

The Impact of the COVID-19 Pandemic on Foreign Body Ingestion Trends in Children: A Comparison of the Pre-Pandemic Period to 2020

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See “Invited Commentary: Chevalier Jackson, the Small Part Test Fixture Tube, the 10th Circuit Court and COVID-19: Impact on Pediatric Foreign Body Ingestions in the United States” by Sinclair and Kay on page 227.

ABSTRACT

Foreign body ingestion (FBI) among children is associated with morbidity and mortality. We used the National Electronic Injury Surveillance System to compare FBI trends from 2017–2019 to 2020 during the spread of SARS-CoV-2. The pandemic and associated stay-at-home orders were associated with uptrends in button battery and magnet ingestions but unchanged total FBI trends.

Key Words: advocacy, emergency medicine, COVID-19 pandemic, foreign body ingestion

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Foreign bodies, such as coins, are commonly ingested by children. Many of these objects reach the stomach and are ultimately excreted without incident. However, some objects can cause serious, fatal injuries when ingested (1,2). The ingestion of dangerous objects like button batteries (BB) and/or small rare-earth magnets

What Is Known

- Foreign body ingestions are common in children, the most clinically dangerous of which are button battery and magnet ingestions.
- Spread of SARS-CoV-2 was accompanied by a national stay-at-home order in early 2020.
- Unfettered access to culprit objects at home has been implicated in foreign body ingestions by children.

What Is New

- The COVID-19 stay-at-home order was associated with uptrends in button battery and magnet ingestions.
- Escalation of care for foreign body ingestion increased in 2020.
- Total foreign body ingestion trends were unchanged during 2020, despite an overall decrease in total medical care

(magnets) are associated with an increased risk for complication, including tissue perforation, exsanguination, sepsis, or death (3,4).

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In January 2020, spread of the SARS-CoV-2 virus in the United States (US) and other countries led the World Health Organization to declare a Public Health Emergency (5). Further spread of the virus throughout the US resulted in 42 state-led, mandatory stay-at-home orders in March 2020 (6). During this time, the Center for Disease Control used mobile device location data to confirm a significant decrease in median population movements for participating regions (6). Even after many of the mandatory, state-led measures taken to limit the spread of SARS-CoV-2 were transitioned to an advisory status in May of 2020, 50% of learners from kindergarten to 12th grade participated in either fully virtual or hybrid learning (i.e., a high rate of academics being conducted in the home) through December 2020 (7). These stay-at-home orders have been associated with increased injuries related to some consumer products like firearms (8,9). Our study aims to investigate whether the coronavirus disease 2019 (COVID-19) pandemic was associated with an increase incidence of foreign body ingestions (FBI) by children.

METHODS

We used the National Electronic Injury Surveillance System (NEISS) to evaluate the annualized incidence of suspected FBI in children 0–17 years of age who presented to emergency departments (EDs).

The NEISS database catalogs emergency department (ED) visits for injuries related to consumer products over a nationwide census. Because all encounters catalogued in NEISS must be related to injury from a consumer product, the database can be used as a surrogate for overall ED injury trends only (i.e., NEISS does not provide incidence data on disease such as viral bronchiolitis). Specifically, the system functions as a stratified national probability sample of hospitals that provide 24-hour emergency medical services, have at least 6 beds, and contain an ED.

We identified 2017–2019 and 2020 as the pre-COVID-19 and COVID-19 periods, respectively. An estimated, annualized pre-COVID-19 value was generated by calculating the mean of the estimated population value for FBIs from actual ED encounters for years 2017, 2018 and 2019 using previously published methods (1,3). The pre-COVID-19 and COVID-19 periods were then compared (e.g., if there were 100 FBI in 2017, 300 in 2018, 200 in 2019, and 400 in 2020, then the pre-COVID-19 period value of 200 was compared to the COVID-19 period value of 400). We then compared FBI cases for children to all pediatric NEISS encounters for the study period of interest. This generated a proportion of FBIs to total NEISS encounters and served as the closest surrogate available to describe FBI trends with respect to all other consumer product-related injury patterns within the database.

We grouped children by age and by the consumer product(s) ingested according to the NEISS coding manual (10). Electronics, coins, toys (excluding electronic toys), jewelry, fasteners (e.g., nails, screws, tacks, bolts, or hair pins), holiday objects, desk supplies, and bathroom objects were included. Search criteria are further defined in Supplemental 1, <http://links.lww.com/MPG/C838>. Objects that do not have a specific product code in NEISS required term search within the narrative for each encounter. For example, magnet ingestion cases were identified based on ingestion encounters that contained the word “magnet” anywhere in the case narrative section. BB ingestions were defined similarly by Orsagh-Yentis et al as encounters which involved product code(s) batteries or battery chargers/adapters and the accompanying case narrative term(s): disc, button, small, or round (2). Escalation of care (EOC) was assigned to cases that were “treated and transferred,” “treated and admitted/hospitalized,” or “held for observation.”

