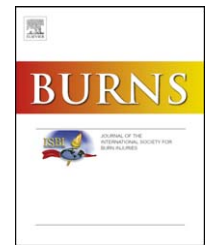


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Review

Burn prevention programs for children in developing countries require urgent attention: A targeted literature review

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ABSTRACT

Background: Paediatric burns are a significant international public health problem. Developing and developed countries report similar challenges regarding paediatric burn prevention programs. Paediatric burns requiring healthcare often incur significant health and opportunity costs, death or long-term disability. This paper reviews international burn prevention strategies, and considers implementation of effective prevention strategies in South Africa. **Review question:** Are there differences between developed and developing countries regarding causes and prevalence of paediatric burns, prevention strategies, and evidence of effectiveness?

Review framework: Implementing effective burn prevention strategies in South Africa.

Method: This systematic literature review identified, and narratively synthesized information from studies reporting population-based initiatives to prevent paediatric burns. Strategies from developing and developed countries were compared. Common strategies were identified, and evidence of effectiveness described.

Findings: 30 studies were included from 16 developed/developing countries, reporting similar prevention strategies. Multi-pronged community-based interventions were most effective. Common elements comprised raising awareness of how burns occur, how burns can be prevented, the speed of sustaining significant injuries, and the short- and long-term effects of burns. Burn prevention strategies relevant to South Africa were provision of education in different formats (written, pictorial and verbal) in places frequented by children and parents, monitoring children more closely in hazardous areas (e.g. kitchens), and better planning of homes to reduce hazards.

Conclusion: More work is required to establish effective, sustainable community-wide prevention programs in developed and developing countries. Effective paediatric burn prevention programs for South Africa should acknowledge parent and child literacy, how and where information is best accessed, the need to adapt effective hazard reduction programs to informal settlements, and the importance of legislated minimum safe housing standards. This requires significant commitment from Government, communities and individuals.

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1. Introduction

Injury prevention for children is a worldwide concern, and a public health priority in many countries [1]. 'Unlike an accident, a childhood injury is an understandable, predictable, and preventable occurrence' [2]. It requires overt attention at individual, family, community and health policy/legislative levels to minimise risks and occurrences of childhood injury [1]. Childhood injury prevention can be considered in terms of its epidemiology, biomechanics and behavioural science. Haddon [3] described the epidemiology of childhood injury prevention in terms of a matrix of phases of event-related modifiable risk factors, and the host, cause and environment. Biomechanics refers to the factors causing injury, and behavioural science relates to the environment in which the child is injured [1]. The management of risks of injury is commonly considered in hazard hierarchies of control [4–6]. A common hazard reduction model is outlined by the Australian Workers Union, from the lowest level of control (eliminating the hazard), through substitution, engineering or isolating

controls, administrative controls, to the highest level of control (Personal Protective Equipment). The least expensive approach is to eliminate the hazard [7].

1.1. Epidemiology

Throughout the world, paediatric burns continue to pose a significant public health challenge, in terms of morbidity and long-term disability. The full psychosocial and economic long-term costs of sustaining a paediatric burn are potentially huge, and difficult to quantify [8]. Examples of worldwide research into burn epidemiology over the past 15 years are provided from Sub-Saharan Africa [9], China [10], India [11], Taiwan [12], France [13], Japan [14], Hong Kong [15] and Iceland [16]. Despite this sustained level of interest, a recent international review of paediatric burn epidemiology, Burd and Yuen [17], highlighted the need for standardised injury definitions and data collection strategies to support a common platform for international reporting. This review found that the health and social burden of paediatric burns was particularly felt in developing countries such as Africa

(which accounted for the highest prevalence of hospitalised paediatric burns), and Asia (from which over half the reports of severe burns arose) [17].

