Scientific Research Publishing

Journal of Service Science and Management, 2026, 19(1), 63-80
https://www.scirp.org/journal/jssm
ISSN Online: 1940-9907
ISSN Print: 1940-9893

Food Items as a Contributor to Paediatric Burns: A Scoping Review

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How to cite this paper: Phillips, W., Phillips, K., & Chow, J. S. F. (2026). Food Items as a Contributor to Paediatric Burns: A Scoping Review. *Journal of Service Science and Management, 19,* 63-80.
https://doi.org/10.4236/jssm.2026.191004

Received: December 17, 2025
Accepted: February 21, 2026
Published: February 24, 2026

Abstract

Background: Paediatric burn injuries from contact with flame, wet or dry agents, are a global problem with high hospital admission and mortality rates. Cooking is a known risk factor, but it is not known if some foods pose a greater risk of burns in children. The aim of this scoping review is to examine published literature to identify if specific foods posed a greater risk of paediatric burns. **Methods:** A review of articles was undertaken with the defined inclusion and exclusion criteria of articles published between 2009-2019 and the search was updated to include articles published between 2020-2022. Database were searched for English-language empirical studies conducted in paediatric patients on burn injuries between 2009-2019, followed by a selection process conducted with the project team. Quality appraisal and data extracted were independently assessed by two reviewers, including population characteristics, burn etiology and outcomes. Descriptive statistics were used for burn incidence and t-test for mean difference. **Results:** Sixteen publications from five continents represent 760,056 children with a mean age of 8.8 years. The reported incidence of burns to scalds was conflicting. Hot water, food viscosity and the cooking method are agents of concern. **Conclusion:** There is substantial heterogeneity in how the burn injuries are defined and how the data are measured, likely contributing to considerable variability in reported rates. Standardised measures for reporting burn injuries in paediatric are required to improve comparability.

Keywords

Burn, Classification, Epidemiology, Food, Paediatric, Scald

1. Introduction

Burns, defined as a tissue injury from heat, radiation, radioactivity, electricity, friction, chemicals or smoke are a serious global public health issue responsible for at least 265,000 deaths annually (World Health Organisation, 2018). The global mortality rate does not demonstrate geographical distribution. Burn injuries and mortality rates within high-income countries are declining but mortality remains high within low-income countries with high rural populations (World Health Organisation, 2018; Smolle et al., 2017).

Moreover, as some burns that occur in the home environment may not cause death and may not receive formal treatment, the global incidence of burn injuries is not definitively known. What we do know, is that each year burn injuries result in 450,000 health care attendances in the United States (US) and Canada (American Burns Association, 2019) and 33 million across Europe (Eurosafe, 2020). Hospital admissions for burn-related injuries are not insignificant with 13,000 individuals in the United Kingdom (UK) and 5700 within Australia admitted to hospitals each year (Australian Institute of Health and Welfare, 2016; European Burns Association, 2020). Of those 50% are paediatric patients under the age of 16 years (European Burns Association, 2020). With such high attendance and admission rates, it is unsurprising that in 2010 alone, the US spent $1.5 billion on burns-associated health care costs (Agency for Healthcare Research and Quality, 2013).

As indicated above, age is a leading risk factor for burns, with children under the age of five at most risk (Australian Institute of Health and Welfare, 2016; Alnababtah et al., 2011). Gender as a risk factor is country specific with some South-East Asian and Pacific countries reporting a higher incidence in females due to their participation with cooking (Golshan et al., 2013; Tripathee & Basnet, 2017; World Health Organisation, 2008) whilst the UK, US, Australia, Iraq and Bangladesh, report that male children are more likely to suffer a burn injury (Australian Institute of Health and Welfare, 2016; Alnababtah et al., 2011). Other reported risk factors include low socio-economic background, living in crowded conditions, and where cooking occurs at ground level (Alnababtah et al., 2011; World Health Organisation, 2008; Battaloglu et al., 2020).

2. Background

The agents responsible for paediatric burns are many. Burn injuries can result from hot liquids causing a scald; hot solids, often referred to as a contact burn, or flames (World Health Organisation, 2018). Whilst scalds from hot liquids feature commonly across the world other causative agents are, to some extent, country specific. For example, flame injuries are most common where cooking is conducted on an open fire (Mehta et al., 2020) whilst contact heat burns from barbeques and grills feature in high-income countries (Al Shamsi et al., 2020; Diab et al., 2021). Alongside the cooking mechanism, food items can also be a source of injury from spillage and splashing especially if cooking and sleeping occur within the same area (Bhatta et al., 2021). It is not known if some foods pose a greater

risk of burn injury.

