,55,57,63-65] Unintentional caustic burns appeared without apparent explanation in four cases, they were mostly deep burns. There appeared to be no pain initially, which is consistent with the burn type. Diagnosis was made as result of careful history and, where appropriate, after testing clothing for chemicals. One case described a traditional remedy involving copper sulphate. The age range of these cases was between 0 to 11 years.

Causes

Causes of unintentional caustic burns included burns by alkaline battery fluid,[64] bathing in bleach,[63] carrying Calcium Chloride crystals in a pocket[65] and the application of topical analgesic with salicylate and menthol, aggravated by hot water, toothpaste and potato puree.[57] Other causes included prescribed potassium permanganate solution with undissolved crystals,[43] laundry detergent spilt onto clothes[50] and a copper sulphate mixed with egg white dripped in circular pattern on dorsum of hands which was used as a headache remedy.[55]

2.5 Key evidence statements

A detailed, careful history of the events (mechanism, agent) immediately prior to, and the scene of, the injury must be taken for all children with non-scald burns. The clothing for suspected caustic burns must be examined. The burn must be matched to the potential burn agent. In contrast to other physical injuries, children up to teenage years are subjected to intentional non-scald burns.

2.6 Research implications

- There is an urgent need for large-scale comparative studies of contact burns, including intentional and unintentional burns, highlighting distinguishing features between these two groups
- A comparative study looking at intentional and unintentional cigarette burns in children would be of great value
- There is a need for studies to determine the prevalence of non-scald burns in children who are abused.

2.7 Limitations of review findings

- For intentional non-scald burns there were small numbers of children described
- There were no comparative studies of cigarette burns
- There is a lack of detailed comparative data for all non-scald burns

Findings of clinical question 3 Intentional burns mimickers

Many skin disorders, caused by internal or external environmental factors, may be mistaken for intentional burns. We have systematically reviewed this literature to define their characteristics and enable this distinction. A number of traditional remedies involve burns and it is important to recognise these.

Mimickers of intentional burns

For this question, 30 studies were included where various conditions were initially considered to be caused by abuse.[48,50,66-93] The age ranged from 0 to 15 years. For studies in which there was data, there were a total of 51.5% girls and 48.5% boys (33 children). No study addressed the diagnosis of mimickers of intentional scalds in disabled children.

3.1 Exogenous skin disorders

Drug induced conditions: mimickers of intentional burns

Cetirimide reaction

Two studies described Cetrimide reactions.[81,86] One case was to the perineum and upper thigh[86] and one to the anterior chest,[81] both were aggravated by the area being occluded.

Laxative induced dermatitis

Four cases[82] were described of children who had ingested a commercial laxative which lead to diarrhoea and a sharply demarcated area of erythema with multiple bullous lesions over the buttocks. The lesions extended 5 cm from the anus, sparing skin around anus and perineum in ¾ cases. The lesions continued to extend to precise limits of the nappy. Lesions progressed from blisters to large bullae.

Caustic burn

A single case[50] of partial thickness burn due to laundry detergent on medial aspect of thigh, delayed presentation was reported.

Pressure/friction injuries

Four cases[74] of pressure/friction injuries were mistaken for burns. All children had U-shaped curvilinear marks on the backs of their legs. One case was matched to a swing seat; one to the upper margin of boots; two felt to be pressure injuries. All had remarkably similar descriptions and course to congenital curvilinear palpable hyperpigmentation.

Unintentional electrical burns

A seven-year-old using an enuresis blanket had 5mm papules and ulcers distributed linearly on the dorsal aspect of the right forearm, this was due to a faulty enuresis blanket.[72]

Unintentional contact burns

Seventy four children aged five years and under suffered accidental contact burns to the feet.[91] The cause of the burns was naturally heated surfaces during summer months.

Insect lesions

Three post-mortem cases were described where there were sudden unexplained deaths and what appeared to be multiple superficial skin lesions on exposed skin (arms, face, neck, legs) due to cockroaches eating skin. These lesions were confused with burns in an included case.[71]

Two live cases noted to have unexplained curvilinear marks, brownish-red in hue which were caused by a millipede inside clothing.[70,76] Swelling and tenderness may be present with insect lesions.