NEISS supplied weights and variance variables were used in all analyses. Taylor series linearization was used to generate national estimates with 95% confidence intervals (CI). Rao-Scott Chi-square was used for all categorical comparisons.

A *P* value <0.05 was considered statistically significant. SAS 9.4 (SAS Institute, Cary, NC) was used for all analyses (11). This study was approved by the Walter Reed National Military Medical Center and Albert Einstein College of Medicine Institutional Review Boards.

RESULTS

There were an estimated 114,859 (CI 83,330–146,387) FBI cases generated from 10,141 ED visits of children ages 0–17 years between 2017 and 2020. Table 1 describes the comparison values for the pre-COVID-19 and COVID-19 periods. The rate of total foreign body ingestion did not differ between the pre-COVID-19 (3.4 cases per 100,000 persons) and COVID-19 (3.5 cases per 100,000) periods, *P* = 0.6 (Table 1). The proportion of FBI cases to total NEISS cases for children ages 0–17 years increased from 1.6% in the pre-COVID-19 period to 2.1% during the COVID-19 period, but this change was not significant.

As in the pre-COVID-19 period, children who were younger than age 6 years continued to demonstrate the highest frequency of FBI during the COVID-19 period. However, compared to the pre-COVID-19 period, there were significant increases in the proportion of children with FBI who were older than age 6 years, *P* = 0.01. The median age of presentation for FBI during the COVID-19 period was 3.8 years (interquartile range, 2.3–6.7 years).

Children presenting for FBI during the COVID-19 period were also more likely to be male (*P* = 0.04) and incur injuries at home (*P* = 0.03) as opposed to school (*P* = 0.001). There was an increase in both electronic FBI (9.2 cases per 100,000, up from 7.8 cases per 100,000; (*P* = 0.01)) and BB FBI (2.2 cases per 100,000, up from 1.5 cases per 100,000; (*P* = 0.01)) during the COVID-19 pandemic (Fig. 1). Similarly, the frequency of total magnet ingestions (*P* < 0.001), small/round magnets (*P* < 0.001), and multiple magnet (*P* < 0.001) FBI all increased in 2020 (Fig. 1), as did bathroom (*P* < 0.001) and holiday object (*P* < 0.001) ingestions. There was a significant decrease in coin ingestions during the COVID-19 pandemic (25.9 cases per 100,000, down from 35.1 per 100,000, *P* < 0.001) but no change in the ingestion incidence of toys, jewelry, fasteners, or desk supplies. Lastly, escalation of care was more frequent and discharge from the ED less frequent for FBI during the COVID-19 period, *P* = 0.01.

DISCUSSION

Our study provides the first assessment of national foreign body ingestion (FBI) trends by children in the United States during the COVID-19 pandemic. Overall rates of FBI did not change between 2020 and the preceding 3 years. The proportion of FBI cases to total NEISS cases for children ages 0–17 years did increase during the pandemic, but this result was not significant. This is notable, however, in that overall pediatric ED care decreased 45.7% during the pandemic – including visits for common diagnoses such as poisoning (33.1% decrease), open wound (17.6% decrease), asthma (73.9% decrease), epilepsy (33% decrease), and gastroenteritis (73.9% decrease) (12,13). While no definitive conclusions can be drawn, these data suggest that FBI would have likely increased in 2020, were it not for a decrease in total care during the COVID-19 pandemic.

Care patterns also changed based on the foreign bodies analyzed. There was a significant increased incidence in dangerous foreign bodies like button batteries and high-powered magnets, for example, and a decreased ingestion incidence in less dangerous

TABLE 1. National Emergency Department Visits for Pediatric Foreign Body Ingestions in the United States from 2017–2019, Compared to 2020. Changes in clinical features, patient demographics, and product ingestions during the COVID-19 pandemic as compared to pre-COVID-19 pandemic characteristics

