

## Environmental risk factors of burns in children – review

### Czynniki środowiskowe oparzeń u dzieci – przegląd piśmiennictwa

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#### ABSTRACT

The problem of burns is relatively a common issue in many developing and developed countries. Most burns occur at home, so the home environment plays an important role in these injuries. Considerable attention has been recently paid to environmental factors such as socioeconomic including family, living conditions and their influence on frequency of burns.

This manuscript reviews papers published in the last few years to show if environmental factors influence the risk of burns in children. The researchers point to the relationship between age, education of parents, number of siblings, home environment and the frequency of burns in children. Identification of risk factors plays an important role in planning preventable measures.

**Key-words:** burns, children, risk factor, environment, family

#### STRESZCZENIE

Tematyka oparzeń u dzieci wciąż jest aktualna zarówno w krajach rozwijających się, jak i rozwiniętych. Do większości tego typu urazów dochodzi w domu, więc środowisko domowe może odgrywać istotną rolę w ich powstaniu. Ostatnio znaczną uwagę zwrócono na czynniki środowiskowe, takie jak czynniki socjoekonomiczne, w tym rodzinne, oraz warunki życia i ich wpływ na częstość oparzeń.

W pracy dokonano analizy piśmiennictwa z kilku ostatnich lat poruszającego temat wpływu czynników środowiskowych na ryzyko oparzeń u dzieci. Przeprowadzone badania wskazują na związek pomiędzy wiekiem, wykształceniem rodziców, liczbą rodzeństwa oraz warunkami mieszkaniowymi a częstością oparzeń u dzieci. Zidentyfikowanie tych czynników ma istotne znaczenia dla planowania działań profilaktycznych.

**Słowa kluczowe:** oparzenia, dzieci, czynnik ryzyka, środowisko, rodzina

#### INTRODUCTION

Burns – injuries can be caused by thermal, chemical or electrical agents. They are called „one of the most devastating conditions encountered in medicine”. Most burns are due to flame injuries and scalds. Burns caused by electrocution and chemical injuries are less common. Burns are a relatively common problem in many developing and developed countries [1–4].

The injuries are not only a significant accidental and non accidental cause of death [5]. Deaths are generally related to flame burns accounting for about 13% of burns, often reinforced by inhalation of smoke and toxic gases [6]. Fortunately, most burns are less serious, resulting mainly from scalds,

which comprise up to 85% of burns [6, 7] but can also lead to permanent scars and complications requiring rehabilitation, such as limited operation of fingers in hand after burn [8]. There are many psychological problems in patients suffering from such injuries as for example perception of stigmatization [9].

It is commonly known that children under 4 years of age are at the highest risk of burns, especially scalds. Most accidents and about 92% of burns occur at home, so home environment can play an important role in these kinds of injuries [7]. Eminson et al. suggested that particular personality characteristics of the child (so called “accident proneness”) together with family and environmental factors can lead to repeated accidents in

childhood [10]. Much research on epidemiology of burns in children has been done, but only a few consider the socioeconomic situation, home environment and the family as a potential risk factor of burns.

Quite recently, considerable attention has been paid to environmental factors influencing frequency of burns. This manuscript reviews papers published in the last few years. The aim is to reveal if the environmental factors influence the risk of burns in children.

## METHODS

To search the articles EBSCOhost was used. The literature research was performed using the keywords: children and burns and risk and environment.

### Geographical factors

A large amount of literature has been published on epidemiology of burns in children in different countries (table 1).

Table 1. The environmental risk factors of burns in developed and in developing countries

Tabela 1. Środowiskowe czynniki ryzyka oparzeń w krajach rozwiniętych i rozwijających się