1.2. Differences in approach between developed and developing countries

It has long been recognised in the public health literature that paediatric burns are preventable, irrespective of the country/culture in which they occur [18]. There is therefore little debate that the best approach for reducing paediatric burns is prevention [8]. There is also overwhelming evidence that childhood burns are largely related to the physical environment in which they occur [8]. There are many factors which mitigate against successful burn prevention in developing countries including lower environmental health and safety regulation, lower levels of caregiver knowledge about burn prevention, and poorer access to power and water utilities. These socio-economic factors are rarely a focus of Western medical philosophies, used to underpin the approach to burn prevention in developed countries. Finally opportunities to evaluate prevention programs across developed and developing countries are compromised by inconsistent methodology.

There has been a recent international call for the development of a common approach to prevent paediatric burns across developed and developing countries, in order to address the current lack of uniform public health strategies to reduce burn incidence, burn mortality, and events of hospitalisation for burns [8]. Congruently there is a call to develop a uniform framework to evaluate the effectiveness of burn prevention intervention strategies, irrespective of the country in which the intervention is applied [17,8].

This paper considers reports of paediatric burn prevention programs, and how they could be standardised across developing and developed countries, in terms of causes of burns, prevention strategies and evaluation approaches. The paper also considers the relevance of these findings to developing countries, by considering the findings within a South African context.

2. Methods

2.1. Study approach

A comprehensive electronic library database search was undertaken, using keywords relating to the search aims. Data was extracted regarding the commonalities and differences in reported burn prevalence, common causes of paediatric burns, and the components of paediatric burn prevention programs, for developed and developing countries using the hazard hierarchy of control. How the burn prevention programs were evaluated was considered, and evidence of effectiveness was sought. Our review framework was to interpret the findings into the South African context (a developing country) using the hazard hierarchy of control.

2.2. Primary review question

Are there differences between developed and developing countries in terms of causes and prevalence of paediatric burns, burn prevention strategies, their evaluations and effectiveness?

2.3. Secondary review questions

1. Do paediatric burn prevention strategies fit the hierarchy of hazard control?
2. Do paediatric burn prevention strategies have the potential to be standardised across developed and developing countries?
3. Can recommendations be developed for paediatric burn prevention relevant to South African contexts?

2.4. Key search terms

The key search terms were 'paediatric burns', 'children with burn injuries', 'prevention', 'programs' and 'strategies'. Appropriate operators, terminology and truncations were used for each specific database.

2.5. Database sources

The database sources were Cochrane library, Medline, Cinhal, Web of Knowledge, PubMed, Proquest, Journals at Ovid, and Scencedirect.

2.6. Exclusion criteria

Articles were excluded if not in English, or if not available in full text. No date exclusions, or restrictions on research designs were applied.

2.7. Inclusion criteria

Literature was included from any country, on any child aged up to 15 years. It could describe any strategy to reduce paediatric burns.

2.8. Critical appraisal

We did not critically appraise the methodological quality of the included literature, as our primary purpose was to collate and compare information on prevalence and causes, with respect to international paediatric burn prevention strategies.

2.9. Data extraction

Data was extracted from each study based on country, burn prevalence and demography, intervention/prevention strategies, target audience, application of the prevention strategy, how it was evaluated, and evidence of effectiveness. Countries were divided into developed (predominantly European, North American, British/Australia/New Zealand) and developing (Africa, Asia, India, Pacific region, South American [19]).

