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ORIGINAL PAPER

Characteristics of burns in children – results of a Polish multicentre study

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ABSTRACT

Aim of the study: To characterise burns in Polish children according to sex, age group, and depth of burn.
Material and methods: The anonymous survey included 200 children under 18 years old hospitalised due to burns in five Polish hospitals. The location of burn was characterised in detail and also in agreement with ICD-10 classification. The surface of burned skin (% TBSA) was counted with use of Lund-Bowder chart for children under 16 years old and with the rule of nines for children over 16 years old. Depth of burn was assessed clinically. The study was accepted by the Bioethical Committee of Wroclaw Medical University. Statistical analysis of the obtained data was performed using Excel and Statistica v. 12.
Results: 60% of the burned children were boys (120) and in 40% were girls (80). Children under one year old comprised 50.5% of all participants of the study. Among participants of the study thermal burns comprised 93.0%, chemical burns – 4.5%, and electrical burns – 2.5% of all cases. Boys underwent chemical (5.0% vs. 3.8%) and electrical (3.3% vs. 1.3%) burns more than girls ($p > 0.05$). There were statistically significant differences in the type of burn in different age groups. In 84.5% the thermal burns were caused by hot liquid, in 3.7% by a hot object, and in 4.3% by flame. Most commonly burns affected the trunk (57%) and upper extremity (50%). The average burn surface area was 8.26 ±7.87% TBSA. Most burns did not extend to the full depth of the skin (I degree – 3%, II degree – 61.5%).
Conclusions: Prevention programs should be aimed at minimising the risk of burns in the group at highest risk – children under one year old.

KEY WORDS:
children, Poland, burns.

INTRODUCTION

Burns are known to be one of the most devastating types of trauma that can occur in children. Decreasing trends in the number of burns are observed in many countries [1, 2]. Furthermore, the problem of burns in children remains due to the complications and sequels of burn injury such as contractures, scars, and loss of function [3, 4].

Moreover, the assessment of child and adolescent injury prevention and safety promotion in Poland made by Malinowska-Cieślik *et al.* revealed that child home safety related to prevention of falls, burns and scalds, choking, and strangulation has not received adequate attention [5]. Information about the epidemiology of burns in children can provide a means for targeting efforts in burn prevention [6].

It is well known that children in low- to middle-income countries are at higher risk of sustaining severe

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burns than those in high-income countries [3]. However, according to the analysis of medical rescue operations performed by medical rescue teams from all over Poland in patients with burn wounds, made by Nadolny *et al.*, the problem of burns remains significant in Polish emergency medicine [7]. Moreover, even in wealthy societies sequels of burn injury in childhood can significantly affect survivors' life quality.

The aim of this study was to characterise burns in children according to sex, age group, and depth of burn.

MATERIAL AND METHODS

An anonymous survey included 200 children under 18 years old hospitalised due to burns in give Polish hospitals: Department of Paediatric Surgery, Marciniak Hospital in Wrocław (146 patients); Department of Paediatric Surgery, Burns, and Paediatric Urology "Zdroje" in Szczecin (31 patients); Department of Paediatric Surgery, WCM in Opole (16 patients); Department of Plastic Surgery, SCM in Polanica-Zdrój (five patients); Clinic of Paediatric Surgery and Paediatric Urology in Wrocław (two patients).

The questionnaire had two parts. The first part was filled in by parents/caregivers and included questions about the circumstances of the injury, housing conditions, the economic situation of the family, and family structure. The second part was filled in by the doctor and provided information about the location of the burn, the area of burned skin (% TBSA), the depth of the injury, the type of treatment (surgical or preservative), and the length of the hospitalisation. The location of burn was charactersed in detail and also in agreement with ICD-10 classification. The area of burned skin (% TBSA) was measured with use of Lund-Bowder chart for children under 16 years old and with rule of nines for children over 16 years old. The depth of burn was assessed clinically. The severity of burns was assessed with use of the American Burn Association (ABA) scale.

Inclusion criteria were:
1) hospitalisation due to burn,
2) agreement of caregivers and patient over 16 years old to participate in the study,
3) patient age under 18 years.

The exclusion criterion was disagreement of the caregiver/patient to participate in the study.

The study was accepted by the Bioethical Committee of Wroclaw Medical University (decision no. KB – 109/2014, no. KB – 305/2015, no. KB – 493/2015, no. KB – 518/2015, and no. KB – 141/2016). The study was performed from 5.03.2014 to 5.03.2016.

