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Pediatric Ingestions of Christmas Past, Present, and Future: A Review of Holiday Trends, 1997 to 2015

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Abstract

During the observance of Christmas, many families display decorations, which increases the risk of unfettered access and subsequent ingestion of small objects by children in the home. Our aim was to characterize the epidemiology of Christmas foreign body ingestion (CFBI) by children. National Electronic Injury Surveillance System data from 1997 to 2015 were obtained for children aged 0 to 17 years who presented to United States Emergency Departments matching "ingested" for "artificial Christmas trees"; "Christmas tree lights"; "Christmas tree stands or supports"; "Christmas decorations, nonelectric"; and "Christmas decorations, electric" (excluding tree lights). An estimated 22 224 children (95% confidence Interval = 18 107-26 340) presented to the emergency department for CFBI over the study period. Children aged 2 years and younger ingested Christmas objects most frequently ($P < .001$). CFBI visits demonstrated a seasonal trend ($P < .001$). Christmas decoration ingestions are a frequent reason for children to present to the ED, which require dedicated awareness for appropriate diagnosis and care.

Keywords

pediatric, ingestions, Christmas, seasonal, emergency, preventative

Introduction

Pediatric patients are prone to foreign body ingestions, which are frequently evaluated in the emergency department (ED). These ingestions can cause a wide range of injuries warranting hospital admission, endoscopy, or even surgery.[1-5] This is best demonstrated in button battery and magnet ingestions, which can result in serious injury to the gastrointestinal tract and death.[2,6-8] Young children pose a particularly high risk for foreign body ingestions and present a unique opportunity for prevention by limiting access to small objects in the home.[9-12] Proper understanding of the epidemiology and potential harm associated with certain ingestions is crucial for recognition and prevention.

D'Ippolito et al identified spikes in all types of pediatric injuries around federal holidays. Injuries occurred more frequently during the summer holidays (Labor Day, Memorial Day, and the Fourth of July) and less frequently during seasonal holidays (Halloween, Thanksgiving, and Christmas).[13] Celebration of the Christmas holiday varies, but for many people in the United States, traditions include decorating the house.[14] This provides unique and unfettered access to small objects. Ingestions around the winter holiday season have been associated with respiratory compromise, gastrointestinal perforation, gastrointestinal resection with subsequent short bowel syndrome, sepsis, and death.[1,3-5,11,15,16] Unique Christmas-related injuries have been documented including ingestions of Christmas bow pins and even dreidels.[17-19]

The seasonal risk of foreign body ingestion around Christmas is unknown. The goal of this investigation is to determine the trends of pediatric Christmas foreign body ingestions (CFBIs) presenting to US EDs.

Methods

We used the National Electronic Injury Surveillance System (NEISS) database to evaluate the frequency of

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suspected CFBI. Based on the NEISS coding manual classification, we focused exclusively on Christmas object product codes (due to absence of other distinguishable holiday codes such as Hanukkah) and searched for ingested objects between 1997 and 2015.[20]

Data Source and Study Population

The NEISS database catalogues ED visits in the United States for injuries related to consumer products from urban, suburban, and rural hospitals. Specifically, the system functions as a stratified national probability sample of greater than 100 hospitals, including 8 children's hospitals. This presents a stratified probability sample of over 6000 hospitals in the country that boast ≥6 beds provided in a 24-hour service model. All institutions included in the database possess the basic capabilities to treat children.

The NEISS can serve as a public health tool allowing for correlative conclusions regarding product risks association with populations to be drawn. Each participating ED documents data daily into the NEISS, including information regarding patient demographics, consumer product codes, diagnosis, affected body region, type of product involved, and disposition. The NEISS provides a foundation for researchers to make population-wide adjusted inferences on various injurious trends and apply them to a national macrocentric concept. Specifically, the NEISS facilitates logging of injury types such as internal (for foreign body ingestions) as well as coding for the object(s) that caused injury, such as Christmas decorations.

Inclusion Criteria and Variable Classification

Subjects from 0 to 17 years old were included using a primary search term for diagnosis of "ingested object" during the time period of January 1, 1997, to January 1, 2016. A single Christmas year celebratory season (celebratory season) included temporally linked days from December to January of follow-on years (ie, the days in December 2015 leading up to Christmas and the period following New Year's Day on January 1, 2016, were reported as Christmas year group 2015). The inclusion criteria for this study was 3-fold: (1) age (0-17 years); (2) the injury documented was ingestion/internal; and (3) the suspected product involved matched one of the following from the NEISS coding manual[20]: artificial Christmas trees (1701); Christmas tree lights (1711); Christmas tree stands or supports (1712); Christmas decorations, nonelectric (1729); and Christmas decorations, electric (excluding Christmas tree lights) (1736).