An emerging area of concern in high-income countries is burn injuries from instant microwaveable soups or noodles. Such foods are inexpensive, easy to prepare and often packaged in containers with wider tops compared to the base, affecting stability (Greenhalgh et al., 2006; Palmieri et al., 2008). Furthermore, noodle ingredients contained in some instant soups retain heat and stick to the skin possibly increasing the risk of more serious burns (Shalom et al., 2007). Considering the increasing popularity of instant soups in some Asian countries and the US (Chen et al., 2021), and anecdotal evidence from a public hospital in a culturally diverse region of Sydney, Australia, implying that paediatric burns associated with instant soups and noodles were rising, a scoping review of published literatures was undertaken to identify if specific foods posed a greater risk of paediatric burns.

3. Methods

A scoping review was conducted to provide high-quality robust search method of the literature (Siddaway et al., 2019). The project team had expertise in conducting scoping reviews and were involved in the review process. This paper reports on the methods and findings in accordance with the recommendations for the conduct, reporting, editing, and publication of scholarly work in medical journals. The search question was developed using standard population, intervention, comparator and outcome (PICO) described to enhance research and review questions, with clear inclusion and exclusion criteria (Johnston & Fineout-Overholt, 2005) (**Table 1**).

Table 1. PICO question.

Participants	Paediatric patients (aged 0 - 18 years).
Intervention	Any studies of burn injuries in paediatric patients. All types of study methodologies.
Comparator	Any comparators on clinical management of the burn injuries in paediatric patients.
Outcome	Impact on patient outcomes (hospitalization, mortality, morbidity, other patient reported outcomes).

3.1. Aims

1) To identify categories of burn injuries in paediatric patients.

2) What are the etiological sub-categories for burn injuries in paediatric patients with an emphasis on food or cooking associated items?

3) What patient outcomes are reported for burn injuries in paediatric patients?

3.2. Search Strategy

A systematic search for relevant articles was performed by two independent researchers and a librarian. Databases searched were Cochrane, PubMed, CINAHL, Google Scholar and ProQuest. Medical subject headings and free-text terms of

child* or paediatric/pediatric* and burn*or scald*, and noodles or ramen were combined with the search filter all types of study methodologies. Titles and abstracts were screened by two of three assigned reviewers with studies excluded if they did not meet the inclusion criteria. The full manuscripts of potentially eligible studies were then reviewed by two reviewers for inclusion. Any disagreement was resolved through discussion and by a third reviewer if necessary. Searches were conducted over a ten-year period from January 2009 to December 2019, to assist with identifying any trends in line with the reported popularity of instant foods (Adams et al., 2016).

Inclusion criteria included empirical research related to burns in children aged 0 - 18 years (**Table 1**), although records with a paediatric and adult population were included if paediatric data were able to be extracted. Exclusion Criteria included adult studies, intervention and outcomes that did not relate to burn injuries in paediatric patients. To ensure recency, publications where data were collected prior to 2005 were excluded, as were grey literature or print media, electronic data, theses, or government records where publishing is non-commercial and not the primary activity (Adams et al., 2016; Paez, 2017; Woods et al., 2020).

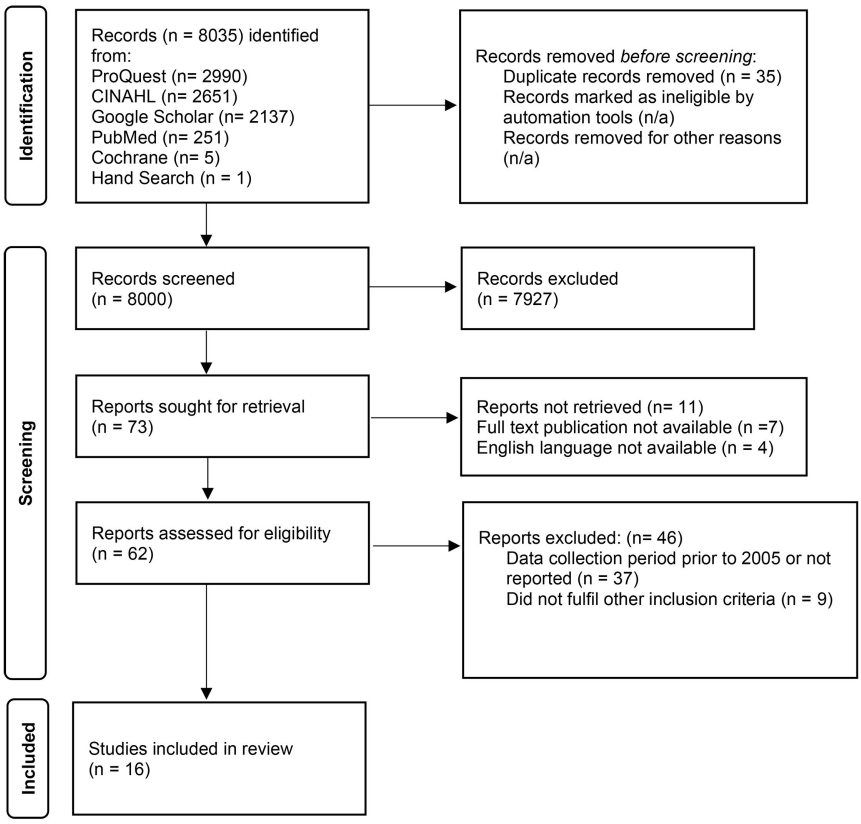

Figure 1. PRISMA flow diagram.

