



Geographic health disparities in the Los Angeles pediatric esophageal foreign body population



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ABSTRACT

Objective: To assess geographical sociodemographic differences in the pediatric esophageal foreign body population of Los Angeles.

Methods: We retrospectively reviewed the medical records of 128 consecutive pediatric patients at Children's Hospital Los Angeles (CHLA) from 2014 to 2017 with a diagnosis of a retained foreign body in the esophagus removed by rigid or flexible esophagoscopy. Sociodemographic information including zip code of residence was extracted and analyzed with Chi-square, Fisher's exact test, and multivariable logistic regression.

Results: The average age of patients with a retained esophageal foreign body in this study was 2.5 years old, 52.3% were male, 91.4% had no past medical history, 53.1% were Hispanic, 82.0% had public health insurance, and 63.3% were transfers from an outside hospital. The most common foreign body removed was a coin. There were no significant differences in gender, race, type of health insurance, or income between patients that lived within 10 miles of CHLA versus farther than 10 miles. On multivariable analysis, zip codes with a high volume of esophageal foreign bodies were more likely to be lower income neighborhoods. Gender, race, type of health insurance, and distance from CHLA were not risk factors for zip codes with a high volume of esophageal foreign bodies.

Conclusion: Geographic areas in the greater Los Angeles community with a high volume of retained esophageal foreign bodies requiring endoscopic removal at our institution are associated with lower income neighborhoods. Further studies should be performed to better understand health disparities within the U.S. pediatric esophageal foreign body population.

1. Introduction

Foreign bodies (FB) in the aerodigestive tract are a significant cause of morbidity in children. This type of injury is usually simple to treat, but must be managed urgently to prevent the adverse effects of delayed diagnosis [1]. Negative outcomes and complications depend mainly on the length of time or type of foreign body that has been lodged in the aerodigestive system [2,3]. A delay in care can lead to significant complications such as dysphagia, dyspnea, respiratory infection/pneumonia, cyanosis, hemoptysis, or even perforation [4,5].

In the United States, 68,371 cases of foreign body ingestion in children five years old and under were reported to poison control centers in 2015 with coins being the most commonly ingested foreign body [6]. Developmental curiosity and immature swallowing coordination likely predispose this population to foreign body ingestion [7].

Despite being associated with serious consequences, children with esophageal foreign bodies may initially present with minimal symptoms, and in some cases may even be asymptomatic [4]. The most common locations where a foreign body becomes lodged are in the cervical esophagus distal to the cricopharyngeus, thoracic inlet, and aortic arch. Management includes immediate removal via esophagoscopy for symptomatic children and batteries. Initial watchful waiting with serial radiographs is advised for asymptomatic children followed by esophagoscopy if there is evidence the foreign body is lodged [8].

Numerous studies have demonstrated that prevention and patient education play a crucial role in the management of foreign body injuries, due to the risk of late diagnosis or delay of care [4,9,10]. Risk factors for foreign body ingestion that have been described in the literature include a male predominance, average age between 2 and 5 years old, and history of neurodevelopmental delay [11]. However, there have been no studies reported in the literature assessing whether

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geographic health disparities exist in the pediatric esophageal FB population in the United States. In this study, we examine the relationship between geographical sociodemographic characteristics and pediatric esophageal FBs seen at a single institution in a large diverse U.S. metropolitan area.

2. Methods

We performed a retrospective chart review of all children who underwent esophagoscopy for suspected FB ingestion at Children's Hospital Los Angeles, the largest regional referral center for children in southern California, from May 19, 2014 to May 18, 2017. The protocol was approved by the University of Southern California's Institutional Review Board under expedited review and in compliance with HIPAA guidelines. Patients were identified by searching for CPT codes "43194" and "43215", which code for flexible or rigid esophagoscopy with foreign body removal, as well as manually searching surgical scheduling records for all esophagoscopy procedures. Patients were included in the study if 1) the patient was between 0 and 18 years old; 2) the foreign body was removed in the operating room; 3) the foreign body was in the proximal esophagus, defined as located at or below the cricopharynx and above the lower esophageal sphincter per the operative report. All other patients were excluded. Included patients had their medical records reviewed and data collected included self-reported demographic information, clinical, and medical history. Patients were classified as having a comorbidity if they had any chronic medical problem documented such as asthma, developmental delay, cardiac disease, etc. Type of FB was also recorded. Time of FB removal was categorized into seasons: winter (Jan.–Mar.), spring (Apr.–Jun.), summer (Jul.–Sep.), and fall (Oct.–Dec.). There were no patients in this study that had recurrent FB ingestions.

