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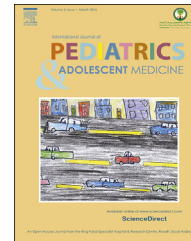


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ORIGINAL RESEARCH ARTICLE

Foreign body injuries in children: Are the younger siblings doomed?



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Abstract *Background and objectives:* Foreign body injury (FBI) is a considerable public health issue for children. Although the relationships of FBI with age, gender, and objects of injury have been studied, the extent to which other demographic factors influence FBI is unclear. We hypothesized that the risk for FBI increases with the number of children in the household.

Design and settings: This was a retrospective analysis of 223 patients aged 2–10 years who presented to the emergency department of an inner-city pediatric hospital and who were found to have FBI.

Patients and methods: The guardians were contacted via phone to examine the associations of FBI with income, parental educational level, number of children in the household, and birth order while controlling with a matched population of 250 patients. Statistical analyses using frequencies and univariate and multivariate analyses were performed.

Results: For each increase in the number of children, the risk of FBI increased 1.44-fold (OR = 1.442). With each increase in the number of caregivers, the risk of a FBI decreased 33% (OR = 0.673). With each increase in income category, the risk of a FBI decreased 59% (OR = 0.413).

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Conclusion: The results suggest that an increase in the number of children in a household is associated with a greater risk of FBI.

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1. Introduction

Foreign body injuries (FBIs) in the auditory canal, nasopharynx, and oropharynx of pediatric patients represent substantial causes of morbidity and mortality in young children. Foreign body exposure is one of the five most common hazardous pediatric exposures, and 4100 deaths were attributed to FBIs in the oropharynx and trachea in 2006 [1,2]. The current body of literature suggests that FBI is associated with the male gender, a young age, and medical and psychiatric comorbidities [3–5]. The combined rate of death and anoxic brain injury associated with pediatric foreign bodies is approximately 4% [1,4]. Furthermore, FBI represents a large financial burden. The annual overall inpatient cost associated with pediatric oropharyngeal FBI is approximately \$12.8 million. The current body of evidence suggests that foreign bodies are most commonly found in the auditory canal followed by the nasopharynx and oropharynx, and oropharyngeal injury results in the greatest mortality [1]. The population that is at the greatest risk is young children; studies have reported increased risk among children ranging in age from under 18 months to less than 10 years [3–6]. Furthermore, male children appear to be at a greater risk of FBI [3]. The most common objects of injury include beads, toys, and seeds [3]. More recent studies have linked FBI vulnerability with different populations. A study by Shlizerman et al identified young male Arab patients as a population in the area that is more vulnerable to FBI [6]. Furthermore, medical comorbidities, such as developmental delays, have long been established as risk factors, and recent literature has identified links between FBI and psychiatric and behavioral conditions such as ADHD (Attention Deficit Hyperactivity Disorder).

Although previous studies have identified age, male gender, and medical and psychiatric comorbidities as risk factors for FBI, the roles of other demographic factors, including urban neighborhood, number of children in the household, parental education, and socioeconomic status (SES), are unclear [3,4,7–13]. The primary objective of the present study was to investigate the associations of household demographics, parental education level and socioeconomic status with and foreign body injuries in a pediatric population [14].

We hypothesized that the risk of FBI would increase with increases in the number of children in the household, lower parental educational level and lower socioeconomic status and decrease with the number of adults in the household.

The clinical goals of this study were to establish specific and effective protocols of anticipatory guidance for families to prevent injuries such as FBI that are associated with potentially high mortality and morbidity.

2. Patients and methods

This study was approved by the St. Christopher's Hospital for Children and the Drexel University College of Medicine institutional review boards.

2.1. Participants and data collection

The hospital records of 650 patients between the ages of 2 and 10 years who were seen at the St. Christopher's Hospital for Children Emergency Room with FBI beginning in 2010 were obtained through a retrospective electronic medical record review. St. Christopher's Hospital is a level 1 trauma center with approximately 75,000 visits per year. Patients with documented developmental delays were excluded. The remaining 250 patients were contacted by telephone, and demographic parameters, including household members, caregivers, highest level of education in the household, and income, were collected via surveys conducted by research personnel. Two hundred twenty-three of those contacted agreed to participate. Once the data were collected, the study was expanded to include matched controls. Another 250 patients between the ages of 2 and 10 years who were seen at St. Christopher's Emergency Room for reasons other than FBI were identified and contacted for phone survey. Of these patients, 250 agreed to participate, and the same demographic information was collected. Of the 250 controls, the three most common diagnoses were otitis media ($n = 66$), acute upper respiratory infection ($n = 49$), and viral infection ($n = 39$). In total, there were 473 participants aged 2–10 years, and the mean age was 3.4 years.