To test the reliability of search terms, a preliminary search was undertaken by a health librarian trained in database and literature searching. The search was repeated by the authors and extended across the five databases. The initial search re-

sulted in 8035 records including one obtained from hand-searching as shown in Figure 1. Following the removal of duplicates (n = 35) and initial screening of titles and abstracts 73 reports were retained for full-text review by both authors. Eleven publications were not available in full-text or the English language, therefore 62 reports were assessed for eligibility and 16 publications retained in this review.

3.3. Data Extraction

A data extraction tool was purposely developed by the project team using Microsoft Excel. A process of data extraction of all included studies was conducted with author, country, methods, intervention, and outcomes incorporated. Data to be extracted were entered into the quality assessment tool and reviewed by two reviewers independently, with each entry cross-checked and inconsistencies discussed until resolved. In the case of multiple publications of a study, these were highlighted and grouped. Authors of the articles were contacted if needed for clarifications regarding additional unpublished data. Extracted data included study and participant characteristics; burn injury incidence, aetiology, and descriptors; and hospital and patient-related outcomes. No assumptions were made about missing data.

Burn injuries were categorised as either a burn or a scald depending on a dry or wet causal agent (World Health Organisation, 2018) and divided into 12 aetiological sub-categories, with an emphasis on food or cooking-associated items. For example: hot liquids, soup or stew, noodles, and fire.

3.4. Quality Appraisal

All the studies included were then reviewed for quality assessment as there were a variety of methods reported. The 43-item Epidemiology Appraisal Instrument (EAI) (Genaidy & LeMasters, 2006; Genaidy et al., 2007) was used to assess the validity and quality of included publications. Each item was scored from 0 - 2 with 0 for not described; 1 for unclear, and 2 if the item was clearly addressed in the publication. Items considered not applicable were not scored. Following the recommendation by Genaidy et al. (Houshyarikhah et al., 2012), the mean score was calculated for each study. Publications with mean scores of 1.4 or greater were described as 'good'; a mean score of at least 1.1 was considered 'average' and studies with a mean score of 1.0 or less 'poor'. The instrument was independently applied to all articles included in the review by the researchers and any differences in scoring or reasoning were discussed until consensus was achieved. The mean score of studies was 1.6 (SD 0.2) therefore all articles were retained in the review (Table 1).

3.5. Analyses

Statistical Database IBM SPSS v27 with alpha set at 0.05 was used for analyses. Descriptive statistics were used to calculate the incidence of burn injury by category and sub-categories, and student's *t*-test (2-tailed) was used to compare the incidence of burns and scalds.

4. Results

4.1. Study Characteristics

Sixteen publications were included in this review (Table 2). The publications described data originating in the US (n = 4), Europe and the UK (n = 4), Middle East (n = 3) Australasia (n = 3) and Africa (n = 2). Most studies (n = 15) aimed to explore the epidemiology, incidence, demographics, and characteristics of children who had sustained a burn or scald. Study designs were primarily retrospective and epidemiological (n = 14) with a focus on burn (n = 12) or scald (n = 4) incidence (Johnston & Fineout-Overholt, 2005; Koltz et al., 2013; Laitakari et al., 2005), demographics (Li et al., 2011; Marashi et al., 2016; Murphy & Amblum, 2014; Paez, 2017; Palmieri et al., 2008), aetiology and risk factors (Laitakari et al., 2005; Li et al., 2011; Marashi et al., 2016; Murphy & Amblum, 2014; Paez, 2017; Peck, 2019; Riedlinger et al., 2015; Rizzo et al., 2019; Samuel et al., 2011), injuries and outcomes (Li et al., 2011; Marashi et al., 2016; Murphy & Amblum, 2014; Palmieri et al., 2008; Riedlinger et al., 2015; Rizzo et al., 2019; Samuel et al., 2011; Shalom et al., 2007; Shields et al., 2015; Siddaway et al., 2019; Smolle et al., 2017). Two studies addressed burns or scalds secondary to cooking (Shields et al., 2015) with one focusing on instant noodles (Siddaway et al., 2019).

Table 2. Study designs and sample characteristics.

