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## ORIGINAL ARTICLE

# Magnet ingestion knows no borders: A threat for Latin American children<sup>☆</sup>

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### KEYWORDS

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Ingestion;  
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### Abstract

**Introduction and aims:** The ingestion of foreign bodies, such as magnets, is a potentially lethal accident that affects children and is associated with bleeding and gastrointestinal perforation, as well as death. There are no Latin American reports in the literature on cases of magnet ingestion in children. Our aim was to establish whether said ingestion has been seen by pediatric endoscopists and gastroenterologists in Latin America, to determine the scope of that potential threat in their patient populations.

**Materials and methods:** We collected data regarding endoscopies performed on children in Latin America, within the time frame of 2017-2019, through questionnaires that were distributed to pediatric endoscopists at the 2nd World Congress of Gastrointestinal Endoscopy (ENDO 2020). The questionnaires provided information on foreign body location, the presence and number of ingested magnets, and the description of complications and surgical interventions.

**Results:** Our cohort from 12 Latin American countries reported 2,363 endoscopies due to foreign body ingestion, 25 (1.05%) of which were the result of having swallowed one or more magnets. Mean patient age was 5.14 years (SD 2.5) and 10 (40%) of the cases were girls. Three (12%) of the patients presented with severe complications and 2 (8%) cases required surgery.

**Conclusions:** Our preliminary study suggests that the ingestion of magnets is not common in Latin American countries, but said cases are frequently associated with complications. Constant monitoring of the incidence of such cases is extremely important, so that through education and awareness of those events, life-threatening complications in children can be prevented.

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**PALABRAS CLAVE**

Imanes;  
Ingestión;  
Niños;  
América Latina

## La ingestión de imanes no conoce fronteras: una amenaza para los niños latinoamericanos

### Resumen

**Introducción y objetivos:** La ingestión de cuerpos extraños, tales como imanes, es un accidente potencialmente letal que afecta a niños y está asociado con sangrado, perforación intestinal e incluso muerte. No hay literatura que reporte casos de ingestión de imanes en niños en América Latina. Nuestro objetivo fue establecer si dicha ingestión también es vista por endoscopistas y gastroenterólogos pediátricos en América Latina, para así determinar la magnitud de esta posible amenaza en la población estudiada.

**Materiales y métodos:** Recolectamos datos de América Latina a través de cuestionarios entregados a endoscopistas pediátricos durante el Segundo Congreso Mundial de Endoscopia Gastrointestinal (ENDO 2020) en relación con las endoscopias realizadas a niños entre 2017-2019. Esto con el propósito de recoger información con respecto a la ubicación de cuerpos extraños, la presencia y el número de imanes ingeridos, la descripción de complicaciones y las intervenciones quirúrgicas.

**Resultados:** Nuestra cohorte de 12 países de América Latina reportó 2,363 endoscopias realizadas debido a la ingestión de cuerpo extraño, de los cuales 25 (1.05%) casos involucraron la ingesta de uno o más imanes. La edad media fue 5.14 años (DE 2.5) comprendiendo 10 (40%) de sexo femenino. Con respecto a las complicaciones, 3 (12%) fueron categorizadas como graves, con 2 (8%) sujetos que requirieron intervención quirúrgica.

**Conclusiones:** Nuestro estudio preliminar sugiere que la ingestión de imanes no es común en países de América Latina; sin embargo, dichos casos están frecuentemente asociados con complicaciones. Es de suma importancia monitorear continuamente, con el fin de educar y crear conciencia para evitar complicaciones que pongan en peligro la vida de los niños.

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## Introduction and aims

The accidental ingestion of foreign bodies (FBs) is common in children. More than 100,000 FBs are ingested per year by children in the United States (US) alone.<sup>1</sup> Most FB ingestions do not result in life-threatening complications, but cases involving rare-earth magnets are prone to having severe complications, including bleeding, gastrointestinal perforation, and even death.<sup>2</sup> The rare-earth magnets composed of iron, boron, and neodymium are at least 5 to 10-times more powerful than traditional magnets. Although initially very expensive to produce, rare-earth magnets (such as neodymium magnets) have become less expensive, and are currently marketed as construction toys for children. With their increasing availability, the frequency and severity of rare-earth magnet ingestion has become a significant threat to children's health. A 2012 survey of 201 pediatric gastroenterologists in the US identified 481 cases of magnet ingestion over the past 10 years.<sup>3</sup> Despite the magnitude of the problem, the sale of magnets continues to grow, and along with it, the frequency of complications. In response, the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN) has called for a ban on their sale. Outside the US, cases of magnet ingestion have been reported in Japan,<sup>4</sup> Canada,<sup>5</sup> and France, where a retrospective multicenter study reported 40 cases of FB ingestion, 60% of which involved multiple magnets.<sup>6</sup> To the best of our knowledge, there are no published Latin American reports

of magnet ingestion in children. Given that the majority of such cases are likely to go unreported, the aim of the present study was to establish whether the problem has been seen by pediatric gastrointestinal endoscopists in Latin America, in an effort to assess the magnitude of this potential threat to Latin American children and appropriately address the situation.