Country	Author	Year of publication	References	Undertaken risk factors
Australia	Simons et al.	2002	24	Hot iron.
Bangladesh	Mashreky et al.	2000	14	A household with a separate kitchen, rural areas, a kitchen without a door, the traditional kerosene lamp (kupi bati).
Brazil	Vendrusculo et al.	2010	39	Low socioeconomic and educational levels of mothers and those responsible for the children at the moment of the accident, small houses considering the number of occupants and unsafe kitchen equipment.
Canada	Alaghebandan et al.	2012	25	Labrador/ Newfoundland region.
China	Zhou et al.	2014	16	Rural areas.
Cuba	Gonzalez et al.	2014	35	Rural origin, the low perception of risk of accidents, the bad living conditions.
Egypt	Kamal	2013	17	Education of parents, mothers' age, household socioeconomic standard.
Ghana	Forjuoh et al.	1995	31	Characteristics of the child: age at time of the burn, sex, tribe, birth order, history of previous injury, sibling burn and sibling death from the burn, pre-existing impairment of the child. Socio-environment: parental education, income, presence of parents at the time of burn, family size, father's smoking habits, hours spent away from home by mother, storage of flammable substances in the home.
Lithuania	Kubilius et al.	2014	19	Lack of hot water supply.
Mongolia	Khandarmaa et al.	2012	37	Urban origin, number of children in the household, caregivers' knowledge and practices on childhood burns, physical environment at home.
Peru	Delgado et al.	2002	20	Lack of water, low income, crowding, the presence of a living room, better maternal education.
Republic of South Africa	Van Niekerk et al.	2006	40	Housing conditions, child dependency, socio-economic barriers.
Sweden	Freccero et al.	2000	41	Immigrants; cooking with water and oil, familiarity with Swedish safety standards and measures, difficulties in communicating (language), limited social network.

Tanzania	Outwater et al.	2013	36	Home environment, cooking fires.
Uganda	Kalanzi et al.	2014	21	Bed net.
United Kingdom	Duncan et al.	2006	22	Hair straighteners.
United Kingdom	Woodbridge et al.	2010	38	Camping and caravanning holidays, access to free flowing water, distance to reach the nearest Emergency Department.
United Kingdom	Pearce et al.	2012	3	Socioeconomic circumstances: social class, maternal education, lone parenthood status and tenure. Proxy indicators of housing quality (build type, storey, garden access, rooms per capita, central heating and presence of damp) and safety equipment use (use of fireguards, safety gates, electric socket covers and smoke alarms).
United Kingdom	Brewster et al.	2013	15	Deprived areas of residence, ethnic minorities, urban areas.
United Kingdom	Shah et al.	2013	26	Child covariates: gender, age at the time of injury, birth order. Maternal covariates: age at childbirth, depression during pregnancy or 6 months after delivery, hazardous/harmful alcohol consumption prior to the scald injury. Household covariates: the Townsend Index of material deprivation, the number of adults within the household.
United Kingdom	Sarginson et al.	2014	23	Hair straighteners.

According to the World Bank analytical income of economies for fiscal year 2014, WHO income groupings divides countries into four categories. Several publications have appeared in the recent years documenting the scale of the problem of burns in children in all these groups: low income, lower mid income, upper mid income, high income countries [1, 3, 11].

Forjuoh indicates that while much has been accomplished in the areas of primary and secondary prevention of fires and burns in many developed or high-income countries, due to sustained research on the descriptive epidemiology, risk factors, the same cannot be said of developing or low and mid-income countries. In his opinion burns in different countries groups have the same descriptive epidemiological characteristics but slightly different risk factors including the presence of pre-existing impairments in children, lapses in child supervision, storage of flammable substances in home, low maternal education, overcrowding as well as several treatment modalities and preventable efforts including immediate application of cool water onto a burned area [12].

Poulos et al. claim that significant declines in deaths and hospitalizations for burns achieved in industrialized countries over the recent decades are related to the development of specialist burn treat-

ment centres, effective burn prevention strategies and broader societal changes. They pay attention to the fact that these benefits have not been shared by children across all socioeconomic groups. In their study they undertook to explore the geographic patterning of child fire and burns in the state of New South Wales in Australia they discovered that the geographic pattern of relative risk varied by age group; higher than average risks were observed for children residing in rural and remote areas, as well as in scattered local government areas closer to the coast and in some metropolitan regions. Advantages of these maps are: clear visual representation, readily identified high risk areas, highlighting the need for further investigation or intervention, identification of the spatial patterning of injury. The authors suggest that mapping the occurrence of injury gives injury practitioners the opportunity to identify high risk communities for further investigation of risk factors and implementation of targeted interventions within a defined area [13].