Statistical analysis of the obtained data was performed using Excel and Statistica v. 12.

RESULTS

AGE AND SEX

60% of the burned children were boys (120) and in 40% were girls (80). Children under one year old comprised 50.5% of all participants of the study. 88.5% of the participants were children under five years old. The average age of the burned children in the study group was M ±SD = 3.85 ±2.71. Children were divided into four age groups (Table 1). There were no statistically significant differences between girls and boys in the different age groups ($p > 0.05$).

TYPE OF INJURY

Burns can be classified as thermal, chemical, electrical, or radiation burns. Among participants of the study, thermal burns comprised 93.0%, chemical burns – 4.5%, and electrical burns – 2.5% of all cases. The type of burn injury was similar in both sexes. Boys underwent chemical (5.0% vs. 3.8%) and electrical (3.3% vs. 1.3%) burns more than girls, but the differences were not statistically significant ($p > 0.05$). There were statistically significant differences in the type if burn in different age groups (Table 2). In 84.5% the thermal burns were caused by hot liquid (158 cases), in 3.7% (7 cases) by hot objects, and in 4.3% (8) by flame. Teenagers (age range: 12–17 years) more often than younger children (< 5 years old) were hospitalised due to burns caused by flames ($p < 0.001$). Scalds occurred more often in children under two years old than in children between 12 and 17 years old ($p < 0.001$). The aetiologic factors of scalds were tea (28.7%), water (28.7%), coffee (21%), milk (5.1%), soup (5.7%), and oil (4.5%).

CHARACTERISTICS OF BURN INJURY

Burn injury can be classified according to the anatomic location, extension, and depth.

Anatomic location of burns assessed according to the classification ICD-10 was similar in both sexes ($p > 0.05$)

TABLE 1. Number of burned children in different age groups

Sex	Age group (years old)								Test χ^2 p
	Under 2 ($n = 149$)		3–5 ($n = 29$)		6–11 ($n = 7$)		12–17 ($n = 15$)		
	n	%	*n*	%	*n*	%	*n*	%	
Girls	56	37.6	16	55.2	1	14.3	7	46.7	0.148
Boys	93	62.4	13	44.8	6	85.7	8	53.3	

TABLE 2. Type of burn and age of children

Type of burn	Age group (years old)								Test χ^2 *p*
	Under 2 (*n* = 149)		3–5 (*n* = 29)		6–11 (*n* = 7)		12–17 (*n* = 15)		
	n	%	*n*	%	*n*	%	*n*	%	
Thermal	142	95.3	26	89.7	7	100.0	11	73.3	0.011
Chemical	7	4.7	1	3.4	0	0.0	1	6.7	0.901
Electric	0	0.0	2	6.9	0	0.0	3	20.0	< 0.001

TABLE 3. Anatomic site of burn (according to the classification ICD-10) and age of children

Anatomic site of burn	Age group (years old)								Test χ^2 *p*
	Under 2 (*n* = 149)		3–5 (*n* = 29)		6–11 (*n* = 7)		12–17 (*n* = 15)		
	n	%	*n*	%	*n*	%	*n*	%	
Head and neck	30	20.1	1	3.4	0	0.0	1	6.7	0.017
Trunk	94	63.1	11	37.9	1	14.3	8	53.3	0.008
Shoulder and upper limb (except wrist and hand)	62	41.6	8	27.6	1	14.3	8	53.3	0.167
Hand and wrist	21	14.1	7	24.1	1	14.3	6	40.0	0.060
Hip and lower limb (except ankle and foot)	32	21.5	12	41.4	5	71.4	5	33.3	0.005
Ankle and foot	10	6.7	4	13.8	2	28.6	1	6.7	0.148
Internal organs	6	4.0	1	3.4	0	0.0	1	6.7	0.898

Proportions do not add up to 100 because more than one answer was marked in many cases

TABLE 4. The extent of burns in different age groups

Surface of burn (% TBSA)	Age group (years old)				Kruskal-Wallis test *p*
	Under 2 (*n* = 149)	3–5 (*n* = 29)	6–11 (*n* = 7)	12–17 (*n* = 15)	
M ±SD	8.8 ±7.8	6.2 ±5.0	12.3 ±17.6	5.3 ±3.3	0.101
Me (Q1; Q3)	6 (4; 12)	4 (2; 8)	4 (3; 14)	5 (2; 8)	
Min–max	1–70	1–18	1–51	1–10	