Citation & Country	Aim	Design & method	Site & sample (n)	Sample characteristics		Mean EAI
				Male %	Mean age years (SD)	
Abramowicz et al., 2019; US	To examine burn injury outcomes from 2008-2013	*Design*: retrospective. *Method*: descriptive by Diagnosis Related Group	*Site*: 20% of Emergency Departments (ED) nationally *Sample*: paediatric burn patients aged 0 - 18 yrs (n = 746,593 ED visits)	55.8	6.0	1.5
Agbenorku, 2013; Ghana	To identify scald demographics, aetiology & mortality risk factors from 2009-2012	*Design*: retrospective. *Method*: descriptive	*Site*: Reconstructive Surgery & Burns Unit within a large teaching hospital *Sample*: admitted paediatric burn patients aged 0 - 5 yrs (n = 166)	55.4	2.18	1.6
Al-Zacko et al., 2014; Iraq	To identify paediatric burn characteristics & risk factors from 2011-2012	*Design*: cross-sectional *Method*: NR	*Site*: Teaching Hospital Burns Unit, Mosul *Sample*: admitted paediatric burn patients aged 0 - 14 yrs (n = 209)	52.6	4.7 (3.61)	1.9
Bachier et al., 2015; US	To compare cooking associated and non-cooking scald injuries	*Design*: retrospective *Method*: trauma registry and medical record review	*Site*: Paediatric trauma centre, Tennessee *Sample*: admitted paediatric scald patient aged <18 yrs (n = 308).	>51.9	Median 2 - 3 yrs (range 0.14 - 17.5)	1.7

Continued

Battle et al., 2016; UK	To report burn incidence, mechanisms & environmental factors from 2008-2014	*Design*: retrospective *Method*: medical record review	*Site*: regional Emergency Department, South Wales *Sample*: admitted paediatric burn patients aged 0 - 16 yrs (n = 1387)	57.8	Median 2 (Inter quartile range 1 - 8)	1.7
Elrod et al., 2019; Switzerland	To explore country of origin and injury related data of paediatric burn patients between 2006-2018	*Design*: retrospective *Method*: electronic medical record review	*Site*: University Children's Hospital, Zurich *Sample*: admitted and outpatient paediatric & adolescent burn patients (n = 4373)	57.2	3.8 (3.9)	1.7
Houshyarikhah et al., 2012; Iran	To explore the pattern of paediatric burns from 2006-2007	*Design*: retrospective *Method*: medical record review	*Site*: Burns hospital, Khuzestan province *Sample*: admitted paediatric burn patients aged 0 - 12 yrs (n = 211)	59.7	3.2 (Standard Error 0.188)	1.6
Koltz et al., 2013; US	To explore adult & paediatric burn injuries from instant noodles between 2007-2011	*Design*: retrospective *Method*: burn database review	*Site*: University Burns Centre, New York *Sample*: scalds associated with noodles (n = 121/852)	71.1	13.2 (17.1)	1.2
Laitakari et al., 2005; Finland	To explore the aetiology of burn injuries in the paediatric outpatient population from 2005-2009	*Design*: retrospective *Method*: medical Record review by ICD-10 codes‡	*Site*: Children & Adolescent hospital, Helsinki *Sample*: non-admitted children with burns aged 0 - 1 yrs (n = 106)	51.9	57% aged 9 - 12 months	1.2
Laitakari et al., 2012; Finland	To explore burn injuries in the inpatient population from 2005-2009	*Design*: retrospective *Method*: medical record review by ICD-10 codes‡	*Site*: Children & Adolescent hospital, Helsinki *Sample*: admitted children with burns aged 0 - 1 yrs (n = 20)	40	6.4 months	1.3
Li et al., 2011; China	To explore the epidemiology and economic factors of admitted paediatric burns from 2011-2015	*Design*: retrospective *Method*: medical record review	*Site*: large university-military research burn unit, southwest China *Sample*: admitted burn patients aged 0 - 14 yrs (n = 2478)	58	2.9 (2.86)	1.0
Marashi et al., 2016; Iran	To explore the aetiology and severity of hospitalised paediatric burns from 2014-2015	*Design*: retrospective cross-sectional *Method*: medical record review	*Site*: burn referral centre in Fars province *Sample*: admitted paediatric burn patients aged 0 - 15 yrs (n = 122)	54.9	67.5% aged under 4 yrs	2.0
Riedlinger et al., 2015; Australia & New Zealand	To investigate demographics, aetiology & treatment of children hospitalised with scalds from 2009-2011	*Design*: retrospective *Method*: burn registry review	*Site*: inpatient burns units (n = 13) *Sample*: paediatric scald patients aged 0 - 14 yrs (n = 730)	57.4	Median 1 yr (Inter quartile range 0 - 3)	1.0
Samuel et al., 2011; Malawi	To describe the aetiology and outcomes from burn injuries 2008-2009	*Design*: retrospective cross-sectional *Method*: trauma registry & medical record review	*Site*: large Central Hospital in sub-Saharan Africa *Sample*: all patients presenting with burn injury (n = 370)	56.2	10.7 (median 4 yrs)	1.9

Continued

Shields et al., 2015; US	To explore the incidence of paediatric scalds 2009-2012	*Design*: retrospective *Method*: National Electronic Injury Surveillance System review	*Site*: Emergency Departments in US (n = NR§) *Sample*: paediatric scald patients aged 0 - 3 yrs (n = 2104)	57.7	54% aged 12 - 24 months	1.3
Stockton et al., 2015; Australia	To describe burns by aetiology, severity, and surgical outcomes for 2013	*Design*: prospective cohort *Method*: pro-forma completed at hospital presentation	*Site*: paediatric burn centre, Queensland *Sample*: admitted and non-admitted paediatric burn patients aged 0 - 16 yrs (n = 758)	60	Median 2.3 yrs	1.6

EAI: Epidemiological Appraisal Instrument.