Photodermatitis

Sun exposure following chemical contact elicits skin lesions. Cases were found on the buttocks due to rue,[79] face and neck due to perfume,[67,77] a dripping pattern over the cheeks, chin, upper chest, backs of hands and red streaks down front of chest due to lime juice,[69] linear blistering lesions to the shoulders and back due to wild parsnip,[68] shoulders and arms due toa citrus drink being thrown at a child[67] and forearm, shin, face and chin due to plant exposure.[85]

Characteristics included initial redness leading to blistering lesions which follow the pattern of contact with a plant/psoralen. All had sun exposure following chemical contact. All lesions appeared to occur spontaneously. All appeared on the sun-exposed area of skin. There may be delayed presentation in these skin lesions.

Infections

Staphylococcal scalded skin syndrome

One study described two cases with these type of infections.[89] Case One had an 8mm ulceration on the forehead, 15mm x 35mm lesion on the left cheek and a 15mm x 18mm lesion on the abdomen, with new lesions appearing over the next few days. Case Two had bullous lesions to trunk, thorax, genitalia, right upper limb, back and left cheek, with new lesions appearing over following days. Culture was positive for staphylococcus aureus in both cases.

Bullous impetigo

Two cases were described of bullous impetigo, both of which occurred "de novo".[48,88] In one case, lesions occurred in areas of skin that were touching one another.[88]

Toxic shock

A single case was described[87] in which the child was systemically ill for two weeks. There were multiple circular lesions on the back which were thought to be cigarette burns. Erythema occurred in a number of areas. The child died of toxic shock; the diagnosis was confirmed on microbiology.

Tinea Capitis

A single case was described of a ten-year old who had tinea capitis on the back of the scalp.[84]

3.2 Endogenous skin disorders

Eczema

One study noted a sustained non-abusive friction burn in which the patient presented to the burns unit.[78] They were noted to have punctate lesions and linear abrasions over the torso and extremities, it was thought to be cigarette burns and abuse due to a poor social history. However, it was then confirmed as eczema. There were no deep craters, however, there were irregular margins and the patient had sparing of palm and the soles of the feet.

Congenital insensitivity to pain

In one study, the history led to a diagnosis of congenital insensitivity to pain which lead to repeated burns to the hands and mouth.[92]

Congenital curvilinear palpable hyperpigmentation

Congenital curvilinear palpable hyperpigmentation was found to occur spontaneously from one month after birth. It appears as loops with a curved centre in a superior position on the calf.[93] Both cases were palpable and symmetrical to both legs; one case had associated developmental delay.

Vulvar haemangioma

A perineal lesion in a five week old thought to be a burn was later diagnosed as an ulcerated capillary haemangioma.[83]

3.3 Burns without malicious intent

Traditional remedies

The following burns resulted from heat sources or chemicals which resulted from a traditional remedy for illness.[66,73,75,80,90,94] They occur predominantly among South Asian populations, they are also described in Somalian children. The age ranged from 0 to 15 years.

Hot boiled egg

Two cases,[80] both of whom had hit their head unintentionally, received contact burns from a hot boiled egg to the face which was administered as a cure for bruising.

Moxibustion

Two studies described Moxibustion.[73,75] The burn agent was moxa herb, burning yarn or a cigarette. The burns were typically located around the umbilicus/abdomen, back, lower rib cage, dorsum of the wrists, elbows, ankles or temple.

Cupping

Cupping produces circular superficial burns to the back.[66,90]

3.4 Key evidence statements

- Mimickers are often presented by parents who are unable to explain the cause of injury; full and careful history must always be taken
- Careful history of sun and possible psoralen exposure must be sought when a blistering rash occurs de novo
- Consideration must be given to traditional remedies, particularly in South Asian populations
- Skin disorders are characterised by progression of the lesions; swabs for culture and sensitivity are advised
- Congenital curvilinear hyperpigmentation may be mistaken for contact burns to posterior calf in infants.

3.5 Research implications

It is of value to continue to report cases of other conditions, which were mistaken for intentional burns.

3.6 Limitations of review findings

Findings could not be extrapolated to wider populations.

Findings of clinical question 4 How do you identify a burn due to neglect?