## Materials and methods

A survey was developed for administration to pediatric endoscopists present at the 2nd World Congress of Gastrointestinal Endoscopy (ENDO 2020), held in Rio de Janeiro, Brazil, in January 2020. The questionnaire was distributed to endoscopists attending a pediatric session. They were given the option of completing it during the session or returning it by mail, if they did not have enough information at hand to answer the questions. The questionnaire consisted of 15 items and spanned a period of 3 years. The questions included the average number of endoscopies performed per year, the number of endoscopies conducted due to FB ingestion, and in cases of magnet ingestion (Table 1), the location of the magnet within the gastrointestinal tract, the number of magnets ingested, and a description of complications and surgical interventions (Table 2). In addition, the participants were asked if they knew other practitioners in their countries that had treated similar cases of magnetic FB ingestion.

**Table 1** Geographic location and characterization of the esophagogastroduodenoscopies, regarding foreign body and magnet ingestion (2017-2019).

Location		Esophagogastroduodenoscopy (2017-2019)			
Country	City	Number per city	Foreign body ingestion, n (%)		Magnet ingestion, n
Argentina	Buenos Aires	750	120	(16.0)	2
	Buenos Aires	1,290	57	(4.4)	4
	Mendoza	984	300	(30.4)	1
Bolivia	Rosario	900	150	(16.7)	0
	Cochamba	300	–	–	0
Brazil	La Paz	240	12	(5.0)	0
	Curitiba	6,000	450	(7.5)	0
Chile	Sao Paulo	1,500	–	–	0
	Sao Paulo	1,500	12	(1.0)	0
	Punta Arenas	90	5	(5.6)	0
Colombia	Santiago	240	41	(17.1)	3
	Bucaramanga	1,950	165	(8.5)	3
Dominican Republic	Cali	360	5	(1.4)	1
	Pereira	1,440	24	(2.0)	0
Mexico	Santo Domingo	1,140	228	(20.0)	2
Nicaragua	Mexico City	225	53	(23.6)	2
	Managua	570	0	0	0
Paraguay	Managua		225		0
	Asuncion	900	105	(11.7)	2
Peru	Lima	600	90	(15.0)	1
Uruguay	Montevideo	960	177	(18.0)	1
Venezuela	Barquisimeto	1,500	144	(9.6)	3

The ratio of magnet ingestion cases to the total number of esophagogastroduodenoscopies (EGDs) and the ratio of complications per country were calculated.

### Statistical analysis

In the present descriptive study, the data were presented as percentage (%) per country, based on the number of procedures, causes, and findings of FBs and magnets and their complications.

### Ethical considerations

Informed consent was not requested for the publication of the present study, given that it contains no personal data that can identify the patients. The authors received the data collected from de-identified questionnaires, in accordance with University of Miami regulations, ethical research. The authors declare that this article contains no personal information that can identify the patients.

### Results

The endoscopists that participated in the survey came from 12 countries: Argentina, Bolivia, Brazil, Chile, Colombia, Dominican Republic, Mexico, Nicaragua, Paraguay, Peru, Uruguay, and Venezuela. Ten (40%) of the patients were females, 12 (48%) were males, and the sex of 3 (12%) subjects was not known (Table 2). Mean age of the children

was 5.14 years (SD 2.50), ranging from one to 10 years of age. Over a 3-year period (2017, 2018, and 2019), a total of 23,439 endoscopies were performed at the participating endoscopists' centers. Of those procedures, 2,363 (10.08%) were due to FB ingestion (Table 1) and 25 cases (1.05%) were specifically due to magnets. There were 16 cases (64%) of multiple magnets in the gastrointestinal tract and 9 (36%) cases of single magnet ingestion. The most common locations seen on the imaging studies were: stomach 15 (60%), small bowel 5 (20%), esophagus 4 (16%), and duodenum one (4%). Of the 25 cases of magnet ingestion reported, 3 (12%) developed serious complications and 2 (8%) of the patients underwent surgical interventions. Seven of the specialists surveyed responded that they knew of colleagues that had treated cases of magnet ingestion, not included in the present study. No deaths were reported.

### Discussion

This preliminary study is the first to survey pediatric endoscopists in Latin America, regarding the ingestion of magnets in children. The study was carried out on a convenience sample of experts that attended an international meeting. Our study suggests that although the ingestion of magnets in this geographic area does not appear to be common, it does exist, and cases are prone to complications. The endoscopists in our sample reported 25 cases of magnet ingestion. Three of those cases were associated with complications (12%) and there were 2 cases of perforations. Importantly, the low number of magnet ingestion reported

**Table 2** Demographic characterization of the cases of magnetic ingestion requiring esophagogastroduodenoscopy, per country and city in Latin America (2017-2019).

