

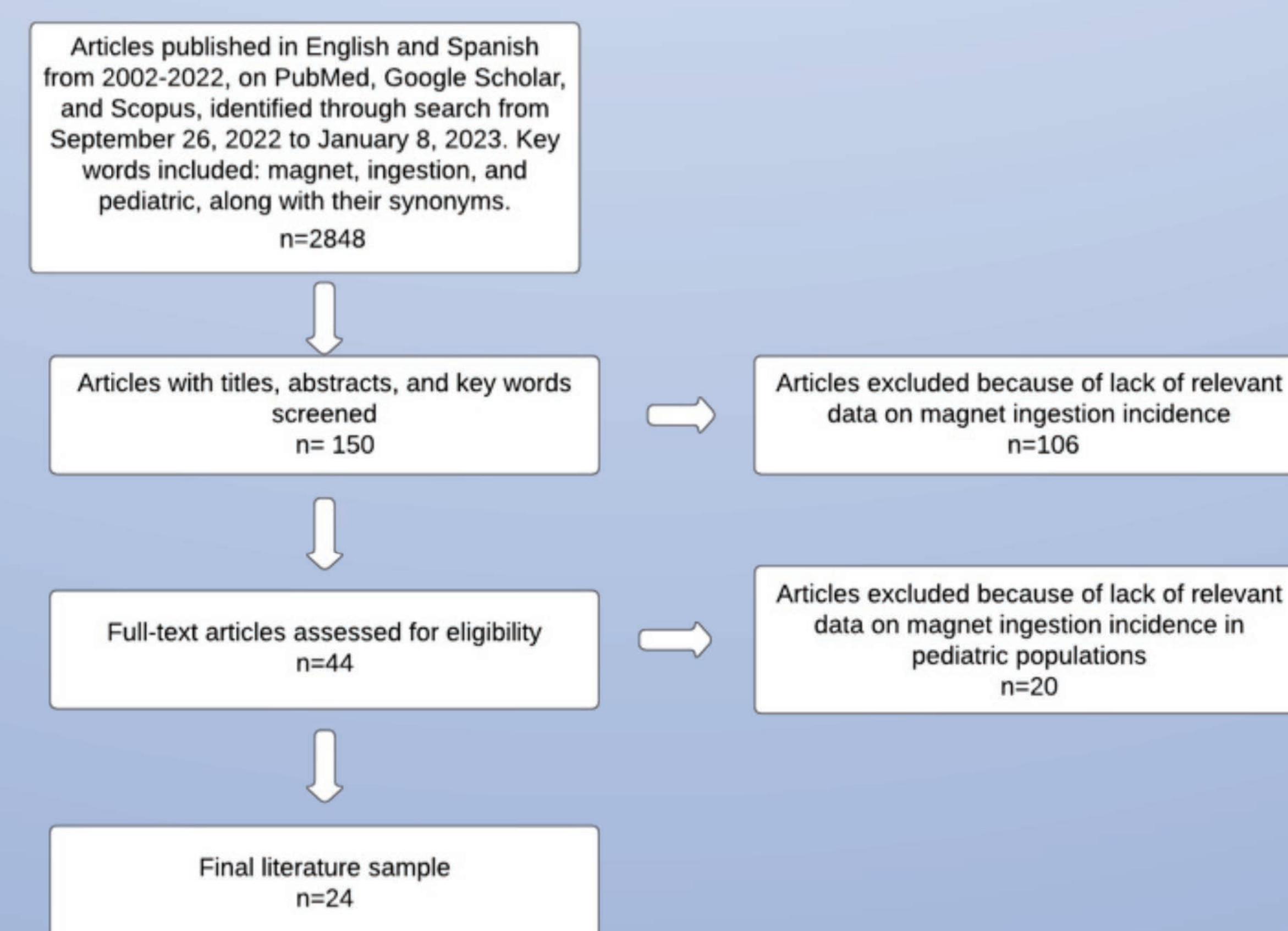
## Introduction

- ❖ Pediatric magnet ingestion can lead to devastating consequences, such as bowel obstruction, ischemia, intestinal erosion, and intestinal fistulas
- ❖ Many countries have enacted policies to limit magnet ingestion including prohibiting sales, labeling products, and restricting magnet strength
- ❖ It is unclear whether policies restricting high-powered magnets is associated with differences in pediatric magnet ingestion rates
- ❖ This study sets out to investigate and compare the global incidence of pediatric magnet ingestion and corresponding national policies