To date, only two studies has addressed this question.[2,95]

A retrospective cohort study highlighted the significant differences between intentional and negligent burns. It was found that intentional burns are significantly more likely to present with historical inaccuracies than negligent burns.[2]

Intentional burns are more likely to appear bilaterally than negligent burns, especially immersion burns or symmetrical/circumferential burns. Splash burns are less likely to be associated with negligent or intentional burns. Furthermore, intentional burns are significantly more likely to be on the lower legs and are particularly associated with burns to the feet and immersion lines/circumferential burns.

Concomitant injuries, especially fractures/haematomas are significantly associated with intentional over negligent burns, this is particularly the case if the burns pattern is suspicious. Finally, the study also found that negligent burns are more likely to need less intensive debridement/treatment than intentional burns.

A retrospective study found that children with burns due to neglect were significantly younger than non-intentional burns.[95] Burns were more commonly found on the neck and anterior trunk and were more likely to occur in the home. Inflicted burns more often involve feet and caused by tap water. Non-intentional burns more often include thighs, lower leg, and genitals, be caused by fire, hot oil or fireworks, and be full thickness or bilateral burns. No differences were found by gender.

4.1 Key evidence statements

There are limited studies (n=2) to draw any strong conclusions when attempting to differentiate burns due to neglect from intentional burns.

Intentional burns are more likely in those with historical inaccuracies and affecting the lower limbs in a bilateral distribution. Furthermore, patients with intentional burns are more likely to have concomitant injuries (i.e., fractures, haematomas).

4.2 Research Implications

Further research needed

4.3 Limitations of review findings

Limited studies therefore unclear if can be generalised to the greater population

Other useful resources

The review identified a number of interesting findings that were outside of the inclusion criteria. These are as follows:

Clinical question 1

Intentional and unintentional scalds

- A study examining **perineum** scalds of a non-abusive nature[96,97]

- Children receiving **steam inhalation** sustained scalds to thighs, genitalia or abdomen due to spilling the container[96,97]
- A study defined the **developmental stage** of children and their **ability to climb into a bath**[98]
- A study which highlighted peoples' lack of awareness of home **tap water temperature**[99]
- A classic study defining the time taken to burn skin at different **water temperatures**[100,101]
- Burns due to **neglect** outnumber those due to intentional injury (9.3% neglect vs 0.9% intentional out of 440 children)[102]
- Four studies (two American and two from the United Kingdom (UK)) found some correlation between low **economic status** and incidence of intentional scalds[103-106]
- One American study implied the opposite, although the definition of higher **economic status** was weak[46]
- Admissions to burns units are higher for children living in **deprived areas**(one UK study)[107]
- A UK study showed that Asian/Asian British and African/African British had a higher percentage of burns admissions than the local population[107]
- Children with **ADHD** sustain more burns than those without[108,109]
- **"Shower steamer"** burn to the abdomen of 17 month old child standing above the jet of steam[110]
- Screening tools to aid in the identification of burns and scalds[111,112]

Clinical question 2

Intentional non-scald burns

- Three cases of **sulphuric acid burns** due to methamphetamine manufacture, deemed to be **secondary to neglect**[113,114]
    - Each case suffered extensive burns to the mouth, larynx/pharynx and oesophagus. Two also experienced extensive burns to their neck, chest and abdomen[113,114] and another to their hands[114]
- A three year old child with **pharyngeal caustic burn** of **intentional cause** ,rank 1 for abuse[115]
    - This study highlights the frequency of non-abusive alkaline caustic ingestions, predominantly in children aged less than three years[115]
- An **estimate of the age of burns** by using inflammatory cell markers has been conducted on **adult** post-mortem samples[116]
- Children with **ADHD** sustain more burns than those without[108,109]

- **Hair straighteners** are becoming an increasingly common cause of unintentional contact burns[117-119]
    - A recent Australian series identified 22 children over a 5 year period ranging in age from 9 months to 14 years with a peak age of 43.4 months[118]
- Injuries from hair straighteners are predominantly in children less than four years of age, affecting dorsal and ventral aspects of hands or dorsal and plantar aspects of feet[119]
- Study highlighting prevalence of **sun burn** in areas of low sun exposure (Ireland) where 46% of children aged less than 12 years experienced sunburn, despite 83% of parents using some sun protection for their children[120]
- A survey of over 2000 children aged less than five years seen in the Emergency Department (ED) annually in the US for non-intentional **cigarette burns** or poisonings. The most common location for the burns was on the eyelids or face (87%), and the most common age was less than two years old (82%). One assumption may be that children were far more likely to be brought to the ED for burns in such locations than to limbs[121]
- Older children may self-inflict burns with aerosol cans (**'frosties'**) which are deep dermal burns and may not present until sometime later[122]
- Studies reporting on the incidence, mechanisms and agents of burns presenting to emergency departments[123,124]

