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## The Parkland Burn Center experience with 297 cases of child abuse from 1974 to 2010

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### ABSTRACT

**Introduction:** Pediatric burns due to abuse are unfortunately relatively common, accounting for 5.8–8.8% of all cases of abuse annually. Our goal was to evaluate our 36-year experience in the evaluation and management of the victims of abuse in the North Texas area.

**Methods:** A prospectively maintained database containing records on all admissions from 1974 through 2010 was queried for all patients aged less than 18 years. Patients admitted for management of a non-burn injury were excluded from the analysis.

**Results:** Of 5,553 pediatric burn admissions, 297 (5.3%) were due to abuse. Children with non-accidental injuries tended to be younger (2.1 vs. 5.0 years,  $p < 0.0001$ ) and male (66.0 vs. 56.5%,  $p = 0.0008$ ). Scald was the most common mechanism of injury overall (44.8%), and was also the predominant cause of inflicted burns (89.6 vs. 42.3%,  $p < 0.0001$ ). Multivariate logistic regression identified age, gender, presence of a scald, contact, or chemical burn, and injury to the hands, bilateral feet, buttocks, back, and perineum to be significant predictors of abuse. Victims of abuse were also found to have worse outcomes, including mortality (5.4 vs. 2.3%,  $p = 0.0005$ ). After adjusting for age, mechanism of injury, and burn size, abuse remained a significant predictor of mortality (OR 3.3, 95% CI 1.5–7.2)

**Conclusions:** Clinicians should approach all burn injuries in young children with a high index of suspicion, but in particular those with scalds, or injuries to the buttocks, perineum, or bilateral feet should provoke suspicion. Burns due to abuse are associated with worse outcomes, including length of stay and mortality.

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Abbreviations: PMH, Parkland Memorial Hospital; TBSA, total body surface area; LOS, length of stay; CPS, Child Protective Services; IQR, interquartile range; OR, odds ratio; CI, confidence interval; REACH, Referral and Evaluation of At-Risk Children; NAI, non-accidental injury.

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## 1. Introduction

Of all the various forms of non-accidental injuries, burns are perhaps the most concerning due not only to long-term sequelae including permanent deformity, loss of function, and long-lasting emotional harm, but also the relatively high risk of mortality. Studies from the 1960's and 1970's reported that non-accidental burn injuries accounted for up to 6–20% of all abuse cases; more recent publications from national samples or from multicenter studies place this rate lower, ranging from 5.8–8.8% [1–3]. In 2013, there were an estimated 122,159 pediatric victims of abuse in the United States; applying the more recent incidence rates suggests that an estimated to 7,085–10,750 children sustained burn injuries as a result of abuse in that year alone [4]. Unfortunately, child abuse as a cause of pediatric burn injury can be challenging to identify in this vulnerable patient population, and literature on this topic is often nonspecific.

The management of pediatric burn patients is already a complex matter, benefiting from a multidisciplinary team approach in order to achieve optimal outcomes; abuse only further adds to the complexity due to the accompanying social, legal, and familial consequences [2,5–7]. Successful management of victims of abuse therefore benefits from not only clinicians, nurses, and child-life specialists with expertise in pediatric burns, but also physicians with special training in child abuse investigation, and social workers with experience working with Child Protective Services (CPS) [8,9]. Many smaller institutions may lack these resources, and the responsibility for identification and reporting of abuse therefore rests on frontline providers.

The purpose of this study was to review our nearly four decade-long experience with pediatric burns in order to evaluate incidence trends over time and to identify patient and injury characteristics which are predictive of a non-accidental injury. These characteristics can aid physicians and nursing staff in the early identification of children with suspicious injuries.

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## 2. Materials and methods

Parkland Memorial Hospital (PMH) is an American Burn Association-verified burn center which serves a large catchment area in North Texas. From 1983 to 2010, Parkland maintained a prospective database to capture details regarding all admissions to our burn unit; admissions from 1974 through 1983 were also added retrospectively. After receiving approval from our Institutional Review Board (UT Southwestern IRB# STU102014-102), this database was queried for all data points regarding patients 18 years of age or younger admitted from January 1974 to October 2010. Data points collected include the following: demographics, burn etiology (e.g. flame, scald, grease, electrical, chemical, contact, other), percent total body surface area (TBSA) injured, location of burn, and whether or not the burn was due to child abuse. Areas of the body were categorized as head/face, chest, back, buttocks, any arm, any leg, perineum, hand, and foot. Children admitted for evaluation or management of a non-burn condition, such as Stevens-Johnson Syndrome/Toxic Epidermal

Necrolysis, were excluded from this study. Of note, our database did not capture patients discharged directly from the emergency room with minor burn injuries.

Per protocol, all children admitted to the Burn Acute Care Unit or Burn Intensive Care Unit are assessed by a social worker and care manager with significant pediatric experience. Any care provider, including physicians, nursing staff, Child Life Services, or the social work/care management staff, can trigger an investigation into the child's social history. In our institution, this involves contacting both local Child Protective Services (CPS) as well as the Referral and Evaluation of At-Risk Children (REACH) service, which is a team of pediatricians trained in the evaluation of non-accidental traumas. For this study, abuse cases were defined *a priori* as a non-accidental injury (NAI) that was determined to be intentionally caused by someone other than the patient (e.g. parent or other care provider). All other patients, including those who underwent investigation and/or CPS referral but were determined to not have an NAI, were used as the control group. In other words, CPS referral alone was not sufficient to characterize an injury as abuse.

The incidence of burns due to child abuse was calculated as the number of events per 1,000,000 children in the North Texas area per year since 1990, based on available population estimates from the Texas Department of State Health Services [10,11]. The proportion of annual admissions due to child abuse from 1974 to 2010 was calculated using the number of pediatric admissions to the Parkland Burn Center as the denominator.

Univariate comparisons were made using Student's *t*-test and  $\chi^2$  for normally distributed data, and Wilcoxon rank-sum testing for non-normally distributed data. Multivariable logistic regression was performed to predict the probability of abuse based on clinical factors, as well as to assess for the impact of abuse on the risk of mortality after adjusting for other known drivers of mortality risk (e.g. age, burn size, and mechanism); initial models were created using any independent variables that were suggested to have an effect on univariate analysis ( $p < 0.1$ ); variable selection was then optimized using the Akaike Information Criterion. Significance for all tests was set at  $\alpha = 0.05$ . Statistics were performed using the R statistical environment (Version 3.2.2, Vienna); logistic regressions were completed using the "rms" package for R.

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## 3. Results

From January 1974 through October 2010, a total of 5,553 children aged less than 18 years were admitted to PMH following a burn injury. Of these, 392 (7.1%) were referred to CPS for evaluation for possible NAI. Following interviews with our social work staff and investigation by CPS and REACH, there were 297 cases of confirmed abuse; the remaining 5,256 served as the control group. From 1990 through 2010, there was no significant trend in either the incidence of pediatric burns due to abuse or the rate of burn cases referred for CPS evaluation per 1,000,000 children in the North Texas area (Fig. 1). Similarly, from 1974 to 2010, there has been no significant trend in either the proportion of pediatric burn admissions that are deemed to be due to abuse (Fig. 2).

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