## Methods

### Inclusion criteria:

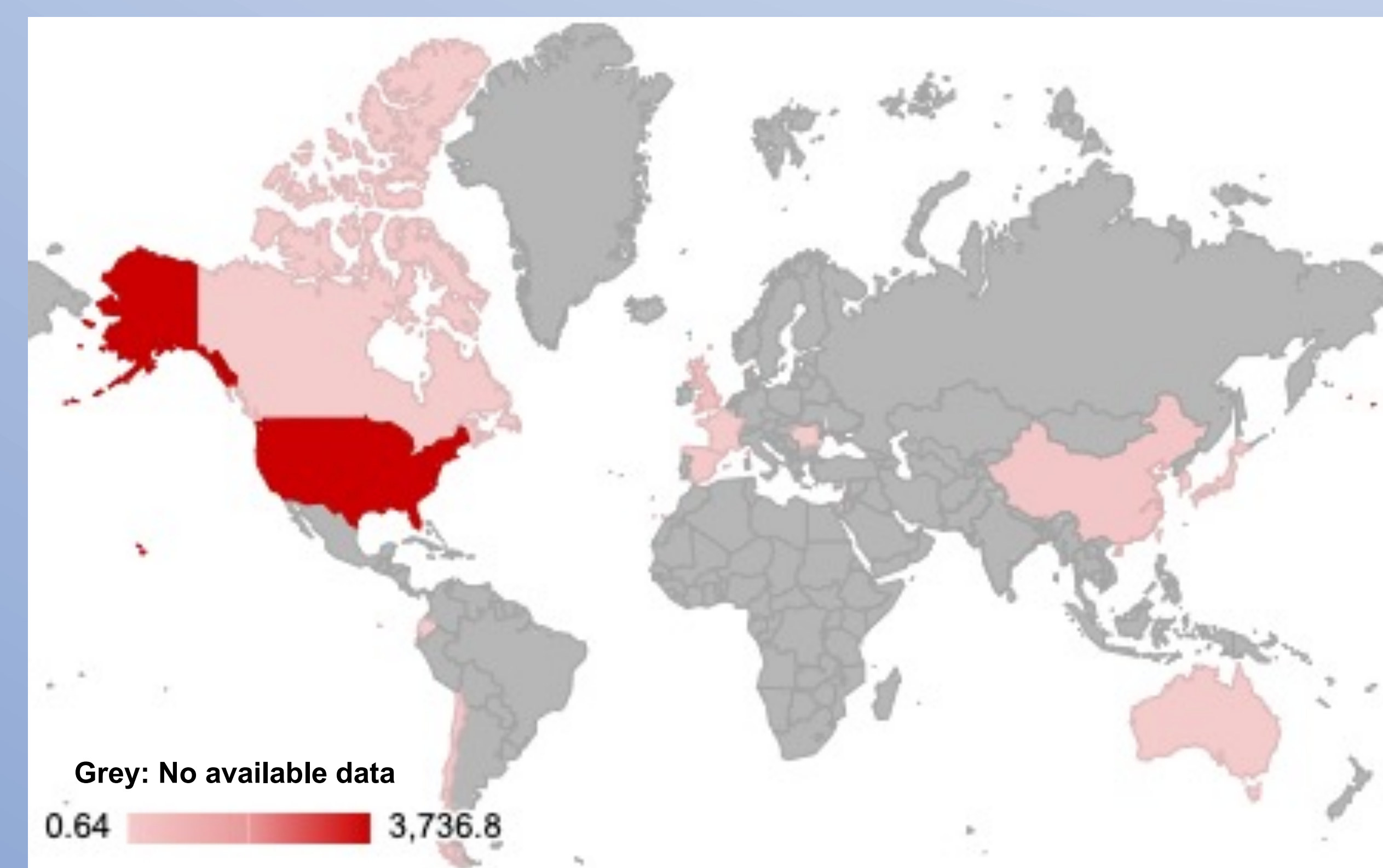
- ❖ Magnet ingestion in 0 to 18-year-old patients
- ❖ Publications with >1 reported cases
- ❖ Papers published from 2002-2022