TABLE 5. Treatment of burns in different age groups

Treatment	Age group (years old)								Test χ^2 *p*
	Under 2 (*n* = 149)		3–5 (*n* = 29)		6–11 (*n* = 7)		12–17 (*n* = 15)		
	n	%	*n*	%	*n*	%	*n*	%	
Conservative	107	71.8	20	69.0	3	42.9	7	46.7	0.205
Surgical	33	22.1	7	24.1	4	57.1	7	46.7	

TABLE 6. Duration of hospital stay in different age groups

Duration of hospital stay (days)	Age group (years old)				Test χ^2 *p*
	Under 2 (*n* = 149)	3–5 (*n* = 29)	6–11 (*n* = 7)	12–17 (*n* = 15)	
M ±SD	6.9 ±4.2	8.6 ±5.5	14.3 ±13.6	15.3 ±13.5	0.046
Me (Q1; Q3)	6 (4; 9)	7.5 (4; 13)	11 (4; 21)	11 (6; 20)	
Min–max	1–17	1–20	1–38	3–48	

but differed significantly in the age groups (Table 3). Most commonly burns affected the trunk (57%) and upper extremity (50%).

In the cases, in whom the circumstances of the injury were known, they were: spilling hot liquid (163), drinking liquid (7), touching a hot surface/object (8), burning with a flame (6), putting fingers in electrical outlet (2), contact with high-voltage lines (2), and gas explosion (1).

THE EXTENT AND DEPTH OF BURNS

The extent of the burn, defined as the percentage of total body surface area (% TBSA), is one of the most important parameters characterising this injury (Table 4). The average burn surface area was 8.26 ±7.87% TBSA. The average burn surface in boys was 0.44% higher than in girls (8.00% vs. 8.44%), but the difference was not statistically significant ($p = 0.076$).

According to the depth of burns, they can be classified into first degree (superficial), second degree (partial thickness), third degree (full thickness), or fourth degree (affects the entire depth of the skin, underlying fat, muscles, bones). Most of the burns did not extend to the full depth of the skin (I degree – 3%, II degree – 61.5%). 30% of children had burns assessed as III degree and 1.5% as IV degree. No significant differences were found between burn depth in girls and boys ($p = 0.397$) or in different age groups ($p = 0.083$).

Most cases (68.5%) did not require surgical treatment. The differences in the type of treatment in different age groups are presented in Table 5. Children under two years old were treated conservatively significantly more often than those aged 12–17 years (76.4% vs. 50.0%; $p = 0.039$).

The average length of hospital stay was 8.07 ±6.48 days. Boys were hospitalised longer (8.63 ±7.32) than girls (7.26 ±4.98), but the differences were not statistically significant ($p > 0.05$). Patients aged 12–17 years were hospitalised longer than those under two years old (Table 6). The difference between length of hospital stay in these two age groups was statistically significant.

The average hospital stay of children ages 12–17 years was longer than those under two years old (11 days vs. 6 days; $p < 0.05$) (Table 6). The difference between length of hospital stay in these two age groups was statistically significant ($p = 0.014$). Children under two years old were treated conservatively more often than those aged 12–17 years (76.4% vs. 50.0%; $p = 0.039$).

BURNS IN THE PAST AND FAMILY HISTORY

The answers to the question about burns in past events revealed that a total of 12 children were burnt in the past (seven of them were under two years old), and one patient required hospitalisation due to burn injury in the past. In 37 cases children required hospitalisation due to reasons other than burns in the past. In 40 cases other family members suffered from burns in the past.

FAMILY, HOUSING CONDITIONS, ECONOMIC SITUATION

The analysis of cases in whom the family structure was known revealed that children were in two-parent families (150; 82.3%), single-parent families (15; 8.3%), and multigenerational families (13; 7.2%). The burnt child was the only child in the family in 44.8%. In 37.7% there were two children in the family. In 17.5% of families there were three or more children.

In 89% the parents assessed the housing conditions as very good or good; in 11% they assessed them as average or poor. In 75% the caregivers assessed the economic situation as very good or good; in 25% they assessed it as average or poor.

DISCUSSION

In the study 60% of victims were boys. Similar results were obtained by Nadolny, who analysed the trips of emergency medical teams to patients diagnosed with burns throughout Poland [7]. Similarly, Noskiewicz *et al.* in a retrospective analysis performed on 310 paediatric patients hospitalised for burns in the years 2010–2017 noticed that the majority of them (66.8%, 207 patients) were boys [8]. The same trends were noticed by Matuszczak *et al.*, Brodzińska *et al.*, Topczewska-Cabanek *et al.*, and Gontko *et al.* [9–13]. Also, Mitchell *et al.* in a study that investigated children < 18 years old treated for burns in United States (US) emergency departments from 1990 to 2014 using data from the National Electronic Injury Surveillance System, in which most patients (58.4%) were boys [1]. Similar observations were noticed in the other countries – most burned patients were male [2].