Many studies have reported that burns occur more often in rural and remote areas [13, 14] Brewster et al have revealed that rates of admission for burns are highest in urban areas and significantly lower in the more sparse rural areas [15]. It was also found that compared with treatment in urban areas,

rural burn patients received less first-aid treatment, underwent more surgery, had more complications and longer and more costly hospital stays [16].

### Home environment

It is commonly known that most burn accidents occur at home, especially in the kitchen [14, 17]. It seems quite possible that characteristics of home environment can play an important role in the risk of injury.

Detailed examination of living conditions including rooms per capita build type, storey of main living accommodation, garden, central heating, presence of dampness or condensation on walls, items of safety equipment such as: safety gates, fireguards, electric socket covers, smoke alarms was performed by Pearce et al. They showed that children living in households with poor housing scores were more likely to have been injured in home than those with no negative housing indicators. Compared with children living in homes with one to two rooms per capita, children living in homes with more than two rooms per capita were slightly less likely to have been injured. Households with between one and three items of safety equipment were at a slight but not-significantly elevated risk of injury compared with those with all four safety equipment use (use of fireguards, safety gates, electric socket covers and smoke alarms). Surprisingly, children living in households without safety equipment were less likely to have been injured than those with all four safety equipment [3]. However it is important to note that most fire related childhood deaths and injuries occur in homes without smoke detectors [7].

The presence of unsafe environmental characteristics was the subject of a study carried out by Kamal. As the most common unsafe environmental characteristics are considered: absence of fire extinguisher, uncovered electric sockets and absence of first-aid kits. The author has also found that homes with injury hazards did not differ significantly from the homes of non-injured except for unsafe storage of sharp objects and absence of first-aid kits in the number of children injured [18].

It has been demonstrated that children living in rented accommodation compared with owned or mortgaged homes were at higher risk of injury [3].

The most common types of burns in children are scalding caused by hot drinks/food or hot water meant for household use. Several studies identified the lack of hot water supply a risk factor for burns in children [19, 20].

A kitchen without a door was also found to create a more hazardous environment compared to a

kitchen with a door [14], because the doors limit children's access to the cooking area. A living room was considered to be a protective factor, which is probably an indicator of socio-economic status of a family [20]. Other risk factors were crowding [20] and flammable substances kept in home [12].

There are also hazardous subjects used in specific populations such as the traditional kerosene lamp called "kupi bat" [14] or insecticide-treated bed nets, which are essential tools to prevent malaria in endemic regions and their use is connected with the increased number of burns [21].

However the most common cause of burns in children is scalding, and burns from contact. Several publications have appeared in recent years documenting the risk of burns related with use of hair straighteners, which can reach temperatures of over 220°C and can lead to significant full thickness injuries [22, 23]. It is also worth mentioning burns from contact with irons, caused by touching the iron or by pulling the cord [24]. Both domestic irons and hair straighteners are risky in a child environment. The authors emphasize these preventable burns warrant our attention and they would advocate the use of heat-resistant pouches and closure clips on the devices to help minimize the risk of injury [23].

### Socioeconomic factors

It seems very probable that differences in the income and social class of the parents result in significant differences in living conditions of their children. Pearce claims that the home environment is the causal pathway between socioeconomic status and injuries occurring at home [3].

Kamal indicates that a high income increases the capability to live in safe home and to buy safety equipment, thus reducing the risk exposure. His study found a significant association between injury risks and low economic status [18], which has been confirmed in many other studies Pearce et al found that children from less advanced socioeconomic circumstances were consistently more likely to live in homes with a poor housing score and also in homes using one or none of the reported items of safety equipment compared with children from the most advanced groups [3]. It seems that children from working class backgrounds were more likely to be injured than those from managerial and professional backgrounds [3].

Alaghehbandan et al. suggest that increased risk of burns in some communities is multi-factorial and includes crowded and dilapidated housing conditions, lifestyle and poor social conditions [25].

## Family

Recently there has been fine interest in the family of injured children. Pearce et. al. suggest that parental factors such as supervision, risk taking behaviors, ability to match children's capabilities to tasks wanting to foster independence in their children, ability to recognize hazards, maternal depression and social support are associated with childhood injuries and may also be distributed across social groups [3].

