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# Epidemiology and resource utilization in pediatric facial fractures

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## ABSTRACT

**Background:** Pediatric facial fractures, although uncommon, have a significant impact on public health and the US economy by the coexistence of other injuries and developmental deformities. Violence is one of the most frequent mechanisms leading to facial fracture. Teaching hospitals, while educating future medical professionals, have been linked to greater resource utilization in differing scenarios. This study was designed to compare the differences in patient characteristics and outcomes between teaching and non-teaching hospitals for violence-related pediatric facial fractures.

**Methods:** Using the 2000–2009 Kids' Inpatient Database, 3881 patients younger than 18 years were identified with facial fracture and external cause of injury code for assault, fight, or abuse. Patients admitted at teaching hospitals were compared to those admitted at non-teaching hospitals in terms of demographics, injuries, and outcomes.

**Results:** Overall, 76.2% of patients had been treated at teaching hospitals. Compared to those treated at non-teaching hospitals, these patients were more likely to be younger, non-white, covered by Medicaid, from lower income zip codes, and have thoracic injuries; but mortality rate was not significantly different. After adjusting for potential confounders, teaching status of the hospital was not found as a predictor of either longer lengths of stay (LOS) or charges.

**Conclusions:** There is an insignificant difference between LOS and charges at teaching and non-teaching hospitals after controlling for patient demographics. This suggests that the longer LOS observed at teaching hospitals is related to these institutions being more often involved in the care of underserved populations and patients with more severe injuries.

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## 1. Introduction

According to the Centers for Disease Control and Prevention (CDC), over 16,000 deaths occur per year as a result of interpersonal violence and assault [1]. Annual assault-related emergency department visits are estimated at over 2 million [1]. Interpersonal violence and assault have been known as frequent mechanisms of facial fractures, and several studies

have identified the craniofacial region as the most common body part injured during interpersonal violence [2–14]. Facial fractures have a special place among injuries as the facial skeleton has a complex structure, which protects the eyes, forms the airway, and is the entrance to the alimentary canal. It has also been shown that facial fractures are frequently accompanied by severe injuries of other body parts [2,8,10]. Children account for nearly 14% of all facial fractures [15]. A

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survey of pediatric facial fractures has shown that children with facial fractures have more severe injuries to the head and the chest, longer lengths of hospital and intensive care unit stays, higher hospital charges, and higher mortality rates compared with other pediatric trauma patients who did not sustain a facial fracture [2]. Due to this complexity, management of facial fractures usually requires collaboration of different specialties including otolaryngology, plastic, maxillofacial, and general surgery.

Evaluation of independent risk factors for poor outcomes in this patient population would help to stratify patients into those who may need extra attention. This could be achieved by using a large sample derived from national representative data. Previous studies have used available national databases to characterize patients with facial fractures; however, the main focus of most of these has not been on violence against pediatric populations. Furthermore, none have evaluated the role of teaching hospitals as a plausible independent predictor of outcomes by adjusting for potential confounders.

The American Hospital Association introduces the role of the teaching hospital "... (to) educate and train future medical professionals, conduct state of the art research, care for the nation's poor and uninsured people, and stand ready to provide highly specialized clinical care to the most severely ill and injured" [16]. Several previous studies have indicated correlation between teaching hospitals and greater resource utilization based on longer lengths of stay (LOS) and higher total charges in various surgical and medical conditions [17–21]. In the current environment, such excess resource utilization will hamper the ability of those providers to provide that care, if the excess resource utilization truly does exist. The objective of the present study was to compare the epidemiology and outcome of violence-related pediatric facial fractures between teaching and non-teaching hospitals by using the largest all-payer inpatient pediatric database.

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## 2. Methods

The Kids' Inpatient Database (KID), as a part of the Healthcare Cost and Utilization Project, developed by the Agency for Healthcare Research and Quality, was studied to identify patients with facial fractures [22]. It is the largest US administrative all-payer pediatric inpatient database based on discharge data of patients younger than 21 years of age from more than 4100 US community hospitals. This database has a unique sampling design by providing discharge weights, which enables national estimation of inpatient stays. The KID has been available every 3 years since 1997.

Using the KID 2000, 2003, 2006, and 2009, a total of 21,533 patients younger than 18 years old, with at least one International Classification of Diseases (ICD)-9 diagnosis code for a facial fracture were identified. Patients without injury codes associated with violence were excluded, and only the patients with an ICD-9 external cause of injury code for assault, fight, or abuse were included in the study. All data were weighted to represent US discharges. A total of 3881 patients were included, representing 6165 pediatric hospitalizations for facial fractures during the 4 analyzed years. For the purpose of this study, all data analysis was performed using the weighted

sample. Patients were divided into two groups based on the teaching status of the hospital. Forty-seven patients were excluded due to missing values for hospital teaching status. Healthcare Cost and Utilization Project classifies a hospital as a teaching hospital if it has an American Medical Association–approved residency program, is a member of the Council of Teaching Hospitals, or has a ratio of 0.25 or higher of full-time equivalent interns and residents to beds [22].

Evaluated demographic data included age, race, primary payer, and median household income for the patient's zip code. The fractured facial bone(s) and concomitant injuries were identified using the respective ICD-9 codes. Injuries were defined by any fracture, dislocation, sprain or strain, open wound, blood vessel injury, or internal organ damage. Superficial wounds were not considered as concomitant injuries. Concomitant injuries were categorized as cranial, head and neck, cervical spine, abdominopelvic, thoracic, extremity, or other injury. Mortality, LOS, and total hospital charges were evaluated as outcomes of interest. Total charges for years 2000–2006 were adjusted for inflation rate. The patients treated at teaching hospitals were compared to patients treated at non-teaching hospitals in terms of demographics, site of fracture, and concomitant injuries using chi-square tests for categorical variables and the Student's t-test for the only numerical variable (age). The association of hospital teaching status with mortality was assessed using the chi-square test. The correlation between teaching status of the hospital with LOS and hospital charges was evaluated using the Student's t-test. Because the residual of this association did not have a normal distribution, a logarithmic transformation was applied to the LOS and charges data. The resultant residual distributions were normal. Finally, using separate multiple regression models, the effect of teaching status on LOS and charges was evaluated while adjusting for other potential confounders. Statistical analysis was performed using Statistical Analysis System 9.3 (SAS Institute Inc, Cary, NC), and significance was defined as  $P < 0.05$ ; odds ratios were reported with 95% confidence intervals where applicable.

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## 3. Results

Using the described inclusion and exclusion criteria, 3773 patients were identified representing a weighted sample size of 6086. The weighted frequency was 4652 (76.4%) for teaching hospitals and 1434 (23.6%) for non-teaching hospitals. Table 1 summarizes demographic characteristics by hospital type. Most of the patients in both groups were male (92.6% and 91.6%, respectively;  $P = 0.41$ ), and no significant gender difference existed between teaching and non-teaching hospitals. Frequency of violence-related facial fractures showed significant increase by age with the mean age for patients treated of 15.3 and 15.6 years at teaching and non-teaching hospitals, respectively ( $P < 0.0001$ ). The two groups were significantly different in terms of race and primary payer ( $P < 0.0001$ ). Most of the patients treated at non-teaching hospitals were white (51.3%) and covered by private health insurance (51.2%), whereas the patients treated at teaching hospitals were more likely to be African American (42.9%) and covered by Medicaid

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