2.2. Predictor variables

The investigated predictor variables included household members, caregivers, level of education, and household income. The participants were asked to list all of the people living in their household, their relationships, and the total number of children cared for. The participants were asked to specify the primary caregiver, which was defined as the individual who spent the greatest portion of time caring for the child outside of teaching professionals. Education levels were tabulated in the following categories: some high school, high school graduate or equivalent, some college, and college graduate. Yearly income levels were categorized as follows: \$0–20,000, \$21,000–\$40,000, \$41,000–60,000, \$61,000–90,000, and greater than \$90,000. These intervals were modeled after the categorization for state benefits of the Pennsylvania Department of

Health and Human Services. Other collected information included the neighborhood of residence, patient age, FBI site, and final diagnosis from the St. Christopher's Emergency Room.

2.3. Statistical analyses

Descriptive analyses were performed on both the outcome and predictor variables to identify differences in FBI based on demographic factors. Statistical significance was defined as $P < .05$. Initially, univariate analyses in which each possible risk factor was independently evaluated in terms of its relationship with the occurrence of FBI were performed. The statistically significant risk factors identified in the univariate analyses (i.e., father as caregiver, number of children in the household, and income) were evaluated in combination to determine their relationships with FBI in a multivariate analysis. The number of children per household, the father as the caregiver, and income were further analyzed with univariate and multivariate analyses in terms of the relations of these factors with specific FBI (i.e., auditory canal, nasopharynx, and oropharynx injuries).

3. Results

3.1. Sample characteristics

3.1.1. Households

Of the 233 patients with FBI, 38% had auditory canal injuries ($n = 89$), 39% had nasopharyngeal injuries ($n = 92$), and 23% had oropharyngeal injuries ($n = 51$). All 233 participants lived in urban settings, which was consistent with the control population. Sixteen percent reported that the patient was an only child ($n = 37$), 36% reported having two children in the household ($n = 84$), and 48% reported having more than three children ($n = 112$). Overall, 84% of the participants had more than two children in the household ($n = 196$). Eighty-six percent reported the mother as the primary caregiver ($n = 201$), 12% reported the father as the primary caregiver ($n = 28$), and 2% reported a primary caregiver other than the mother or father, and these findings were consistent with the corresponding findings from the controls.

3.1.2. Income and education

Twenty-three percent of the participants reported some high school as the highest level of education ($n = 53$), 50% reported being high school graduates ($n = 116$), 8% had some college education ($n = 19$), and 19% were college graduates ($n = 45$). Among the families with FBI, 14% reported yearly incomes of \$0–20,000 ($n = 32$), 44% reported \$21,000–40,000 ($n = 102$), 21% reported \$41,000–60,000 ($n = 49$), 4% reported \$61,000–90,000 ($n = 9$), 3% reported incomes greater than \$90,000 ($n = 7$), and 22% did not disclose their incomes ($n = 51$). The income and education data were consistent between the patient and control populations. [Table 1](#) presents all of the sample characteristics with comparisons with the control data.

Table 1 Socioeconomic characteristics of study participants. The children who presented to the ED with foreign body injury (FBI) and those who presented for different medical reasons are compared.

| Variable | With FBI (n = 223) | Without FBI (n = 250) |
|--|-----------------------|--------------------------|
| <i>Children in household</i> | | |
| Only child | 16% | 63% |
| 2 children | 36% | 23% |
| 3 or more | 48% | 14% |
| >1 | 84% | 36% |
| <i>Highest level of education in household</i> | | |
| Some high school | 23% | 10% |
| High school graduate | 50% | 49% |
| Some college education | 8% | 24% |
| College graduate | 19% | 17% |
| <i>Caregiver</i> | | |
| Mother | 86% | 87% |
| Father | 12% | 7% |
| Other | 2% | 6% |
| <i>Income</i> | | |
| 0–20,000 | 14% | 18% |
| 21,000–40,000 | 44% | 23% |
| 41,000–60,000 | 21% | 19% |
| 61,000–90,000 | 4% | 10% |
| >90,000 | 3% | 7% |
| Below poverty line (2014) | 60% | 41% |
| Did not disclose | 22% | 23% |

3.2. Descriptive analyses

The univariate and multivariate analyses revealed statistically significant relationships of FBI with the number of children in the household, the number of caregivers, the father as the primary caregiver, and income stratification. With each increment in the number of children, the risk of FBI increased by 1.44-fold (OR = 1.442). With each increase in the number of caregivers, the risk of a FBI decreased 33% (OR = 0.673). Furthermore, the father as the caregiver was associated with a 2-fold increase in the risk of FBI (OR = 2). With each increase in income level, the risk of FBI decreased 59% (OR = 0.413). The other investigated demographic factors were not predictive of FBI.