It has been demonstrated that children of sole parents compared with two natural parents were at higher risk of burns [3, 26, 27]. Moreover Wadsworth et. al., revealed that children in stepfamilies were more likely to have had an accident reported by their mother during their first five years of life than children from two natural parents families. Children in stepfamilies were also more likely to have repeated accidents (two or more). Children in sole parent families were slightly more likely to have accidents or repeated accidents than children in two natural parents, but the differences were less pronounced than for children in stepfamilies [28].

In literature, several theories have been proposed to explain the increased accident rate associated with atypical (single or step) families. For example parents in such families may be preoccupied, they can have personal and financial difficulties facing lone parents with sole responsibility for their children [28]. Such families are more likely to live in potentially dangerous environments and children may have behavioral problems due to the arrival or loss of either a father or a mother [28].

Several studies have shown that maternal age is an important determinant of risk of burns. Children of young mothers, especially the children of teenage mothers, are at higher risk [17, 26, 28].

The burns risk was shown to be inversely related to the level of parents' education [17, 26]. Delgado claims that better maternal education is a protective factor [20]. The research demonstrated the importance of taking family history. Data from Tkaja's study have identified the birth order (fourth or higher compared with first) and multiple birth (twin or triplet compared with single to) affected the risk of injury death among infants as did large families [27, 30]. Forjuoh found history of burns in a sibling and history of a sibling death from a burn to be the main risk factors for childhood burns [31].

The medical staff having contact with burned patients must always remember the possibility of non-accidental burns. Chester et al reported that parental drug abuse, delay in presentation of more than 24 hours and a lack of first aid are statistically more

prevalent in the "neglect" group than in the "accidental" group. Children in the "neglect" group were also statistically more likely to have deeper burns and require skin grafting [32]. In each case of non-accidental burn injury it is always difficult to differentiate non-accidental burn injuries from accidental.

## DISCUSSION

The paper concentrates on environmental risk factors of burns in children, who are known as the group of the highest risk of such injury, especially under 4 years of age. The author's attention was focused on geographic (including country, rural or urban areas), but also home environment, family, socioeconomic status of the family.

The presented results confirm the relationship between environmental factors and the risk of burns in children.

However, a number of limitations need to be considered. For instance, difficulties with precisely defining the socioeconomic status of the family. The data must be interpreted with the caution because the studies were performed in different countries. It must also be mentioned that the risk of burns is multi-factorial, so it is difficult to describe which of the factors had the biggest influence in particular burn cases.

We must also pay attention to the fact that children under 4 years old are at the risk, because they are starting to explore the world around them and sometimes a very short moment without supervision can lead to the injury.

## CONCLUSIONS

The findings of the presented studies have a number of important implications not only for the medical staff, but also for the young parents to better supervise their children, pay attention to the risk factors of burns and arrange the home environment in a safe way for example not leaving hot fluids accessible to the children, lowering the temperature of hot water heaters to 50°C or even 49°C, buying spill-proof mugs and also smoke detectors, having identifiable escape routes and a fire extinguisher, and guards around wood fire stoves [6, 7].

The results of the findings can contribute considerably to the development and evaluation of preventive programs, which should concentrate on creating a safe home environment for the child and courses of first-aid for burned children of the young

parents. Prevention programs should include activities of primary, secondary and tertiary prevention. The aim of primary prevention is to avoid the burns in children, which can be realized by education of parents about the risky situations, creating a safe home environment. Secondary prevention should concentrate on education the parents about first-aid in burns. The aim of tertiary prevention is to reduce negative impact of burns, for example rehabilitation of burned children. Injury prevention programs can be categorized according to the target population. They can be directed to parents of infants and toddlers or schoolaged children. K. Peleg et al. reported a statistically significant reduction in the rate of hospitalizations due to burns was found for infants and toddlers from places where intervention programs were implemented [33]. According to Parbhoo et al. the most common are interventions regarding home safety, caregiver education, and general environmental safety, especially safety at the kitchen and bathroom [34].

Future research should concentrate on the efficacy of these preventive strategies.

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