In the study 88.5% participants were children less than five years old. In the study of Noskiewicz at al. burns occurred most frequently in children between the first and third year of life [8]. Brodzińska *et al.* also indicated that children who undergo hospital treatment are mostly aged 1–2 years old [10, 11]. Also, Gontko *et al.* revealed that most often this type of injury was observed in children between one and two years [13].

Also, other Polish studies on burns in children revealed that the most common cause of burns were hot liquids [8–11, 13]. Similar observations were made in different countries. The analysis of the epidemiology and outcomes of paediatric burns over 35 years at Parkland Hospital revealed that the most common causes of admission were scald (42%), flame (29%), and contact burns (10%) [14]. In the study of den Hollander *et al.* common causes for the burns in children were: hot liquids (71%) and open flame (24%) [15].

The results of other studies performed in the Polish population indicate that in most cases burnt children were treated conservatively [8, 9]. In the study most cases (68.5%) did not require surgical treatment. Children under two years old were treated conservatively significantly more often than those aged 12–17 years (76.4% vs. 50.0%; $p = 0.039$). The differences in the type of treatment in different age groups may be associated with the fact that, according to the indications, every burned infant (regardless of the degree and area of the burn) requires hospital observation, which increases the number of conservatively treated patients in this age group, while not all burned teenagers require hospitalisation. Kurnatowski pays attention on the fact that age under two years puts a child at risk and is an indication to hospitalisation [16]. Also, in the study of Matuszczak *et al.* about hand burns in children, most patients with hand burns (88%) were treated conservatively [17].

In the study most burns affected the trunk and upper extremity. A similar observation was made by Gontko *et al.* in their study that involved 190 children treated in the Paediatric Surgery Department of SZOZ nad Matką i Dzieckiem in Poznań from 1 January to 31 December of 2010 [13]. The analysis of the structure of burns in children in Lower Silesia also revealed that upper the extremity was often affected [18]. In the study of Topczewska-Cabanek *et al.* most of burns affected the thorax [11].

The average burn surface area in participants of the study was 8.26 ±7.87% TBSA, which was smaller than in the study of Gontko *et al.*, in which the average TBSA was 12.13% TBSA ±SD 8.64% [13]. In the study of den Hollander *et al.* the mean total body surface area (TBSA) burned for children was 12% (interquartile range 8–25%) [15].

Delgado *et al.* revealed that lack of water supply, low income, and crowding were associated with an increased risk of burn injury in children, while the presence of a living room and better maternal education were protective factors [19]. Vendrusculo *et al.* noticed that the majority of victims of burn accidents in the domestic environment had family income lower than two times the minimum wage [20]. Also, in the study of epidemiologic characteristics, knowledge, and risk factors of unintentional burns in rural children in Zunyi (Southwest China), children living in high-income families were less likely to sustain burns when compared with middle-class families [21]. In contrast to that, in our study 75% of the caregivers assessed the economic situation as very good or good. However, the results are limited because the question was about subjective assessment of the economic situation. Natterer *et al.* also concluded in the results of their study that there does not seem to be an increased risk in the immigrant population or in low-economic-status families [22].

In the study of Palmieri *et al.* about paediatric soup scald burn injuries, households had a mean of 3.0 ±0.3 children in residence [23]. In our study, only in 17.5% of families were there three or more children.

In our study, most of the children lived in two-parent families. Adronicus *et al.* suggest that children with non-accidental burns were more likely to come from single-parent families [24]. Among the potential factors that can lead to increased risk of injury in single-parent families are lower socioeconomic status of the family and lack of adult caregiver supervision.

CONCLUSIONS

Most paediatric patients hospitalised due to burns were under five years old and were more frequently boys. The most common type of injury was thermal burn, usually caused by a hot liquid. The injury usually affected the trunk and upper extremity, did not extend to the full depth of the skin, and was treated conservatively.

That means that the prevention programs should be aimed at minimising the risk of burns in the group at highest risk: children under one year old, and should concentrate on education of caregivers about situations that put their children at risk of burn injury and on limiting the possibilities of injury.

DISCLOSURE

The author declares no conflict of interest.

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