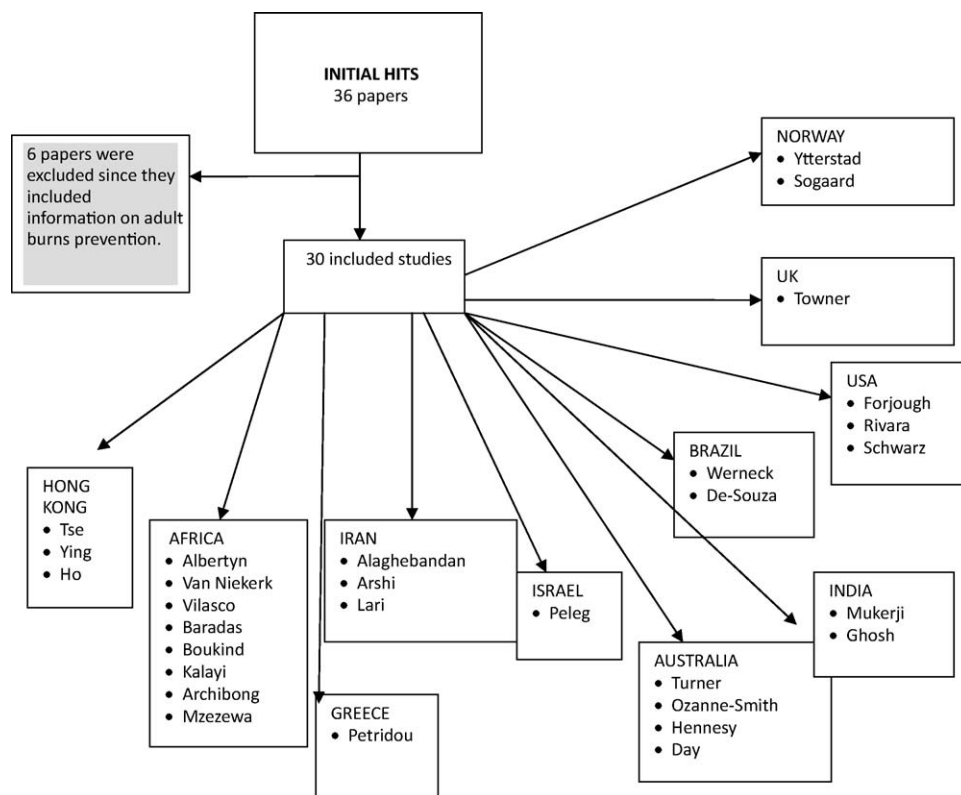


Fig. 1 – Consort diagram of studies included in this review.

2.10. Data analysis

Descriptive data analysis was used to collate key information. Where possible, quantitative analysis of homogenous study measures was attempted to summarise the findings.

3. Results and discussion

3.1. Study sample

36 papers were identified as potentially relevant to this review. Four papers were excluded as they reported on adults with burns. Two further papers were excluded as they did not separate adults and children. The retained papers all examined incidence/prevalence of paediatric burn injuries in specific countries. A consort diagram (Fig. 1) describes the study inclusion process.

Table 1 describes the research designs identified in the review, and the intent of each study. A range of research designs was reported, however, despite differences in countries, economic status and cultures, burn prevention investigations appeared to be similar.

3.2. Prevalence and causes

There was considerable variability in the way that prevalence/incidence of paediatric burns was described in the included articles, constraining opportunities to compare information. This related to the place of data capture

(hospital, home, community clinics, or survey) as well as the sampling frames and generalisability of the findings. Table 2 provides a summary of prevalence/incidence and causes of burns, as well as causes of paediatric burns and demography of affected children. These elements are explored below.

3.2.1. Causes of burn

The most common cause of paediatric burns, independent of country and socio-economic status, was contact with hot liquids, resulting in scalds. Flames were the second most common cause of burns. However, the environmental circumstances of scalding differed between developed and developing countries. In developed countries, with formal housing and electricity supplies, scalds were mostly caused by the child pulling at kettle cords. In developing countries, where overcrowded informal housing settlements and lack of access to utilities predominates, scalding occurred when a pot or vessel of boiling liquid on a fire, or gas stove at ground level, was knocked over.

3.2.2. Demography of injured children

The age range most commonly affected, independent of country and status, was from birth to four years of age. Despite inconsistencies in reporting, children from developing countries were more frequently burnt, than children in developed countries. Children below the age of two years were most at-risk. Males were burnt twice as often as girls of the same age.

Table 1 – Summary of studies, country and type of study design.