Clinical question 3

Traditional remedies

- Three cases of extensive photodermatitis to **both hands** due to **lime juice and sun exposure.**[125] Phytophotodermatitis has also been described following the application of a fig-leave decoction believed to heal developmental retardation (Turkey)[126]
- Some **traditional remedies** are recognised as being used and potentially causing burns to children. These include the use of **garlic, cupping and Vietnamese 'coining'**[127], although no primary studies relating to their use in children have been identified to date
- A case report[94] described a 15-month-old child who received unintentional burns to the feet as a result of raw garlic being placed in her socks overnight as a cure for a fever.

Unintentional burns mimicking abuse

- A burn to the lateral thigh in an eleven month old infant as a consequence of an over-heated plastic **car seat**[128]
- Alkaline caustic burn sustained by a child hugging father who was covered with **cement** dust[13]
- Burn-like injuries following prolonged cutaneous exposure to lemons while playing in the Arizona sunshine. A 7-year-old girl squeezed lemon juice onto her skin while in the sunshine and within 24 hours, experienced pain, erythema, and blistering to multiple areas of her skin[129]

Other mimickers

- Phytophotodermatitis caused by giant hogweed. Consider when reviewing a child with a burn and ask appropriate questions when taking a history[130]
- Bullous impetigo lesion in a 15-month-old female that was initially suspected as an undisclosed thermal injury[131]

Related publications

Publications arising from burns review

Maguire S, Moynihan S, Mann M, Potokar T, Kemp AM. A systematic review of the features that indicate intentional scalds in children. Burns. 2008;34(8):1072-1081

Kemp AM, Maguire S, Lumb RC, Harris SM, Mann MK. Contact, cigarette and flame burns in physical abuse: a systematic review. Child Abuse Review. 2014;23(1):35-47

Primary study arising from Burns review

Davies M, Maguire S, Okolie C, Watkins W, Kemp AM. How much do parents know about first aid for burns? Burns. 2013;39(6):1083-1090.

Other useful related publications

Kemp AM, Jones S, Lawson Z, Maguire SA. Patterns of burns and scalds in children. Archives of Disease in Childhood. 2014;99(4):316-321

Maguire S, Okolie C, Kemp AM. Burns as a consequence of child maltreatment. Paediatrics & Child Health. 2014 August 22 [In Press, Corrected Proof]

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2. Collier Z.J., Ramaiah V., Glick J.C., *et al.* A 6-Year Case-Control Study of the Presentation and Clinical Sequelae for Noninflicted, Negligent, and Inflicted Pediatric Burns. *Journal of Burn Care and Research* 2017; 38(1): e101-e124 https://academic.oup.com/jbcr/article-abstract/38/1/e101/4568920?redirectedFrom=fulltext.

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Appendix 1 – Methodology

We performed an all-language literature search of original articles, their references and conference abstracts, published since 1950. The initial search strategy was developed across OVID Medline databases using keywords and Medical Subject Headings (MeSH headings) and was modified appropriately to search the remaining bibliographic databases. The search sensitivity was augmented by the use of a range of supplementary 'snowballing' techniques including consultation with subject experts and relevant organisations, and hand searching selected websites, non-indexed journals and the references of all full-text articles. The current update was run in 2021.

Prior to the 2021 update, identified articles, once scanned for duplicates and relevancy, were transferred to a purpose-built Microsoft Access database to coordinate the review and collate critical appraisal data. Where applicable, authors were contacted for primary data and additional information. Translations were obtained when necessary. Relevant studies were scanned for eligibility by the lead researcher and those that met our inclusion criteria were reviewed. For the

2021 update studies were managed using Endnote and only data included in English language papers or with an English language abstract were accessed for relevancy. No contact was made with authors in this update.