Country	City	Age (years)	Sex	Location	Number of magnets	Attached vs separated	Complications	Surgical resolution
Argentina	Buenos Aires	3	M	Stomach	2	Attached	No	No
	Buenos Aires	3	M	Stomach	3	Attached	No	No
	Buenos Aires	7	M	Stomach	2	Separated	No	No
	Buenos Aires	5	M	Stomach	2	Attached	No	No
	Buenos Aires	2	F	Stomach	2	Attached	No	No
	Buenos Aires	8	F	Stomach + duodenum	4	-	No	No
Chile	Mendoza	-	-	Stomach	3	Attached	No	No
	Santiago	1.5	F	Esophagus	1	NA	No	No
	Santiago	2	M	Esophagus	1	NA	Eschar at site of impaction	No
Colombia	Santiago	5	M	Stomach	1	NA	No	No
	Bucaramanga	6	M	Stomach	1	NA	No	No
	Bucaramanga	7	M	Duodenum	2	-	No	No
	Bucaramanga	5	F	Stomach	1	NA	No	No
Dominican Republic	Cali	6	M	Stomach	1	NA	No	No
	Santo Domingo	6	-	Small bowel	2	Attached	No	No
Mexico	Santo Domingo	4	-	Esophagus	2	Attached	No	No
	Mexico City	10	F	Stomach	2	Attached	No	No
Paraguay	Mexico City	8	F	Small bowel	2	Attached	Perforation	Yes
	Asuncion	4	F	Esophagus	1	NA	No	No
Peru	Asuncion	3	M	Small bowel	1	NA	No	No
	Lima	2	F	Small bowel	3	Attached	Peritonitis + sepsis	Yes
Uruguay	Montevideo	11	M	Small bowel	4	Attached	No	No
Venezuela	Barquisimeto	4	F	Stomach	2	Separated	No	No
	Barquisimeto	8	M	Stomach	1	NA	No	No
	Barquisimeto	3	F	Stomach + small bowel	Multiple	Separated	No	No

NA: not applicable.

in the survey should not be interpreted as an inconsequential problem. In some of the cases described, the ingested magnets were attached to each other, but did not result in a perforation that most likely would have occurred, had a timely procedure not been performed.

The strengths of our study include the wide representation of Latin American countries among the responders and the fact that the questionnaire was completed by experts that attended an international meeting dedicated to endoscopy. Given the expertise of the responders, the most difficult cases (such as those involving magnets) were likely to have been referred to them, and they were probably aware of many of the local cases, as well. To account for the possibility of cases that were not managed by the responders, they were asked if they were aware of cases of magnet ingestion treated by other practitioners in their cities. Seven of the 22 gastroenterologists responded in the affirmative, implying that there are more cases than those described in the present study. It is also likely that some cases of magnet ingestion are seen at local emergency rooms and treated by surgeons, without the intervention of a pediatric gastroenterologist, reinforcing the supposition that the problem is more widespread than our data show. In all probability, the low number of cases is an underrep-

resentation of the real data of each country because EGDs are not readily available in many regions and patients have to travel for hours to reach a pediatric gastroenterologist equipped with an endoscope. Multiple magnet ingestion was reported in more than one city in some countries, whereas no magnet ingestion was reported in other countries, which could reflect the differences between regions in relation to access to magnets by children, the marketed use of magnets, and to having endoscopy as a diagnostic/therapeutic option.

The limitations of our study include its poor generalizability and the feasible selection bias regarding the practitioners that completed the survey. The participants were a particular selected group of endoscopists that traveled to attend an international meeting and are not necessarily representative of the majority of endoscopists in their countries, nor indicative of the reality of all the cities in their countries. Moreover, only a small group of the total of 200 attendees completed the survey. However, our study was not intended to provide a complete representation of Latin America regarding magnet ingestion, but rather to call attention to the problem. Not all the endoscopists contacted their offices or searched a database to answer the questions. Thus, there is the possibility of recall bias, albeit the rarity of magnet

ingestion and the peril associated with it make the vivid recollection of those cases more likely.

## Conclusion

To the best of our knowledge, the present study is the first report describing magnetic FB ingestion in a Latin American population. Given the general lack of use of electronic medical records and centralized reportable databases inherent in Latin American countries, the prevalence of cases of ingested magnets is still unknown. Nevertheless, our study shows that despite being infrequently reported, magnet ingestion has high morbidity. Given its low numbers, magnetic ingestion may be seen as a small threat, but it should be viewed as a significant problem that can lead to complications. We speculate that with the phenomenon of business globalization, magnetic FB ingestion rates are likely to increase, along with the potential of dangerous complications. Therefore, the development of educational campaigns among pediatricians, emergency doctors, teachers, and parents is of the utmost importance, to prevent children from having contact with magnetic toys and to recognize the complications derived from the ingestion of magnets. Larger prospective studies need to be conducted, and if their data confirm our findings, the prohibition of the commercialization of those types of toys should be considered, a task that has been difficult to achieve in the US, despite the NASPGHAN's best efforts.

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## Conflict of interest

The authors declare that there is no conflict of interest.

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