Most studies (n = 8, 50%) included children aged 0 to 18 years, four studies focused on children to 5 years (Laitakari et al., 2005; Li et al., 2011; Marashi et al., 2016; Paez, 2017; Shields et al., 2015) and one study included children to 12 years (Johnston & Fineout-Overholt, 2005). The calculated mean age was 8.8 years (n = 10, SD 4.16; median 3.05). A slightly higher incidence (56%) of burns was reported in male children (n = 14) although one small study reported a higher ratio of females in children aged under one year (Shields et al., 2015).

Data were collected over 3.6 years on average (SD 2.88, range 1 - 12), had a mean sample size of 47,504 (median 339) and focused on hospital emergency presentations (n = 11) or hospital admissions (n = 14) (**Table 2**). Admission rates ranged from 2.9% (Finland) (Shields et al., 2015); 4.3% - 14.6% (US) (Li et al., 2011; Rizzo et al., 2019); 12.7% (Australia) (Al Shamsi et al., 2020; Riedlinger et al., 2015); 26.8% (Switzerland) (Murphy & Amblum, 2014), to 86.1% (Iran) (Palmieri et al., 2008). Two studies addressed paediatric burn injuries treated in the outpatient setting (Paez, 2017; Riedlinger et al, 2015).

4.2. Reporting Hospital Admission

Hospital admission rates implied that many burn injuries are severe (10 studies with an aggregate sample population of 759,996, 10 of the 15 articles described admission numbers with a total admitted population of 36,881). The severity of burn injuries in terms of size and depth was variously assessed as a percentage of total body surface area (TBSA) (n = 10) in 4 studies (Johnston & Fineout-Overholt, 2005; Laitakari et al, 2012; Peck, 2019; Shalom et al., 2007); mean TBSA (n = 8); by the Lund and Browder chart (Palmieri, 2008) and by mean centimetres (Johnston & Fineout-Overholt, 2005). Burn injury depth was described by degrees (Johnston & Fineout-Overholt, 2005; Peck, 2019; Samuel et al., 2011) or by descriptors such as "deeper than superficial" (Riedlinger et al., 2015), "deep partial thickness" (Laitakari et al., 2005), "mid depth" (Laitakari et al., 2012) and "full thickness" (Siddaway et al., 2019).

4.3. Agents' Response to Paediatric Burns

Numerous categories were reported in 11 studies and used to describe agents responsible for paediatric burns (n = 43) in line with research aims and designs. The most common being scald (n = 11), flame (n = 6) and contact burns (n = 4). The incidence of burns to scalds is conflicting. Most studies (n = 10) reported a higher prevalence of scalds, three studies reported a higher prevalence of burns (Koltz et al., 2013; Riedlinger et al., 2015; Rizzo et al., 2019) and yet the overall incidence of injuries from wet agents were fewer (n = 244,127) than that arising from dry agents (n = 368,112) (95% CI −15,941.6, 46,457.3 and −32559.7, 89192.2 respectively). No correlation was found between burn and scald incidence and high or low-income countries.

Multiple agents (n = 64) were identified as the cause of paediatric burns with hot water calculated to be implicated in 71.5% (n = 55,410) of scald injuries. Hot water was identified as a sole entity (n = 11); probable constituent of hot liquid, beverages and/or steam (Laitakari et al., 2012; Palmieri et al., 2008; Samuel et al., 2011) in cooking and boiled food (Johnston & Fineout-Overholt, 2005; Murphy & Amblum, 2014; Samuel et al., 2011) bathing and hair braiding (Samuel et al., 2011).

Food-related burn injuries were categorised as cooking or non-cooking (Li et al., 2011), by the cooking apparatus e.g. oven door, barbeque or fireplace (Murphy & Amblum, 2014; Paez, 2017), microwave or stove top (Shalom et al., 2007) or an associated action such as grabbing, pulling, touching or spilling food items (Li et al., 2011; Paez, 2017; Samuel et al., 2011; Shields et al., 2015).

Table 3. Burn and scald reported aetiologies and outcomes.