Standardised data extraction and critical appraisal forms were based on criteria defined by the National Health Service's Centre for Reviews and Dissemination.[132] We also used a selection of systematic review advisory articles to develop our critical appraisal forms.[133-137] Articles were independently reviewed by two reviewers. A third review was undertaken to resolve disagreement between the initial reviewers when determining either the evidence type of the article or whether the study met the inclusion criteria. Decisions related to inclusion and exclusion criteria were guided by Cardiff Child Protection Systematic Reviews, who laid out the basic parameters for selecting the studies. The review programme has now been taken over by RCPCH who have adopted the same degree of rigorous methodology.

The panel of reviewers included paediatricians, designated and named doctors and specialist nurses in child protection. All reviewers have undergone standardised critical appraisal training, based on the CRD critical appraisal standards.[133]

Inclusion criteria

The inclusion criteria used in this update of the review are listed in the tables below.

General criteria

Inclusion	Exclusion
Papers with all evidence types	Personal practice
English and non-English articles	Review articles
Patients between 0-18 years of age	Methodologically flawed articles
Intentional scald burns	Management of burns
Confirmation of an accidental aetiology where rank of accident A or B	
Ranking of abuse 1 – 3	Complications of burns

Additional criteria for specific review questions

Inclusion	Exclusion
General inclusion criteria plus:	**General exclusion criteria plus:**
Intentional non-scald burns	House fires
Rank of accident A, B or C	
Ranking of abuse 1 – 4	
Non-abusive cigarette burns alone	

Ranking of abuse

Distinguishing abuse from non-abuse is central to our review questions. The systematic reviews span more than 40 years and include international publications. Standards for defining abuse have changed markedly over time and across continents. To optimise the ability to apply a consistent quality standard across all publications, we have devised the following ranking score based upon legal and social care child protection decision processes where "1" indicates the highest level of confidence that abuse has taken place. These rankings are used throughout our systematic reviews (where appropriate).

Since its introduction, rank 1 in this classification has been expanded to include 'independently witnessed, and reported by the child'.

Ranking	Criteria used to define abuse
1	Abuse confirmed at case conference or civil or criminal court proceedings or admitted by perpetrator
2	Abuse confirmed by stated criteria including multidisciplinary assessment
3	Abuse defined by stated criteria
4	Abuse stated but no supporting detail given
5	Suspected abuse
Ranking	Criteria used to define non-abuse
A1	Independently witnessed accidental cause or forensic recreation of scene

A2	By confirmation of organic disease (diagnostic test and / or diagnosis from clinical profile)
B1	By multi-disciplinary assessment and child protection clinical investigation
B2	Consistent account of accident by the same individual over time
B3	By checking either the child abuse register or records of previous abuse
C1	Accidental cause / organic diagnosis stated but no detail given
C2	No attempt made to exclude abuse / no detail given

Search strategy

This table presents the search terms used in Medline database search, truncation and wildcard characters were adapted to the different databases where necessary. Changes to the search strategy were adopted only after consultation with the Child Protection Subcommittee.

1. Infant/	46. (Accidental or non-accidental scald:).mp.
2. Child/	47. thermal injur:.mp.
3. Child Preschool/	48. chemical burn:.mp.
4. exp Adolescent/	49. ((intentional or deliberate) adj5 (burn* or scald*)).mp.
5. (child: or infant: or baby or toddler:).mp.	50. scald:.mp.
6. (youth or adolescence: or teen*).mp.	51. splash burn:.mp.
7. or/1-6	52. flash burn:.mp.
8. child abuse.mp.	53. friction burn:.mp.
9. child protection.mp.	54. blast burn:.mp.
10. child maltreatment.mp.	55. blast injur:.mp.
11. (battered child or shaken baby or battered baby).mp.	56. caustic burn.mp.
12. Child neglect*.mp.	57. (child: adj3 burn:).mp.
13. or/8-12	58. (iron adj3 burn).mp.
14. (non-accidental injur: or nonaccidental injur:).mp.	59. (tub: adj3 burn:).mp.
15. (non-accidental trauma or nonaccidental trauma).mp.	60. (bath adj3 burn:).mp.