Statistical Analysis

NEISS-supplied strata, primary sampling unit, and weight variables were used in all analyses with national estimates and variance estimates as outlined in the NEISS documentation.[21] Taylor series linearization was used to generate national estimates with 95% confidence intervals (CIs). This procedure generates population aggregate incidence rates while accounting for the effect of sampling variability. Previously validated by Wolter and Shah, this estimation method remains the gold standard for approximating population values from complex samples.[22-25]

Comparative analysis of the study population proceeded initially with demographics and case descriptors including age, race, sex, and ED dispositions.[20] Race was not available for analysis in 10% (N = 80) cases queried. The analysis of age distributions and case descriptors occurred using 3 subgroups, which represented natural stratifications within the dataset: 0 to 2, 3 to 6, and 7 to 17 years to evaluate ingestion frequency by age. Each subject's disposition was classified by NEISS coding as follows: "treated and released or examined and released without treatment," "treated and admitted for hospitalization," or "transferred to higher facility."[20]

A trend analysis across the celebratory seasons was performed using the Cochran Armitage test of trend.[26] This allowed for an evaluation of winter holiday object ingestion–related ED visit trends across Christmas celebratory seasons. These analyses were performed using NEISS national estimate data as the numerator and the national age-specific population per year (supplied by the US Census Bureau) as the denominator.[27] Last, the seasonality of CFBIs was tested using the X-12 procedure, an adaptation of the US Census Bureau's X-12 Seasonal Adjustment program.[28] A combination of 3 F-tests of seasonality were used: the stable seasonality test, moving seasonality test, and the Kruskal-Wallis test for stable seasonality.[29,30] Our team additionally focused on two 7-week periods leading up to and after December 25 (November 12 to February 12) to analyze ingestions frequencies documented as they related to the actual calendar marked holiday.

A P value $<.05$ was considered statistically significant. This study was reviewed and deemed exempt by the Uniformed Services University of the Health Sciences Institutional Review Board as subjects were de-identified and the data are publicly available online.

Results

From 1997 to 2015, there were an estimated 22 224 children (95% CI = 18 107-26 340) who presented to the

Table 1. Pediatric Christmas Foreign Body Ingestion–Related ED Visits in the Unites States, 1997 to 2015[a,b].

Variable	Actual Sample	National Estimate	95% CI	% of CFBI
Total	821	22 224	18 107-26 340	
Age, year				
0-2	683	18 762	15 207-22 317	84.4
3-6	115	2752	1645-3859	12.4
7-17	23	709	320-1099	3.2
Sex				
Male	468	13 175	10 591-15 759	59.3
Female	353	9049	6686-11 412	40.7
Race				
White	406	11 288	8236-14 340	57.5
Black	59	1081	660-1503	5.4
Other	276	8029	5258-10 801	37.2
Location				
Home	646	17 879	17 808-26 639	80.5
Disposition				
Treated and released or examined and released without treatment	780	21 279	16 935-25 624	95.8
Code, product				
1729, Christmas decoration (nonelectric)	549	14 096	11 314-16 878	66.9
1711, Christmas tree lights	234	6979	5426-8531	28.5
1736, Electric decorations (excluding Christmas tree lights	31	1003	468-1766	3.8
1701, artificial Christmas trees	6	75	7-143	0.7
1712, Christmas tree stands or supports	1	72	0-215	0.1
Total	821	22 224	18 107-26 340	

Abbreviations: CI, confidence interval; CFBI, Christmas foreign body ingestion.
[a]The table depicts basic epidemiology for Christmas foreign body ingestions by children. % CFBI = (Christmas Foreign Body Ingestions of the variable described/Total number of Christmas foreign body ingestions identified).
[b]Ten percent (N = 80) cases did not include data regarding the subject's race.

