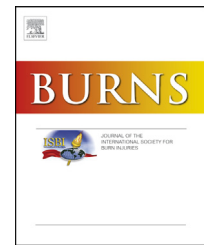


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Trauma mechanisms and injury patterns in pediatric burn patients

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ABSTRACT

The objective of this study was to evaluate the frequency, severity, exact patterns and mechanisms of burn injuries in children.

The patient records of children with acute burns admitted to the University Children's Hospital of Zurich were retrospectively reviewed over an 11 year period.

The age group with the highest risk, were children under the age of five (69%). Boys were overrepresented in all age groups, but the gender imbalance increased with age.

Infants and toddlers were mainly injured by scalds and contact burns. Conversely, almost three quarters of injuries over the age of 9 were caused by flame. The majority of scald injuries was a result of pulling down hot liquids. The typical distribution of this accident scenario involved mainly the face, trunk and arms.

More than half of all flame injuries occurred due to fire accelerants. 55% of children were passively involved while other children throwing flammable substances into a fire. Most of these injuries involved the face and arms.

This study shows that burn etiology is age dependent. Additionally, our results demonstrate the diversity of burn accidents and their resulting injuries. These findings may help better specify target groups and subjects for prevention.

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1. Introduction

Burn injuries in children are very common. Children that are burned often suffer lifelong scarring and/or loss of function. To avoid such injuries, attention needs to be paid to prevention. Prevention requires knowledge about both accident mechanisms and child population groups affected by such injuries.

The Swiss Council for Accident Prevention (bfu) extrapolated that approximately 16,750 patients had chemical injuries or were burned annually between 2004 and 2008 in Switzerland (out of a mean resident population of 7,2 million people). About 63% of these cases were children under the age of 16 [1]. (The reason for this extrapolation was that many burn injuries were not treated in hospitals and, therefore, not recorded in registers).

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There are three burn centers in Switzerland where patients are treated in accordance to the American Burn Association guidelines (ABA). Two of these centers treat children. Annually, in Switzerland, about 1000 patients are hospitalized with burn injuries. Between 20-30% of these patients are children. Of these 1000 patients, 180 are treated in one of the three burn centers [2]. In 2009, 89 children with burn injuries were included in a prospective study in the Lausanne area. In this study, the burn mechanisms, ages and burn accident circumstances were analyzed [3]. The study described, that the highest "at risk" candidate for a burn in the Lausanne area, would be a boy aged 15 month to 5 years who is burned by a cup of hot liquid on his hand, at home, around mealtime, in the presence of one or both parents. To the best of our knowledge, this is the only published epidemiological study that exists about pediatric burns in Switzerland.

However, the worldwide published literature on pediatric burn injuries seems to point out three general trends about burn victims. First, children below the age of 4 (mainly 1 year olds) are at increased risk of burn injuries [3-10]. Second, males are overrepresented among burn victims [3-7,9] and third, infants and toddlers particularly suffer from scalds, in contrast to older children who mainly sustain flame burns [4,11].

Although general epidemiological patterns of burn injuries among children are known, previous epidemiological studies among affected children have provided only limited information concerning detailed burn etiology and the agent(s) involved in the burn accidents. Therefore, the objective of this study was to analyze the frequency, severity, main patterns and detailed mechanisms of burn injuries.

2. Methods

The University Children's Hospital Zurich is the only referral center in Switzerland according to the ABA guidelines for pediatric burn injuries exclusively. Our center fulfils two main functions, namely serving as a regional burn center (approximately 1,2 million inhabitants) as well as a national burn center for the Italian and German speaking part of Switzerland (approximately 6 million inhabitants). The admission criteria of our burn unit are listed in Table 1.

For the purpose of this study, all medical records of acute burn patients admitted to the University Children's Hospital of

Zurich between January 1998 and December 2008 were reviewed retrospectively. Readmissions were excluded.

A total of 765 patients with acute burn injuries were admitted to our unit in the observed time period. From this group of eligible individuals, 749 (97,9%) were included in this analysis (Fig. 1).

All pertinent information including age, sex, burn etiology, mode of injury, extent and depth of injury, burn site, child abuse, mortality and the child's involvement in the accident were retrieved from the patient records and initially collected in an excel file. In a second step, data was transformed into SPSS (version 19.0 for Windows). Mann-Whitney U-tests or Kruskal-Wallis tests were used to assess the association between continuous variables, Spearman-Rho test was used to assess correlation between variables. A p-value <0.05 was considered significant. In case of multiple tests, Bonferroni correction was performed.

The study was approved by the Ethic Committee of the University Children's Hospital of Zurich.

2.1. Theory

Epidemiological analyses of pediatric burn injuries in Switzerland, treated in a Third Level Center (which also functions as the local burn care center). This study aimed to identify target groups of victims according to injury pattern and by age.

3. Results

Data showed an increase in hospitalized pediatric burns in our unit over the study period. At the beginning of the study period (1998-2001), 241 patients were hospitalized, giving a mean of 60,3 patients per year. In the middle of the study period (2002-2005), 265 patients were hospitalized, giving a mean of 66,3 patients per year. At the end of the study period (2006-2008), 243 patients were hospitalized, giving a mean of 81 patients per year.

3.1. Age and sex

The median age of burn patients was 2 years 2 months (range 3 days to 15 years 10 months). Of all patients admitted, 479 (64%) were male and 270 (36%) female, giving a male to female ratio of 1,8:1. Males were overrepresented in all age groups, but the gender imbalance increased with age. It started from 1,4:1 at <1 year of age to 5:1 at >14 years of age. The predominance of males was statistically significant for all age groups older than 1 year.

Infants and toddlers (<5years) were most likely to be admitted to hospital for inpatient treatment. Children between one and two years were at the highest risk for burn injuries and accounted for 36% (n=272) of all patients.

3.2. Burn etiology

During the 11-year study period (1998-2008), the absolute number of scalds increased constantly by 193%. The number of

Table 1 – Admission criteria of our unit.

Extent of burn	Baby with Total Body Surface Area (TBSA) >5% Child with TBSA >10%
Depth	Deep second degree burn All third degree burns
Localization	Always: Face, genitals, circumferential burns
Case history	Depending on extent: Hand, feet, joint Suspected inhalation injury High-Voltage injuries (≥1000 Volt) Suspected child abuse Difficult linguistic communication Complicated social circumstances

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