Country	Author	Study design	What was undertaken
Hong Kong	Tse et al. [8]	Epidemiological study	Risk factor identification to develop prevention strategies
	Ying and Ho [20]	Epidemiological study	Incidence and patterns of childhood burn injuries
	Ho [15]	Retrospective study	Description of outcomes of severely burned patients
Africa	Albertyn et al. [9]	Epidemiological study in Sub-Saharan Africa	A review of current information regarding burn care, infrastructure, and traditional methods of treatment. A prevention strategy was formulated
	Van Niekerk et al. [21]	Epidemiological study	Incidence and patterns of childhood burn injuries and identified risks
	Vilasco and Bondurand [22]	Retrospective study to determine epidemiological information	Risk factor and intervention practices to prevent burns
	Baradas [23]	Retrospective study	Hospital statistics to plan prevention strategies in developing countries
Africa	Boukind et al. [24]	Epidemiological study of childhood burn injuries in Morocco	Determine preventative measures in Morocco
	Kalayi [25]	Epidemiological study	Risk factor identification to develop prevention strategies
	Archibong et al. [26] Mzezewa et al. [27]	Epidemiological study Prospective study	Risk factor identification Risk factor identification amongst children in Harare
Iran	Alaghebandan et al. [28]	Retrospective epidemiological study	Reflective study to develop preventative programs in Iran
	Arshi et al. [29]	Prevention orientated longitudinal prospective epidemiological study of accidental burns in rural Iran	Recommendations based on epidemiological findings
	Lari et al. [30]	Epidemiological study	Developed preventative programs in Iran
Israel	Peleg et al. [31]	A prospective survey	Survey of organizations participating in injury prevention programs
Australia	Turner et al. [32]	A review	Reviewed four articles to assess whether community-based programs evaluated injury outcomes
	Ozzanne-Smith et al. [33]	Evaluation report	Injury prevention strategies
India	Mukerji [11]	Epidemiological study	Risk factor identification to establish prevention strategies
	Ghosh and Bharat [34]	Retrospective survey	A survey to establish risk factors and propose effective primary prevention strategies
USA	Forjough [35]	A literature review	Review of descriptive epidemiology, risk factors, treatment and prevention
	Schwarz et al. [36]	Controlled trial of census tracts	Community workers were involved in home inspections and educational programs
	Rivara [37]	A literature review	Experimental studies testing intervention programs
UK	Towner et al. [4]	Systematic review	10 intervention programs
Brazil	Werneck [38]	Case control study	Risk factors to develop strategies for burn prevention
	De-Souza et al. [39]	Retrospective analysis, epidemiological data of hospitalised patients	Specific risk factors to determine the specific preventative educational campaigns directed at specific groups and specific genders
Greece	Petridou et al. [40]	Epidemiological study	Identify risk factors amongst children
Norway	Ytterstad and Sogaard [41]	Epidemiological study	The implementation of active and passive strategies and then relooking at the burn injury data

3.2.3. Location of burns

The majority of paediatric burns occurred in, or near, the home, in both developed and developing countries. Burns occurring in the kitchen, living room and bathroom were commonly reported.

3.3. Prevention strategies

Table 3 reports on 28 prevention strategies identified in the included papers, in terms of types of interventions (home and

environmental safety, education of children and parents/caregivers, legislation and administrative interventions). Interventions regarding home safety, caregiver education, and general environmental safety were the most common, whilst general community, policy development and education of children attracted little attention. Eleven papers examined home safety, with most studies examining safety in the kitchen and bathroom. All studies described specific changes which could be made in the kitchen, such as raising cooking surfaces [25,49], and installing cooker guards [41]. All studies reporting on