ED for CFBI, for approximately 1235 encounters per year (generated from 821 ED visits catalogued into NEISS; Table 1). Of those patients reported, children aged 2 years and younger accounted for 84% of ingestions (estimated N = 18 762; 95% CI = 15 207-22 317), $P < .001$. The majority of CFBI occurred in males (59.58%, 95% CI = 10 591-15 759) and among Caucasians (56.09%, 95% CI = 8236-14 340). By comparison, there were 1 127 112 (95% CI = 928 514-1 325 709) national estimated childhood ED visits for suspected foreign body ingestions (total foreign body ingestions [TFBI]) during 1997 to 2015 (estimates derived from 43 809 reported ED visits for ingestions). Figure 1 demonstrates the incidence of suspected CFBI and TFBI during the study period.

An increase in CFBI occurred in the 7-week block surrounding Christmas, with peak ingestion rates for the product codes of interest noted in the days prior to Christmas (median = 13 days before or after Christmas; interquartile range = 4-23 days; Figure 2). Although there was an uptrend in TFBI during the study years ($P < .001$), there was no significant change in TFBI during the 7-week holiday block. Conversely, there was no annual trend in CFBI ED visits during the study years from 1997 to 2015 (Figure 1).

During the 7-week block before and after Christmas, CFBI represented 12.6% of TFBI. When the CFBI-related ED visits were separated by month, a significant seasonal trend was demonstrated ($P < .001$; Figure 3). In contrast, the annual proportion of CFBI to TFBI remained stable throughout the study period (minimum 1.2%, 2013; maximum 3.5%, 2001, encompassing all ingestions from January to December of a single calendar year; Figure 1). The most common type of CFBIs were in the category of nonelectric Christmas decorations (ie, ornaments, bells, candles, snow globes, and others; Table 1). Approximately 85.2% TFBI are treated and released from the ED annually, including 82.5% TFBI treated and released during the 7-week Christmas timeline. By comparison, CFBI demonstrated a lower percent requiring escalation of care, with approximately 95.8% treated and released from the ED over the timeline. Of 601 children, 2.7% (n = 27 subjects) required escalation of care (ie, either hospital admission or

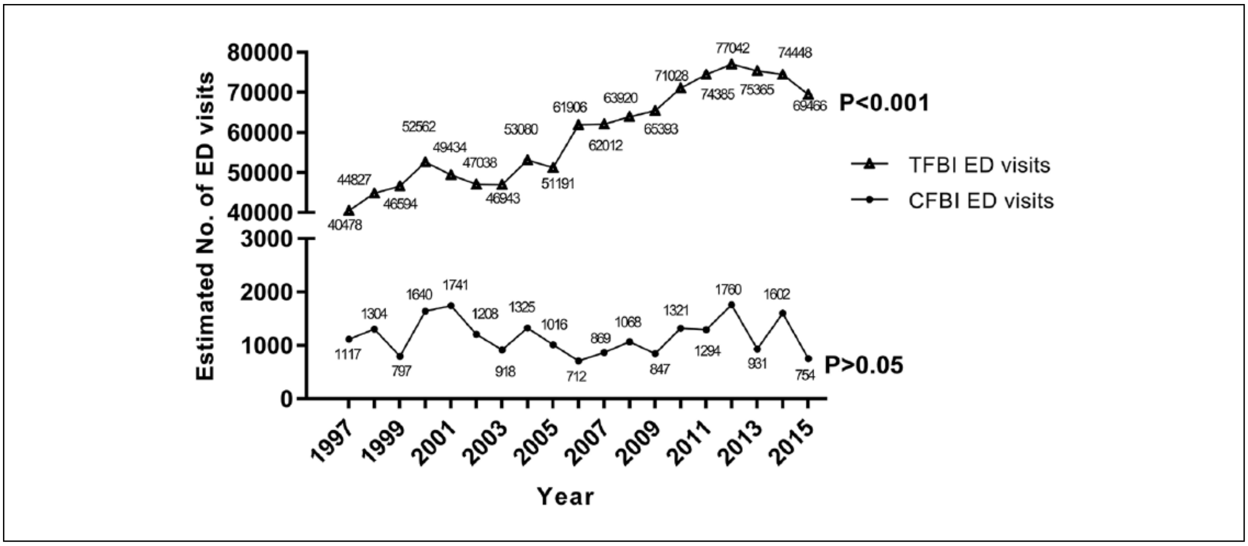

Figure 1. Christmas foreign body ingestions (CFBIs) versus total foreign body ingestions (TFBI) by children, 1997 to 2015. Frequencies of TFBI and CFBI by children, over the study years. While TFBI was demonstrated by Cochrane Armitage Trend to have a significant uptrend ($P < .001$), CFBI did not demonstrate a significant trend.