	2017–2019			2020			P-value*
	N (%)	Rate	Annualized estimate	N (%)	Rate	Annualized estimate	
Total FBI	7531 (100)	81.7	59,933 (42,978–76,888)	2610 (100)	73.4	54,926 (39,698–70,154)	0.62
Age, years							
0–5	5211 (69.2)	57.2	41,917 (29,775–54,060)	1682 (64.4)	47.5	35,513 (25,049–45,977)	0.01
6–10	2017 (26.8)	20.7	15,172 (11,032–19,311)	804 (30.8)	22.9	17,125 (12,563–21,688)	
11–17	303 (4.0)	3.9	2844 (1837–3850)	124 (4.8)	3.1	2288 (1498–3078)	
Sex							
Male	4081 (54.2)	45.4	33,311 (23,387–43,234)	1499 (57.4)	43.6	32,652 (23,318–41,985)	0.04
Female	3450 (45.8)	38.5	28,160 (19,771–36,549)	1111 (42.6)	32.3	24,200 (17,282–31,118)	
Race							
White	3332 (47.6)	35.7	26,202(19,475–32,929)	1193 (48.0)	35.4	26,495 (19,408–33,582)	0.27
Black	1274 (18.2)	9.3	6813 (3556–10,070)	395 (15.9)	7.7	5778 (3553–8004)	
Asian	121 (1.7)	0.9	642 (311–973)	55 (2.2)	0.6	433 (147–720)	
Other	535 (7.1)	0.7	3079 (1886–4272)	125 (4.8)	0.2	2264(1092-3436)	
Not specified	2269 (30.1)	3.1	23,197(6862–39,533)	842 (32.2)	1.1	19,956(5508v–34,403)	
Location							
Home	3532 (47.8)	43.1	31,585 (23,088–40,082)	1232 (47.9)	38.6	28,856 (20,726–36,986)	0.03
School	352 (4.8)	3.7	2678(1855–3501)	46 (1.8)	1.6	1189 (579–1800)	
Other	3647 (48.4)	5.0	25,670 (14,332–37,007)	1332 (51.0)	1.8	24,880 (14,006–35,754)	
Disposition							
Escalation of care	1143 (15.2)	9.4	6923 (4605–9241)	480 (18.4)	10.7	8,041 (5305–10,777)	0.01
Released	6388 (84.8)	72.3	53,010 (38,209–67,811)	2130 (81.6)	62.6	46,869 (33,988–59,750)	
Item type							
Magnet	423 (6.0)	3.9	2891 (1861–3921)	240 (9.5)	6.4	4816 (3213–6419)	< 0.001
Small/round magnet	67 (1.0)	0.8	572 (268–876)	42 (1.7)	1.3	956(384–1528)	< 0.001
Multiple magnets	1 (0.0)	0.04	27†	6 (0.2)	0.1	40†	0.01
Electronics	712 (10.2)	7.8	5757 (3833–7681)	323 (12.8)	9.2	6811 (4417–9344)	0.01
Button battery	142 (2.0)	1.5	1081 (722–1441)	62 (2.5)	2.2	1622 (923–2321)	0.01
Coins	3080(43.9)	35.1	25,722 (1781–33,622)	1001 (39.6)	25.9	19,399 (13,329–25,470)	<0.001
Toys	961 (13.7)	10.2	7484 (5526-9442)	331 (13.1)	10.0	7512 (4942–10,081)	0.35
Jewelry	657 (9.4)	6.0	4408 (2820–5995)	151 (6.0)	4.5	3399(2238–4561)	0.25
Fasteners	420 (6.0)	4.4	3222 (2204–4240)	150 (5.9)	4.5	3357 (2145–4569)	0.43
Bathroom object	291 (4.2)	3.0	2199 (1262–3135)	159 (6.3)	4.3	3236 (2052–4421)	<0.001
Desk supplies	200 (2.9)	2.2	1622 (1091–2152)	39 (1.5)	1.2	922 (320–1525)	0.08
Holiday object	55 (0.8)	0.6	436 (230–641)	23 (0.9)	1.1	796†	<0.001

The table describes the different characteristics of foreign body ingestion phenotypes based on children for the emergency department encounter and the objects they were reported to have been ingested. Rates expressed per 100,000 persons. Annualized incidence provides the median number (95% confidence interval) of foreign body ingestions for the given time period. For categories with multiple factors (e.g., race) ANOVA was employed (e.g., 2 × 5 table). “Not specified” category items were not individually analyzed given lack of organic data of these groups and an inability to yield clinically relevant descriptions for comparison. These *P*-values were not analyzed, so the table cells were not included. **P*-values compare the pre-COVID-19 (2017–2019, annualized estimated frequency) to the COVID-19 period (2020, annualized estimated frequency) for each category of interest. †Denotes that the actual frequency of emergency department visits for ingestion for the particular phenotype of interest was less than 30. This tends to generate very wide confidence intervals that are difficult to interpret and will not be reported. FBI = foreign body ingestion, NEISS = National Electronic Injury Surveillance System.

objects like coins. This suggests that parents and caregivers selectively sought care for FBI, either because they knew the relative danger of the object ingested or from medical advice outside of the ED. There are some data to support the latter point – calls to national

poison control centers increased for certain products early in the pandemic (14). Lastly, escalation of care increased. As with other serious pediatric diseases like appendicitis, care for foreign body