16. (non-accidental: and injur:).mp. 17. soft tissue injur:.mp. 18. (physical abuse or physical neglect or physical harm).mp. 19. ((inadequa* or neglect*) adj3 supervis*).mp. 20. supervisory neglect.mp. 21. (neglect* or home alone).mp. 22. (risk adj3 harm).mp. 23. (or/14-22) and 7 24. 13 or 23 25. exp Burns/ or burn:.mp. 26. Burns, Chemical/ 27. Immersion.mp. 28. Cigarette burn:.mp. 29. Inflicted burn:.mp. 30. Electric burn:.mp. 31. Spill injur:.mp. 32. Splash injur:.mp. 33. Contact burn:.mp. 34. flame burn:.mp. 35. Patterned injur:.mp. 36. Doughnut pattern.mp. 37. Waterline pattern.mp. 38. Branding injur:.mp. 39. Blister:.mp. 40. Pour Burn:.mp. 41. Dry contact burn:.mp. 42. mirror image burn:.mp.	61. (tap water adj3 burn).mp. 62. (radiant heat adj3 burn:).mp. 63. (radiator adj3 burn:).mp. 64. (pullover adj3 burn).mp. 65. (caustic adj3 burn:).mp. 66. electrical burn.mp. 67. (Microwave* adj3 burn*).mp. 68. (hair straightener or curling tongs).mp. 69. or/25-68 70. (Substance Abuse or drugs).mp. 71. illicit substances.mp. 72. (methamphetamine or crack cocaine or crystal meth).mp. 73. exp Street Drugs/ 74. *"Substance Abuse Detection"/ 75. (or/70-74) and 25 76. accidental burn:.mp. 77. unintentional burn:.mp. 78. unintentional injur:.mp. 79. accidental scald:.mp. 80. unintentional scald:.mp. 81. or/76-80 82. 69 or 75 or 81 83. 24 and 82 84. Patient Care Management/ 85. Review.pt. 86. management.ti. 87. Prevention.ti.

43. stocking burn:.mp. 44. ((rope or glove) adj3 burn:).mp. 45. (Accidental or non-accidental burn:).mp.	88. burnout.tw. 89. or/84-88 90. 83 not 89 91. limit 90 to yr="2016 -Current"

Databases searched

Fifteen databases were searched. In previous iterations of this review four journals which were hand searched and two websites as well. For this update and going forward hand searching will no longer be carried out. A complete list of the resources searched can be found below.

Databases	Time period searched
ASSIA (Applied Social Sciences Index and Abstracts)	1987 – 2016**
CareDate	1970 – 2005*
Child Data	1958 – 2009†
CINAHL (Cumulative Index to Nursing and Allied Health Literature)	1982 – 2016**
Cochrane Library (formerly All EBM Reviews – Cochrane DSR, ACP Journal Club, DARE, and CCTR)	1996 – 2016**
EMBASE	1980 – 2021
MEDLINE	1950 – 2021
MEDLINE In-Process and Other Non-Indexed Citations	2006 – 2021
Open SIGLE (System for Information on Grey Literature in Europe)	1980 – 2005*
Pubmed (searching Epub ahead of print)	2016**
Scopus	1966 – 2021
TRIP PLus	1997 – 2008**
Web of Knowledge — ISI Proceedings	1990 – 2021
Web of Knowledge — ISI Science Citation Index	1981 – 2021
Web of Knowledge — ISI Social Science Citation Index	1981 – 2021

* ceased indexing † institutional access terminated ** due to lack of relevancy stopped searching	
Journals 'hand searched'	**Time period searched**
Child Abuse and Neglect	1977 – 2015
Child Abuse Review	1992 – 2015
Websites searched	**Date accessed**
The Alberta Research Centre for Health Evidence (ARCHE)	March 2015
Child Welfare Information Gateway (formerly National Clearinghouse on Child Abuse and Neglect)	March 2015

Pre-review screening and critical appraisal

Papers found in the databases underwent three rounds of screening before they were included in this update. The first round was a title screen where papers that obviously did not meet the inclusion criteria were excluded. The second was an abstract screen where papers that did not meet the inclusion criteria based on the information provided in the abstract were excluded. In this round the pre-review screening form was completed for each paper. These first two stages were carried out by a systematic reviewer at the RCPCH and a clinical expert. Finally, a full text screen with a critical appraisal was carried out by members of the clinical expert sub-committee. Critical appraisal forms were completed for each of the papers reviewed at this stage. Examples of the pre-review screening and critical appraisal forms used in previous reviews are available on request (evidence@rcpch.ac.uk).