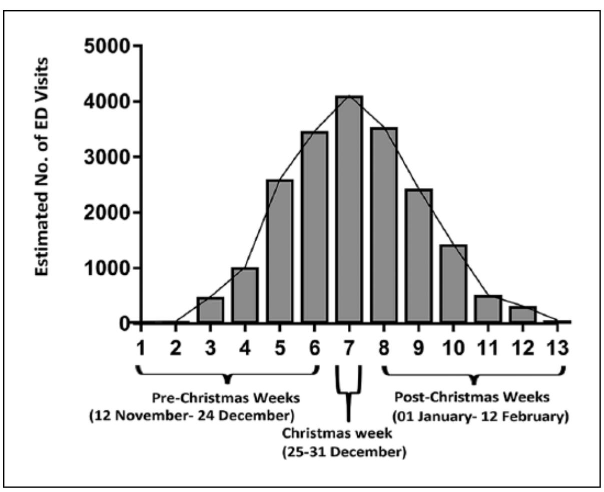

Figure 2. Christmas foreign body ingestions (CFBIs) by children, seasonality histogram in weeks. Frequency of CFBI during the holiday period across the study years, 1997 to 2015.

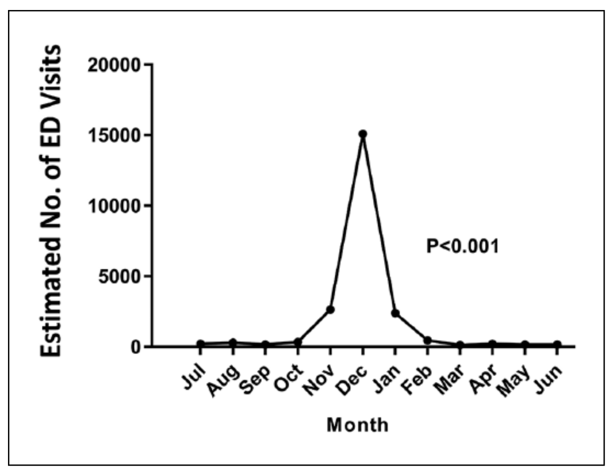

Figure 3. Christmas foreign body ingestions (CFBIs) by children, monthly seasonality plot. Seasonality plot showing a significant increase in CFBI during the winter/holiday months with maximum ingestion frequencies correlating with the Christmas holiday.

transfer from the ED to another facility; 95% CI = 153-1049) from 1997 to 2015.

Discussion

Our study is the first in the literature to describe multiple types of holiday ingestions, in a multicenter setting, with a specific focus on Christmas foreign bodies and trends of ingestion. We found the presence of seasonality associated with the frequency of CFBI concentrated in the months leading up to and following Christmas compared with the remainder of the year. In a more detailed review of the time period around Christmas, we found an increase in CFBI in the days leading up to Christmas, with peak ingestion rates noted in the 13 days before or after Christmas. Additionally, the data were consistent with similarly designed studies that showed that younger children were more likely to ingested foreign bodies, and in this instance, CFBI.[9,11,12] Finally, the study did not reveal any annual trend of CFBI during the time period examined.

Due to the large variety of Christmas object types, CFBI can present medical teams with a multitude of clinical quandaries. A presenting symptom for this type of injury may be oropharyngeal mucosal bleeding or nonspecific gastrointestinal bleed.[31] Our investigation showed that Christmas decorations (nonelectric items with multiple subtypes including ornaments, bells, candles, snow globes, etc) constituted the largest percentage of suspected CFBI on a national scale and present a risk for perforation or impaction. This trend is consistent with Kimia's single-center, case-series description of ornament ingestion in 81% (n = 35) of children.[31] In addition to electrically enhanced ornaments, Christmas tree lights and other electrical decorations present the unique risk of burn and tissue erosion when ingested.[32,33] This risk is compounded by the advent of light emitting diodes and the use of button batteries as a power source. Our study revealed that Christmas tree lights (code 1711) or other electrical decorations (code 1736) constituted 29.5% and 4.7% of the CFBI, respectively. The description of bulb ingestions has been limited previously to small case reports. The frequency of this specific ingestion subtype has been described by Kimia et al (18%, n = 8), Norberg and Reyes (100%, n = 1), and Trout and Towbin (50%, n = 3), with each investigation having documented at least one patient requiring surgical intervention.[31,34,35] Last, Maas et al described the risk for lead toxicity in patients following extended contact with, or ingestion of, older artificial Christmas trees secondary to the breakdown of lead-based structural stabilizers contained within the polyvinyl chloride branches.[36] This investigation demonstrated that approximately 1% of CFBI is attributed to the ingestion of artificial trees in the days following Christmas (possibly linked to the decoration takedown phase). Given to the Center for Disease Control and Prevention's goal for children to have an undetectable serum lead level, the use of older artificial trees as decorations in the home may warrant caution.[37]