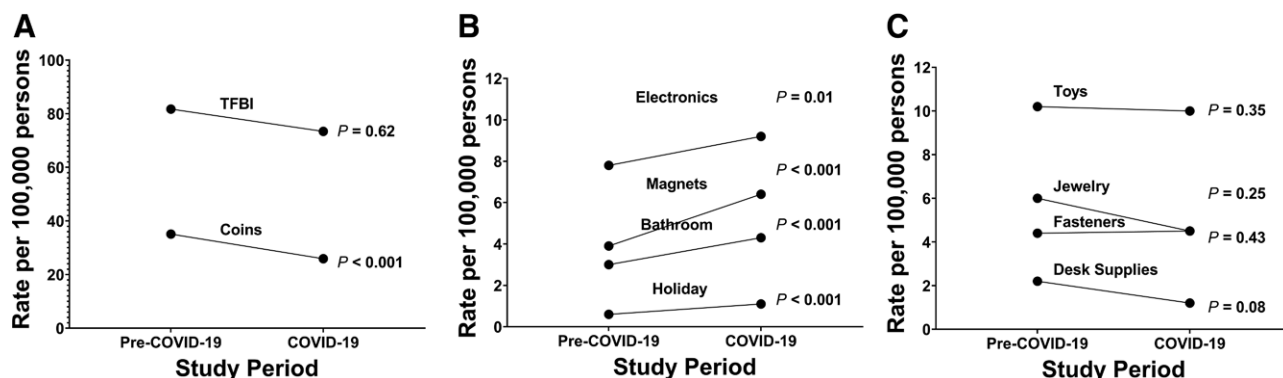


FIGURE 1. National incidence rates for Pediatric Foreign Body Ingestion in the United States comparing the Pre-COVID and COVID-19 periods. (A) Illustration of the incidence rate of total foreign-body ingestions and coins. (B) Illustration of illustrates the incidence rate of single magnet ingestion, electronic, bathroom object, and holiday object ingestions. (C) Illustration of the incidence rate of toy, jewelry, fastener, and desk supply ingestions comparing 2017–2019 to 2020. *P*-values are listed next to the object classification of interest.

ingestions may have been delayed during the COVID-19 pandemic, leading to increased acuity of care upon presentation (15).

The findings in our study compliment the pandemic patterns of FBI noted separately by Pizzol et al and Festa et al in single pediatric referral centers in the US and United Kingdom, respectively (16,17). Our multicenter analysis enhances the robustness of available evidence to support the protection of children from dangerous FBI. Lastly, our data continue to demonstrate an overall uptrend in BB ingestion in younger children as previously described by Orsagh-Yentis et al in a 2015 cohort (2). Whether this uptrend is a continuation of pre-pandemic factors, a specific result of the stay-at-home orders, or both remains to be determined.

Advocacy efforts to address the health risks associated with magnet and BB ingestions are ongoing. Most recently, the Consumer Product Safety Commission recalled Zen Magnets in August 2021 (18). In January 2022, the Consumer Product Safety Commission announced a New Proposed Rule for the safety standard of magnets that is currently in development (19). Similarly, there have been efforts to prevent BB ingestions. Since 2012, the national Button Battery Task Force has worked to deter BB ingestions through collaborative efforts and educational initiatives (20,21). This group was also instrumental in updating the American National Standard tests and requirements (e.g., security packaging) for BB under the ANSI C18.2M, Part 2-2021 standard (22). From a legislative perspective, two separate bills addressing the health hazards of magnets (S.3143) and buttons batteries (S.3278) were proposed by Senator Richard Blumenthal and are currently in committee (23,24). Until the outcome of these efforts are clear, additional research is needed to protect children from these products.

There are several limitations to this study. First, NEISS contains data from Emergency Departments only, which could underestimate rates of FBI managed in the primary care settings. Second, the database does not contain inpatient data that might allow for confirmation of FBI phenotypes. In addition, the NEISS is a consumer product injury database only, which means it should only serve as a surrogate to illustrate broad injury trends for ED encounters (i.e., trends of injuries not related to consumer products cannot be interpreted with the database). Lastly, national incidence was annualized and, for 2020, included a period prior to the start of the pandemic. Assuming pre-pandemic FBI incidence was unchanged to years prior, the findings reported here may be an underestimate. Future study of post-pandemic FBI trends will help determine to what extent, if any, care patterns for common pediatric conditions permanently change.

CONCLUSIONS

Despite a large decrease in overall pediatric care during the COVID-19 pandemic, the incidence of all foreign body ingestions was unchanged, while the ingestion incidence of some dangerous products – like button battery and magnet ingestions – was increased.

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