Citation	Location where injury occurred	Aetiologies by categories & agent(s) (top three)			Injury surface area & depth (SD/IQR)
		n %	n %	n %	
Abramowicz et al., 2019	NR	*Category*: Heat *Agent*: Electrical appliance, hot objects, light bulbs & steam pipes (37%)	*Category*: Accidents *Agent*: Hot liquids & vapour including steam (25%)	*Category*: Hot boiling tap water (7%)	NR
Agbenorku, 2013	Kitchen 85%	*Category*: Hot water (n = 96, 68%)	*Category*: Soup (n = 22, 16%)	*Category*: Hot oil (n = 13, 9%)	*Burn size*: mean TBSA 19.7%
Al-Zacko et al., 2014	Rural area (51%) Residences (n = 197, 94%) primarily the kitchen (65%)	*Category*: Scald (n = 166, 79%) *Agents*: Hot water from pots (n = 92, 44%) Tea (n = 38, 18%) Soup (n = 9, 4%)	*Category*: Flame (n = 42, 20%) *Agent*: NR	*Category*: Electrical (n = 1, 0.5%) *Agent*: NR	*Burn size*: mean TBSA 19.7% (SD 17.15)
Bachier et al., 2015	NR	*Category*: Cooking scald burns (n = 262, 85%) *Agents*: Liquid (n = 111) Semisolid (n = 106) Grease (n = 45)	*Category*: Non-cooking scald burns (n = 46, 15%) *Agents*: Hot water associated with bathing and hair braiding		*Burn size*: median TBSA 5% - 6% (range 0.1 - 70) *Burn depth*: 3˚ median 0.0% (range 0 - 15)

Continued

Battle et al., 2016	Residence (n = 1192, 86%)	*Category*: Scalds (n = 569, 41%) *Agents*: Hot beverage (n = 334, 59%) Domestic water (n = 168, 29%) Food item (n = 67, 12%)	*Category*: Contact (n = 563, 41%) *Agents*: Portable household agent (n = 254, 45%) Fixed household agent (n = 241, 43%) Outdoor agent (n = 61, 11%)	*Category*: Chemicals (n = 43, 3%) *Agents*: Spill (n = 47, 37%) Ingestion (n = 25, 19%) Eye splash (n = 56, 44%)	*Burn size*: median TBSA 1% (IQR 1 - 2) (n = 876)
Elrod et al., 2019	Kitchen-related items (NR)	*Category*: Scald (n = 2381, 55%) *Agents*: Tea (n = 652, 17%) Coffee (n = 284, 8%) Hot water (n = 259, 7%)	*Category*: Burns (n = 1965, 45% *Agents*: Stove/oven (n = 673, 18%) Fire pit/chimney (n = 314, 8%) Candle (n = 64, 2%)	*Category*: Electrical accidents (n = 23, 0.5%) *Agent*: NR	*Burn size*: mean TBSA 3.5% (SD 5.53) (n = 4296)
Houshyarikhah et al., 2012	NR	*Category*: Scald (n = 183, 87%) *Agent*: Hot water & boiled food (n = 183, 87%)	*Category*: Flame (n = 28, 13%) *Agent*: 'mostly' kerosene (NR)		*Burn size*: mean body surface area 20.5 cm (SD 10.26, range 0% - 70%) *Burn depth*: 3˚ 82%; 2˚ 18%
Koltz et al., 2013	NR	*Category*: Scald burn *Agent*: the preparation or consumption of instant noodles (n = 121, 14%)	*Category*: Cooking method (n = 40, 38%)		*Burn size & depth*: TBSA 1.9% partial thickness; TBSA 0.5% full thickness
Laitakari et al., 2005	Residence (n = 80, 86%)	*Category*: Scalds (n = 65, 61%) *Agents*: Coffee/tea cup (n = 36, 34%) Hot water/coffee (n = 13, 12%) Food (n = 13, 12%)	*Category*: Contact burns (n = 40, 38%) *Agents*: Stove/oven door (n = 16, 15%) Fireplace door (n = 11, 10%) Radiator (n = 5, 5%)		*Burn size*: mean TBSA 1.8% (range 0.5 - 7.0)
Laitakari et al., 2012	Residence (n = 15, 75%)	*Category*: Hot cup scalds (n = 7) *Agents*: Tea (n = 5) Hot water (n = 1) Coffee (n = 1)	*Category*: Spilled pot scalds (n = 5) *Agent*: Hot water (n = 5)	*Category*: Contact burns (n = 3) *Agents*: Radiator, oven door & 'warming package' (n = 1 respectively)	*Burn size*: mean TBSA 8.5%
Li et al., 2011	NR	*Category*: Scalds (n = 1959, 80%) *Agent*: NR	*Category*: Flame (n = 347, 14%) *Agent*: NR	*Category*: Electrical, (n = 83, 3%) *Agent*: Low-voltage (<1000 volts) (n = 58, 70%) High-voltage (n = 25, 30%)	*Burn size*: mean TBSA 11.6% (SD 11.61, median 8%) *Burn depth*: deep partial thickness 69%; full thickness 24%
Marashi et al., 2016	Prevalence 1.4% higher in rural regions than urban	*Category*: Scalding (n = 69, 57%) *Agent*: Hot liquids (n = 69, 100%)	*Category*: Explosion (n = 26, 21%) *Agents*: Gas leak (n = 22) Fire-crackers (n = 4)	*Category*: Flame (n = 10, 8%) *Agent*: NR	*Burn size*: mean burn surface area (Lund & Browder chart) 12% (SD 21.18, range 3 - 60)