Country	Incidence	Ages mainly affected	Cause of burn	Sex mainly affected	Environment of burn
Brazil, India, Cote d'Ivoire	Not reported in the studies examined	Infants and toddlers from birth to four years accounted for half of all childhood burns	Scalding from hot liquids accounted for 33–50% of all burns, followed by hot objects and flame. Electrical or chemical burns were rare in low and middle income countries	Not reported in the studies examined	Reported to mainly occur in the home, most commonly the kitchen and then the backyard
Iran	22.7–17.8 burns per 100 000 child-years	Children less than two years of age had the highest burn incidence and burn mortality rates	Hot water was the most frequent cause of scalds (56%). Flame burns caused 35.7% of all burns	Ratio of boys to girls was 2.6	72% occurred in the home. 28% occurred in the street and backyard
Africa	These are the reported injuries per annum Ghana: $n = 1300$ (57.4 per 1000 people/year) Harare, Zimbabwe: $n = 104$ Enugu, Nigeria: $n = 107$ Abidjan Cote d'Ivoire: $n = 195$ Luanda, Angola: $n = 1407$	In Nigeria, 50% of the burn admissions were younger than three years of age In Abidjan, 75% of all paediatric burn admissions were younger than five years old In Ghana, children aged 18–23 months had the highest risk of burns	Scalding and fires caused by traditional cooking vessels	More boys than girls are burned (ratio 2:1)	Most incidences are accidental and occur around the home
South Africa	3.2% of the total South African population are burnt annually, 50% of which are younger than 20 years old. Incidence for toddlers (15.8/10 000 child-years (c-y)). Incidence for infants (15.8/10 000 child-years (c-y)). Incidence for boys (7.0/10 000 child-years (c-y)). Incidence is highest in winter (1.7/10 000 child-years (c-y))	Infants and toddlers	Scalding and fire burns	More boys than girls are burned (ratio 2:1)	Home and near home environment
Western Cape, Cape Town, South Africa	Incidence was 700–800 hospitalised cases per year. An additional 1600 incidences were treated in a clinic	33–40% under the age of three years (mean age 2.65 years)	Main causes of burns are hot liquids (83%) and fire	More boys than girls are burned (ratio 2:1)	Most burns were reported to occur in the home or near the home environment

Country	Incidence	Ages mainly affected	Cause of burn	Sex mainly affected	Environment of burn
USA	4000 deaths each year caused by burns	Not reported in the study examined	Burn deaths caused by fire burns, scalds, clothing burns, electrical injuries	Not reported in the study examined	Burns mainly caused at home
Israel	Third highest cause of deaths amongst hospitalised infants and toddlers (age 0–4 years)	Not reported in the study examined	Scalding was the most common cause of burns	Not reported in the study examined	Burns mainly occurred at home
Hong Kong	23.0 paediatric burns per 100 000 population per year	Median age of the child was three years	Scalds were the most common cause of burn. Flame burns were the second most common cause of burns	Ratio of male to female was 1:0.74	Most common location for a burn injury was the living room followed by the bathroom, kitchen, then bedroom

parent/caregiver interventions focussed on general burn prevention programs. Specific community strategies were also reported, for instance, short radio messages on burn prevention [42] and mass media and community events [43]. None of the studies provided specific information on the content, or implementation, of the interventions.

3.4. Hierarchy of hazard control

To address our secondary aims, we considered the prevention strategies in terms of the hazard hierarchy of control. We found that the majority of interventions were at the third hierarchy level (engineering or isolating controls), with a smaller and similar number of reports of the first hierarchy (removing the hazard), and the second (substitution). There was a small number of reports of administrative or legislative strategies, and perhaps not surprisingly, no reports of personal protection equipment (see Fig. 2).

3.5. Reported evaluation of prevention strategies

Table 4 presents a summary of the two papers whose interventions were evaluated for effectiveness. The paucity of data in this table highlights the need for improved evaluation, and reporting, of program effectiveness. In the few papers which reported on evaluation findings [41,31], there was evidence of a moderate effect in reducing the rate of burn-related hospitalisations of infants, compared with communities where prevention programs did not exist. The greatest effect of such programs was in middle and high socio-economic communities. Prevention programs did not have the same success with school-aged children [31].

3.6. Summary of findings in terms of research questions

There were no differences between developed and developing countries in terms of causes of burns, and burn prevention strategies. The prevalence of paediatric burns could not be compared readily between studies because of different sampling frames, sources of data, and statistical reporting. This highlights the need for standardisation of methodology on recording burn prevalence. The small number of studies which evaluated the effectiveness of burn prevention strategies was noted previously. The reported paediatric burn prevention strategies fitted inconsistently within the hierarchy of hazard control, with only a small number of studies reporting attempts to implement primary prevention strategies such as removing the hazard, or substituting better practices in the home, school and community. The greatest focus of the prevention strategies was re-engineering/redesign. It appears that paediatric burn prevention strategies have the potential to be standardised across developed and developing countries, although they would require different mechanisms of implementation to address different socio-economic status, education, literacy and opportunity to change.