Further univariate and multivariate analyses of the predictors in terms of the site of FBI demonstrated that the number of children in the household and income level were significantly related to all three of the sites of injury. For each increase in the number of children, the risks of FBI increased by 1.42-fold in the auditory canal (OR = 1.416), 1.35-fold in the nasopharynx and 1.67-fold in the oropharynx. With each increase in income, the risks of FBI decreased by 64% in the auditory canal, 56% in the nasopharynx, and 55% in the oropharynx. The father as the primary caregiver was associated with 3.9- and 2.6-fold increases in the risks of auditory and nasopharyngeal FBIs, respectively, but this factor was not significantly related to oropharyngeal FBI. [Table 2](#) presents the results of the univariate and multivariate analyses of all of the investigated predictors.

Table 2 Multivariate analysis of the data with *P*-values and CIs. The number of caregivers, number of children in the household, income and father as the caregiver factors that significantly influenced presentation with foreign body injury.

| Predictor | <i>P</i> Value | Odds ratio | Confidence interval (95%) |
|----------------------|----------------|------------|---------------------------|
| Number of caregivers | .0215 | 0.673 | 0.48–0.943 |
| Number of children | .0014 | 1.44 | 1.152–1.804 |
| Mother as caregiver | .1136 | 1.66 | 0.886–3.108 |
| Father as caregiver | .0139 | 1.994 | 1.151–3.456 |
| Education | .8821 | <0.001 | <0.001–>999.999 |
| Income | <.001 | 0.413 | 0.325–0.525 |

4. Discussion

Our data suggest that FBIs are significantly associated with the number of children in the household, the father as the main caregiver, and lower income.

As noted, each increase in number of children significantly increased the risk of FBI by 1.44-fold ($P < .05$). This finding is consistent with our initial hypothesis that the second and third children are at a greater risk of FBI than the first child. This phenomenon could be the result of false parental impressions of adequate supervision of the younger children by the older siblings. Consequently, caregivers may provide less directed supervision for younger children, which increases the risk of FBI. Furthermore, it is possible that older siblings, many of whom may also be young, may increase the risk of FBI in their younger siblings through play. The role of age differences between siblings was not examined in our study and represents a potential research question. Second, our results suggest the father as the primary caregiver doubled the risk of FBI. While this finding may also be related to decreased targeted supervision of the children, this finding may be limited to our population, and further studies are needed.

Finally, we found that each increase in income level decreased the risk of FBI by 59% (OR = 0.41). This finding may highlight the role of monetary resources in eliciting appropriate childcare. Families with lower SESs may not be able to afford childcare in which the caregiver-to-child ratio is high, and thus directed child supervision may be inadequate and result in an increased risk for and incidence of FBI.

The remaining investigated predictors, including education level, were not significantly associated with the risk of FBI.

The challenges for our study included having the patients agree to the phone survey and communicating with the non-English speaking population. There was also the risk of recall bias because the study was based on phone surveys; however, we attempted to minimize this risk by cross-checking the reported information with the information documented in the patients' charts.

Our results have not been replicated in other studies. As cited earlier, the associations between FBI and demographic factors have been limited to age, gender, and

medical comorbidity. Thus, our results are the first to suggest that the number of children in the household, the father as a caregiver, and low SES are associated with increases in the risk of FBI. One limitation of this study is the congruent population; i.e., all participants were from an urban neighborhood. Further studies involving multiple neighborhoods and variable education levels would strengthen the identified associations.

The relationships of FBI with the number of children per household, the father as the caregiver, and income level highlight the importance of psychosocial context in pediatric injury. Understanding demographic risk factors for FBI can enable appropriate primary injury prevention measures. Our results emphasize the importance of directed supervision and the potential of play-related injuries as avenues for the prevention of FBI.

Disclosure

No financial assistance was received to support this study.

Conflict of interest

The authors declare that there are no known conflicts of interest.

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