Geographic variables included zip codes which were stratified by distance, income, and volume of esophageal FBs. Distance was stratified into 2 groups: patients living in zip codes within a 10 mile radius of CHLA (4650 Sunset Blvd., Los Angeles, CA, 90027) and those living greater than 10 miles from CHLA. Zip codes were considered lower income if the median household annual income was less than \$45,000/year and higher income if the median household annual income was at least \$45,000/year according to the U.S. Census Bureau [12]. Volume of esophageal FBs were stratified into zip codes that were high volume (at least 3 esophageal FBs in the study's cohort) versus low volume (less than 3 esophageal FBs in the cohort).

The data was imported into RStudio (Boston, Massachusetts, USA) for statistical analysis and Google Fusion (Google, Mountain View, California, USA) for geographical mapping. Statistical significance was defined as a *P* value less than 0.05 using the Student *t*-test for continuous variables and chi-square or Fisher's exact tests for categorical variables. Multivariable logistic regression was also performed to examine differences between high and low volume esophageal foreign body zip codes.

3. Results

A total of 128 consecutive patients had proximal esophageal FBs surgically removed by at CHLA over a 3-year period and were included in the study (Fig. 1). The sociodemographic characteristics of the study's cohort are displayed in Table 1. The average age was 2.5 years old ranging from 9 months to 13 years old. Sixty-seven (52.3%) were male, 68 (53.1%) were Hispanic, 117 (91.4%) had no comorbidities or developmental disorders, 105 (82.0%) had public health insurance, and 81 (63.3%) were transferred from an outside hospital. The majority of patients (54.7%) did not live in a zip code within 10 miles of CHLA, and 67 (52.3%) of patients lived in a lower income zip code. Thirty-five (27.3%) of the patients presented from January to March, while 26 (20.3%) esophageal foreign bodies presented between July to September.

Table 2 describes the distribution of esophageal foreign bodies removed in this study's cohort. The majority of foreign bodies (85.9%) were coins, which included pennies, quarters, and nickels. Of the remaining foreign bodies removed, 3 were button batteries, 2 were bottle caps, 2 were organic material, and the remaining 11 were other inorganic objects.

Table 3 compares patients who lived within 10 miles of CHLA versus greater than 10 miles from CHLA. There was a significant difference between the percentage of patients that were transfers from an outside hospital (78.6% versus 55.2%, $P < 0.01$). In patients who lived within 10 miles of CHLA, 72.5% presented with esophageal FB ingestion between January to June while 61.5% of patients living greater than 10 miles from CHLA presented from July to December. There was no significant difference in gender, race, comorbidities, health insurance, or income.

The 128 patients with esophageal foreign bodies in our study resided in 80 zip codes which were then stratified to determine the frequency of esophageal FBs removed at CHLA per zip code (Fig. 2a). Eleven zip codes (Fig. 2b) had at least 3 patients with esophageal foreign bodies and were considered "high volume". Zip code 90011 (historic south-central Los Angeles) had 6 patients with retained esophageal FBs removed at CHLA, the highest frequency out of all zip codes.

Table 4 displays multivariable logistic regression analysis of living in a high volume zip code versus sociodemographic characteristics. Lower income zip codes were associated with a higher volume of esophageal FBs after controlling for gender, race, health insurance, age, distance, and transfer from outside hospital. No other sociodemographic characteristics were found to be associated with high volume zip codes.

4. Discussion

In this study, we are the first in the literature to report geographic health disparities in the pediatric esophageal foreign body population. Specifically, lower income zip codes were associated with a higher volume of retained esophageal foreign bodies that required surgical removal at our institution.

The sociodemographic risk factors for esophageal foreign bodies are not well-characterized, and relatively few studies have been done to assess these risk factors. Previous studies that evaluated risk factors for pediatric foreign body ingestion have focused on age, gender, and medical history. The mean age for foreign body ingestion in other retrospective reviews is between 2 and 4 years of age with a slight male predominance, consistent with our study cohort [7,13–16]. Other conditions that predispose children to retaining an ingested object include anatomic and functional abnormalities of the digestive tract such as strictures, rings, esophageal dysmotility, history of tracheo-esophageal fistula repair, or eosinophilic esophagitis [7,17]. Neurodevelopmental delay also has been implicated as a risk factor for foreign body ingestion. Binder et al. reported that 29.6% of pediatric patients in their cohort with ingested esophageal FBs had social-developmental-psychiatric risk factors, such as high-risk social situations [17]. However, only 9% of the 125 patients in that study required admission for observation or surgical intervention, and the study did not report what percentage of patients had behavioral or social risk factors in the group that required surgery.

It is unclear whether race or ethnicity is a risk factor for foreign body ingestion. In a 10 year retrospective analysis of 248 children seen at an academic medical center in Mississippi, Denney et al. reported that 61% of the esophageal foreign body patients were African American [18]. The vast majority of retained FBs were coins, similar to our study. However, the study was conducted in a predominantly African American community. In our study, the racial and ethnic distribution of esophageal foreign bodies correlates with the racial and ethnic distribution of the overall population of Los Angeles County based on the U.S. Census Bureau statistics (www.census.gov) suggesting

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