3.7. The South African context

This review provided useful information on potentially effective prevention strategies for South Africa. However, in

Table 3 – Intervention strategies.

Author	Home safety	Author	Caregiver education	Author	General environment safety	Author	Education of children
Arshi [25]	Flame retardant clothes, improving home design	Peleg et al. [31]	Community classes for parents	Archibong et al. [26]	Legislation to prevent careless lighting of bushfires	Peleg et al. [31], Ozzanne-Smith et al. [33]	Burn prevention program
Kalayi [25]	Kitchen redesign	Peleg et al. [31], Ghosh and Bharat [34]	General burn prevention programs	Day et al. [43]	Supervised outdoor activities	Petridou et al. [40]	Burn prevention programs for kindergarten children
Kalayi [25]	Kitchen redesign (raising cooking surfaces)	Piccolo [41]	Short radio messages on burn prevention	Ozzanne-Smith et al. [33]	General environmental modification		
Kalayi [25]	Guarding of open fires	Peleg et al. [31]	Education of health workers and policy makers	Day et al. [43]	Playground safety		
Archibong et al. [26], Mzezewa et al. [27]	Provide better ventilation thereby reducing carbon monoxide build-up. Safe storage of flammable substances	Peleg et al. [31]	Professional awareness raising	Tse et al. [8]	Education regarding lighting of festival candles		
Schwarz et al. [36]	Home inspections	Ytterstad and Sogaard [41]	Educational activities				
Ytterstad and Sogaard [41]	Lowering tap water thermostats	Petridou et al. [40]	Multifaceted intervention involving local community leaders and activities for parents, teachers and children				
Ytterstad and Sogaard [41]	Implementation of cooker guards	Day et al. [43]	Mass media and community events				
Petridou et al. [40]	Home visits, counselling on home hazards	Peleg et al. [31]	Education about child supervision				
Ozzanne-Smith et al. [33]	Supply of safety equipment						
Forjough [35]	Proper design of kerosene lamps and stoves						

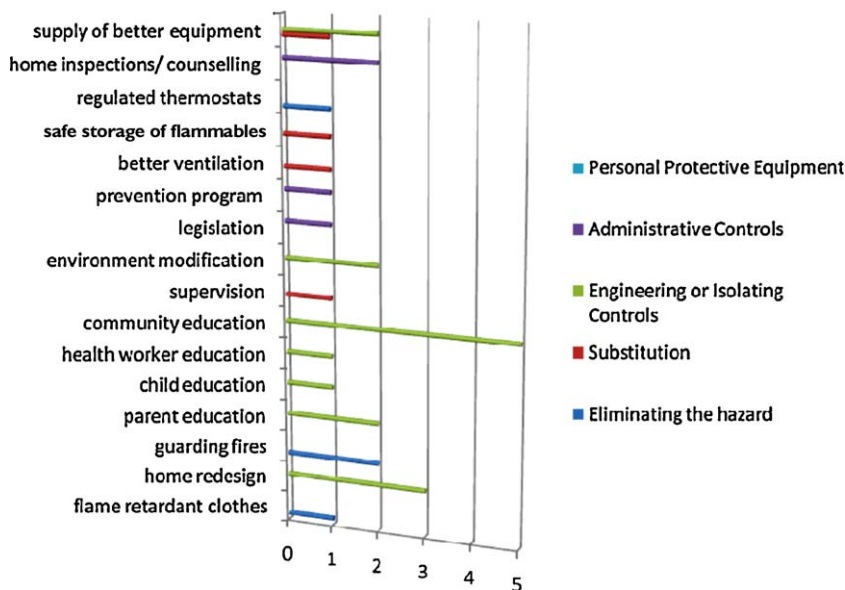


Fig. 2 – Intervention strategies considered in terms of the hierarchy of hazard control.

order to incorporate them into the South African context, they would need to address specific issues of developing countries relevant to the interventions, for instance, equity and access to the strategies, and regulation to support this, economics/poverty, product development, education, overcrowding, literacy and the potential for change.