Continued

Riedlinger et al., 2015	Residences: (n = 663, 91%) primarily the kitchen (n = 429, 65%)	*Category*: Scalding (56%) *Agents*: Hot beverages (n = 262, 36%) Water from saucepan, kettle or jug (n = 195, 27%) Food (n = 113, 16%)	*Category*: Other specified causes (n = 43, 6%) *Agent*: NR	*Category*: Fat/oil (n = 34, 5%) *Agent*: Water from basin, sink or bucket (n = 30, 4%)	*Burn size*: TBSA <10% (n = 627, 81%), =>10% (n = 103, 13%) *Burn depth*: mid depth (n = 163, 37%); deep (n = 155, 35%); superficial (n = 126, 28%)
Samuel et al., 2011	NR	*Category*: Scald (n = 190, 51%) *Agents*: Water (n = 106, 29%) Steam (n = 47, 13%) Porridge (n = 29, 8%)	*Category*: Unknown (n = 89, 24%)	*Category*: Flames (n = 80, 22%) *Agents*: Fire (n = 71, 19%) Petrol/diesel, paraffin lamp (n = 3, 0.8% respectively)	*Burn size & depth*: TBSA < 10% (n = 22, 63%), 10% - 19% (n = 20, 39%), 20% - 29% (n = 4, 8%) TBSA 14% for 2˚ & 3˚ burns (median 10%, range 1% - 76%)
Shields et al., 2015	Residences: (n = 1646, 98%)	*Category*: Grabbing or pulling item (n = 954, 45%)	*Category*: Cooking (n = 365, 17%)	*Category*: Bathing (n = 245, 12%)	NR
Stockton et al., 2015	Residences (82%) primarily the kitchen (90%)	*Category*: Scald injuries (n = 321, 44%) *Agents*: Hot beverages (18%) Food, including instant noodles (11%) Water from saucepans & kettles (7%)	*Category*: Contact injuries (n = 305, 42%) *Agents*: Hot-plate; Coals/ash; Vehicle exhaust	*Category*: Friction (n = 38, 5%) *Agents*: Treadmill injuries; Vehicles or motorbike	*Burn depth*: Deep partial dermal or full-thickness inpatients 67%, outpatients 27%; Deeper than superficial 32%

NR: not reported; SD: Standard Deviation; IQR: Inter-quartile range.

Identified food items were fats, oils or grease (Marashi et al., 2016; Mehta et al., 2020; Peck, 2019; Samuel et al., 2011), soup and stew (Marashi et al., 2016; Mehta et al., 2020; Murphy & Amblum, 2014), porridge (Murphy & Amblum, 2014; Peck, 2019), rice (Murphy & Amblum, 2014) and noodles (Riedlinger et al., 2015; Samuel et al., 2011; Shalom et al., 2007). Foods were also grouped together such as noodles and broth (Samuel et al., 2011), or were not identified, limiting comparisons. Koltz et al. reported that the cooking method for noodles is a risk, with microwave cooking posing a higher risk for older children whereas younger children were at risk irrespective of whether the microwave or stove top were used (Shalom et al., 2007) (**Table 3**).

Most burns occurred in the kitchen (79.7%) but could also occur at outside recreational venues with the latter associated with barbeques, fire pits and fireworks (Murphy & Amblum, 2014; Palmieri et al., 2008). No specific foods were identified for burns associated with outside venues.

5. Discussion

Despite the critical importance of burn injuries in paediatric patients, our study

demonstrates it remains inconsistently defined and reported in randomized controlled trials (RCTs). There was substantial variability in the reported outcomes, including in its definition, level of burns, the terminology used by researchers and clinicians, the populations to which it is applied, the agents responsible for the burns, reasons given for the event and the exact measures used.

To clearly identify the cause agents responsible for the burns is a complex event with numerous potential caused, which can co-exist, and the relative contribution of these varies with cultures and possibly regions. This scoping review sought to determine which, if any, food-related items were associated with paediatric burns, with foods containing noodles one area of interest. No food was isolated, but foods of risk included oil, porridge, and rice products. Foods can be described differently between cultures and possibly regions, making comparisons difficult (Brien, 2021). For example, in some countries, porridge is known as a breakfast meal made with oats whereas in Asian households "conjee" or "congee", a meat and vegetable soup made with boiling water is sometimes referred to as porridge (Brien, 2021; Chiu & Burd, 2010). Instant noodles were identified in a minority of studies, mostly as an ingredient of rice dishes and soups, implying that the risk of injury is likely to be related to the viscosity of foods once cooked. An important consideration for burn risk and injury prevention is therefore the employed cooking process with its' secondary effect on mass and liquidity.