While our study cannot report on management strategies employed using NEISS data, the available literature indicates that escalation of care beyond the emergency room (ie, hospital admission or transfer) can occur in as high as 5.2% of CFBI cases, and that the care of these patients can be complex.[31] Skilled radiologists employing 2-view chest radiograph, multidetector row computed tomography, or providers using handheld metal detectors each appears to play an emerging role in the diagnosis and care of these patients.[38,39] Our data revealed that an estimated 2.7% (n = 601) of children with CFBI required escalation of care. By comparison, 14.8% TFBI required escalation of care in our dataset. Our team posits that the higher admission and transfer rates for TFBI are likely related to the propensity for children to swallow coins, small toys, jewelry, chicken/fish bones, and other metallic objects (ie, magnets, button batteries, and screws), which require more dedicated observation and management.[12,33]

Although we have characterized both injury mechanisms and injury trends, a step toward improving injury prevention will be key to health maintenance in pediatric patients. Previously, D'Ippolito and colleagues recommended that future prevention efforts for holiday injuries should focus on general complaints (musculoskeletal, burn, and concussion).[13] While we agree with this foundational model, the data in our study support the use of additional, targeted holiday-specific injury prevention efforts. Anticipatory guidance during visits with primary care providers in the weeks leading up to Christmas may help prevent CFBIs. These could focus on avoiding risk factors such as leaving young children (age = 0-2 years) unattended around decorations of all types during the holiday season. Potential educational resources that may prove beneficial include the American Academy of Pediatrics choking prevention brochure and the Injury Prevention Program age-based handouts.[40,41] Finally, even though the Consumer Product Safety Commission established a small parts regulation for toys in 1980 and furthered regulation with the Consumer Product Safety Improvement Act in 2008, there does not yet exist a regulation to safeguard children against the risks for small Christmas decoration ingestion.[42,43] Future advocacy efforts might focus on improving social awareness, parental education, or even federal oversight with regard to these possibly dangerous decorations.

The NEISS database has several limitations, which include data collection from EDs only. This potentially underestimates rates of foreign body ingestion by children who might otherwise present to primary care clinics, urgent care facilities, were counseled (through their caregiver) via telephone by Poison Control Centers, or never sought care. All foreign body ingestions recorded were "suspected," and confirmed ingestions and management strategies were not reported. In addition, because the NEISS product codes specify Christmas objects, we could not define Christmas versus other holiday (eg, Hanukkah) versus other winter ornament or decoration ingestions.

CFBIs are a documented reason for children to present to the ED. It is reassuring that many of these children are able to be evaluated and released. Children younger than 2 years of age are at the highest risk for ingestions. In the weeks leading up to Christmas, there is an increase in the number of Christmas decoration ingestions. Medical professionals who care for children need to be aware of CFBIs to provide effective, preventive care and timely anticipatory guidance. By empowering families with the knowledge of the risk for decoration ingestion, the overall number of ingestions may potentially be decreased and the risk or need for invasive procedures mitigated.

Authors' Note

This work was prepared as part of the official duties of Drs Reeves, Pasman, and Nylund, who are employed by the United States Army, Navy, and Air Force, respectively. The views expressed in this article are those of the authors and do not reflect the official policy or position of the United States Army, Air Force, Department of Defense, or the United States Government. Title 17 U.S.C. 105 provides that "Copyright protection under this title is not available for any work of the United States Government." Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person's official duties.

Author Contributions

PTR: Conceptualized the study, interpreted the data analysis, drafted the manuscript, and approved the final manuscript.
JK: Acquired and organized the data, performed the data analysis, and revised the manuscript.
EAP: Contributed to study design, developed the data analysis plan, interpreted the data, and revised the manuscript.
CMN: Contributed to study design, oversaw the statistical analysis, interpreted the data, revised the manuscript, and served as subject matter expert and project manager.
All authors approved the final version of the manuscript.

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