We propose strategies for improving burn prevention in Africa, which are based on learnings from this review. Given the high cost of paediatric burns in terms of health, social, and personal costs, it is important to learn from other countries, and not ‘reinvent the wheel’ in terms of generating data on South African paediatric burns or the context in which such burns occur. Application of prior knowledge with appropriate cultural sensitivities would appear to be the most efficient way to proceed to ensure a swift reduction in South African paediatric burn events [35,44–46]. Proven and promising interventions developed largely in developed countries require evaluation of concept, and adaptation to developed country settings, before they can be put into effective use.

3.7.1. Primary hazard recognition

Teaching families and communities to recognise at-risk situations for child burns within the home and community. This could be operationalised by educating parents and children around the possibility of burns from hot objects, fluid and open fires [18] as well as the safe storage of flammable and toxic substances [26,27]. With limited resources, perhaps the best way to convey information on prevention is via the electronic media and community notices. Regular short radio messages on burn prevention were successful in Brazil, where it contributed to a reduction in the incidence of burn injuries [42]. Training could also be delivered to families and communities in general, regarding administering first aid treatment to burn injuries [47].

3.7.2. Engineering out the hazard

Information should be provided to communities and individual families, of the importance of safe kitchens, such as raising cooking fires on bricks or stones and guarding open fires by using fire grids [48,49]. This could also include the need

Table 4 – Studies for which evaluation was undertaken.

Author	What was implemented	What was evaluated	Findings of this study
Ytterstad and Sogaard [41]	A media campaign, a school intervention and a community initiated intervention	Incidence of burns (no information on whether hospital based or not)	In 1995, a decrease of 52.9% for burn injury rates was reported in the intervention community (from 52.4 to 24.7 per 10 000 person years)
Peleg et al. [31]	A questionnaire-based survey was conducted of organizations participating in injury prevention programs	The numbers of burn injury hospitalisations	There was a reduction in burn-related hospitalisation from 1.39 to 1.05 per 1000 infants, in contrast where programs did not exist. The greatest change was amongst infants and toddlers. There were no significant changes in burn-related hospital admissions amongst school-aged children

for adequate ventilation and the consequences of carbon monoxide poisoning, specifically in traditional dwellings [48].

3.7.3. Legislation

Legislation should be enforced to prevent the careless lighting of bushfires in preparation for planting seasons [26]. This could include basic burn prevention and management information using the World Health Organization's new child health pocketbook in order to bring this to wide community attention [9]. Legislation could also be enacted about housing standards, health and safety services and available equipment [33,43] to ensure that all communities have a minimum basic standard of house safety and health readiness.

3.8. Common themes

Common themes were identified in many of the strategies, which fits with prevention models proposed by Towner et al. [4] and Tse et al. [8]. Effective multi-pronged paediatric burn prevention strategies should focus on all the elements of injury prevention, in terms of the hierarchy of control [4,7]. This involves identification and removal of direct hazards, engineering out these hazards with environmental modifications, parental education, and product redesign and safety, and legislating for safer practices [50]. This approach is reinforced by recent systematic reviews of fire and burn interventions in developed countries, which indicate effective interventions focusing on a three-pronged intervention involving regulation, education, and technology. This includes burn educational campaigns in schools, and homes, as well as targeting flame and scald burns to high risk groups via media campaigns [51-53].

3.9. Effective strategies

Effective prevention strategies should address the causes of paediatric burns within the context of the environments in which they occur [54,55]. Burn prevention for children should be a concern for all adults, and thus effective strategies should include the adults in communities in which burns occur [56]. Prevention of burns involves adults in the home (for instance parents/caregivers), as well as adults involved directly with children (such as health and education workers). Effective burn prevention requires involvement of local government and other community agencies, as well as adults involved in designing and building homes, and manufacturing and selling appliances for the home [54-56,18]. Therefore there is scope for universal themes to be implemented in a local targeted context by considering local cultures, environments, opportunities for administrative control, and opportunities to change behaviours [4,8]. Towner and Downhill [5] reported on the effectiveness of the WHO Safe Communities Model, which combines elements of community diagnosis. This relies on a local surveillance system to provide an accurate picture of the local injury problem, and a local reference group to coordinate activities. Therefore there is the potential for establishing a universal international gold standard for paediatric burn prevention.