With multiple descriptors and modes of categorisation for water, it is unclear whether water as a beverage, in cooking, or associated with an activity is of greater risk. Consistent with former studies (World Health Organisation, 2018; Peck, 2019) this study found that most injuries occurred in a home environment, particularly the kitchen, thereby lending support to the theory that liquids, foods and the cooking mechanism are the major risk factors for paediatric burns.

Considering the lack of a standardised model for categorising burns, and that cultural differences limited comparisons, one suggestion is to follow the lead of Koltz et al. (Koltz et al., 2013) who described the cooking apparatus i.e., stove top or microwave oven. Expanding on this method, food items could be categorised by cooking mechanisms, for example steaming, boiling, roasting; that if clearly defined would be recognised globally, enabling more meaningful comparisons to be made. The need for accurate data is paramount and would enable health practitioners in community, inpatient and outpatient settings to target education around food and cooking risk factors.

The finding that dry-agent burns appeared more prevalent than scalds contradicts well-established paediatric burn epidemiology, which consistently identifies scalds as the dominant mechanism of injury. Rather than attributing this discrepancy solely to classification differences between studies and our binomial coding approach (wet vs dry agents), it is possible that the aggregate pattern was disproportionately influenced by a small number of larger studies with unique or atypical inclusion criteria. For example, studies that included sunburns, friction burns or other high-volume dry-agent mechanisms may have contributed heavily to the

overall totals, thereby shifting the distribution away from the expected predominance of scald injuries. Small sample sizes and missing data in other studies may have further amplified this skew by limiting the balance of contributions across datasets. These factors together suggest that the observed anomaly is likely methodological rather than reflective of a true epidemiological trend, and further research with standardised burn-type definitions is warranted.

Contrary to that formerly reported (World Health Organisation, 2018) burn injuries were slightly more prevalent in males than females. Two thirds of studies were undertaken in high-income countries and focused on children admitted to hospital, possibly indicating that boys' injuries are more extensive. This would help to explain the higher mortality rate in boys following a burn injury (World Health Organisation, 2018). Having a standardised classification system for burn injuries would help to clarify some of these complex factors and importantly, inform targeted prevention programs.

With no universally accepted method to describe burn injuries (World Health Organisation, 2020) and with multiple methods available (Murphy & Amblum, 2014; Rizzo et al., 2019) studies described the burnt area (injury) in various ways, limiting comparability. Such diversity is problematic as total body surface estimations are unreliable with extensive burns (Brekke et al., 2022) and in paediatric populations (Holm et al., 2021); whilst some descriptors for burn depth appear to be subjective. Considering that the size and depth of a burn can provide predictive clues about potential tissue damage, the need for hospital admission, risk of disability and/or mortality, an accurate measure is paramount for future research and policy considerations.

Strengths and Limitations

The extensive search for empirical data was a strength of this study despite the low representation of articles for some countries. Grey literature was excluded meaning that some published data may not have been captured. It is recognised that findings related to burn incidence have likely been affected by studies with small sample sizes or missing data and therefore should be interpreted with caution. However, the global approach has ensured a comprehensive review that has demonstrated the need for definitional consistency with the coding and description of burns and burn injuries, to enhance research rigor and for health promotion purposes.

6. Conclusion

The agents implicated in paediatric burns are many. Hot water with its' many uses is a major risk factor for scalds, but the multiple categorisation methods in use mean that definitive prevalence is unknown. Early implications are that the cooking method and resultant change in foods in terms of viscosity, liquidity and temperature are key risk factors for burn injuries in children.

Descriptors in place for burn injuries are inconsistent, subjective and unrelia-

ble. To help with the identification, assessment, treatment, and prevention of burns, and enhance research rigor, there is urgent need for a universally recognised burn categorisation system.

6.1. What Is Currently Known

- Considering the increasing popularity of instant soups in some Asian countries and the US (European Burns Association, 2020), and anecdotal evidence from a public hospital in a culturally diverse region of Sydney, Australia, implying that paediatric burns associated with instant soups and noodles were rising, a scoping review of published literatures was undertaken to identify if specific foods posed a greater risk of paediatric burns.

6.2. What Does This Article Add?

- In order to enhance research rigor, there is an urgent need for a universally recognised burn categorisation system.
- Early implications are that the cooking method and resultant change in foods in terms of viscosity, liquidity and temperature are key risk factors for burn injuries in children.
- These research findings can be valuable for health professionals who want to improve the paediatric burns associated with food and cooking methods.

Patient or Public Contribution

No patient or public involvement.

Reporting Method

To describe the review of articles, we referred to the PRISMA-ScR-Fillable-Checklist.

Data Availability Statement

Data are available upon reasonable request.

Author Note

The development of the final manuscript has been after the first author Wayne Phillips' passed away following a short illness. Wayne devoted his specialist paediatric nursing career to improving the quality of care for children, in particular among those following a burn injury.

Trial Registration

This was a review of articles and was therefore not a trial and did not require trial registration. The study did not require Human Research Ethics Application (HREA) review and approval.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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