Ytterstad and Wasmuth [57] demonstrated that the most successful educational intervention programs are those

combined with passive prevention methods, such as the installation of hot water thermostats and oven guards. Hot water thermostats have a demonstrated record in reducing hospitalisation rates for child burns [58]. However, lowering hot water heater temperatures is an intervention more relevant to developed countries, as it makes less sense in developing country households without electricity [46].

3.10. Challenges to implementation of strategies relevant to developing countries

Whilst a number of strategies were raised that could be of potential use in South Africa, wider factors would need to be addressed for successful implementation in any developing country, including, but not limited to, regulation, equity, economics/poverty, product development, education, overcrowding and the potential for change.

Particularly relevant to developing countries was the finding that broad community-action interventions to improve socio-economic status were proposed as potentially effective primary prevention strategies for burns [59,60]. These interventions comprised parental/caregiver education, improved housing, safe provision of basic amenities such as water and electricity, proper regulation and design of industrial products such as kerosene stoves, proper storage of flammable substances, and adequate child supervision, particularly for those with impairments. This emphasised the need to tailor burn prevention programs to specifically address the characteristics of the key causes of paediatric burns within the local context.

Improving the socio-economic status is pertinent in South Africa, where there is consistent evidence that most paediatric burn injuries occur in informal settlements, related to overcrowding, lack of space in the house for safe cooking and heating, poverty, lack of education of adults, and lack of regulation/legislation for safe behaviours [21]. The cost of developing and disseminating widespread mass media for instance would be prohibitive in some developing countries. Opportunities for parents/caregivers to access these messages were also often constrained, by language, access to community resources, or to mass media itself. This appeared to prevent many communities from adopting burn prevention programs that has been found to be effective in other places.

3.11. Potential for improving and standardising evaluation strategies

The paucity of published evaluation and the lack of consistency of evaluation strategies identified in the review are underpinned by the international lack of agreement on the most effective evaluation research design and strategies [8]. This reflects the context of the environment and the prevention strategy [61]. An essential element in evaluation of prevention strategies is appropriate capture of injury events so that the effect of intervention can be appropriately monitored. However, children with burns may not be admitted to hospital in some developing countries because of lack of access, knowledge and/or finances, which is a recognised constraint on accurate burn epidemiology [17].

Thus this review suggests that essential evaluation elements include:

- strategies that reach parents and caregivers of all children with burns (hospital admissions, or not),
- tracking admissions to hospital,
- tracking consultations by community health workers,
- using a standard mechanism for reporting burn prevalence and incidence.

4. Conclusion

This review highlighted the considerable body of research from many countries with different cultures and living environments, which reported paediatric burn prevention strategies. The research highlighted fragmented initiatives and strategies, threaded throughout the hierarchy of hazard control. Many were promising, but lacking evaluation.

Although the countries contributing research to this review had different socio-economic situations (for instance USA versus India), the issues related to the causes and prevention of paediatric burns were similar. The importance of providing children with a safe home was a common thread, as was the importance of educating parents and caregivers in recognising and addressing risks for burns, and reinforcing the importance of their role in ensuring the safety of their child. The research highlighted the importance of increasing the focus on engineering out the hazard in preventing burns, for instance, encouraging parents/caregivers to purchase flame retardant clothing for children, lamps that did not tip over, safely designed gas stoves, etc. This raises some questions over the ability of lower economic groups to participate in solutions that required consumer-based approaches.

The greatest evidence of effectiveness came from multi-pronged programs of caregiver education, public policy, community monitoring and legislation, supported by repetition of the prevention message in different forms. Community willingness to adopt burn prevention strategies often related to the costs associated with implementing them, and not to a lack of intent or goodwill. It is possible to establish a standardised approach to burn prevention if countries and communities are provided with flexibility to implement solutions appropriate to local context, as well as realistic timescales for implementing aspects of prevention strategies which may require greater resources and or governmental involvement.

Conflict of interest statement

There are no conflicts of interest.

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