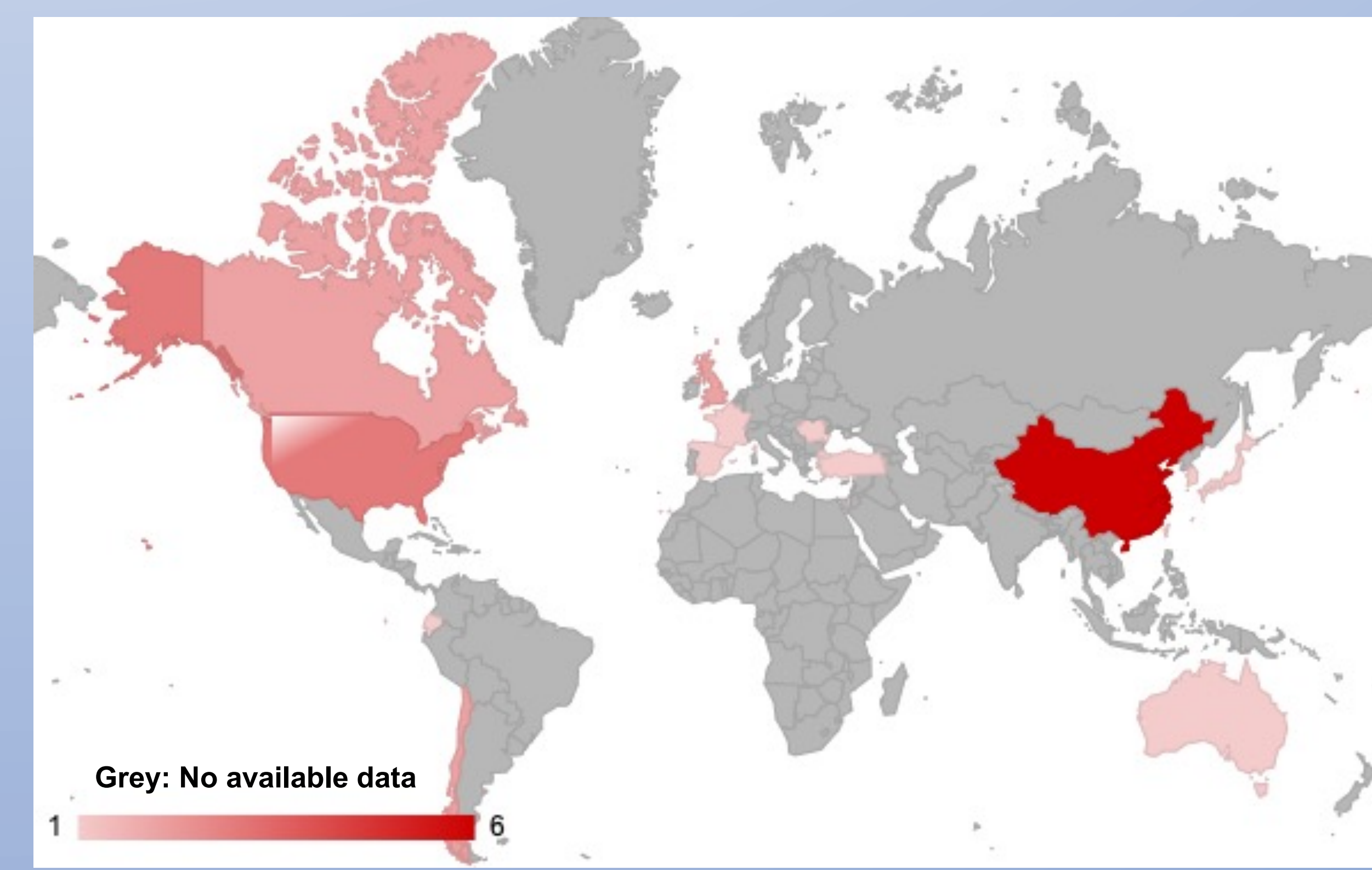
## Results

Article Title	Author(s)	Type of Article	Years Studied	Location	Incidence Rate Reported	Incidence/Year	Interventions Reported
Multicenter investigation of pediatric gastrointestinal tract magnets ingestion in China	Wang et al.	Retrospective study	2009-2019	China	74	7.4	Gastroscopy, colonoscopy, laparoscopic surgery or laparotomy surgery
Clinical characteristics of magnetic foreign body misingestion in children	Huang et al.	Retrospective study	2017-2020	China	14	4.6	Gastroscopy, laparoscopic surgery or laparotomy
Digestive Tract Injuries Caused by Ingested Foreign Bodies Containing Magnets	Su ZL et al.	Retrospective study	2017-2018	China	16	16	Laparoscopic surgery with magnets attached to snares or laparotomy
Management of magnetic foreign body ingestion in children	Zhang S et al.	Retrospective study	2017-2019	China	49	24.5	Gastroscopy or surgery
Management of foreign bodies ingestion in children	Chen et al.	Retrospective study	2020	China	119	119	Transanal surgical removal, laparotomy, laparoscopy, or gastroscopy
A nationwide questionnaire survey on accidental magnet ingestion in children in Japan	Miyamoto et al.	Nationwide questionnaire	2015-2017	Japan	104	52	Oesophagogastroduodenoscopy or surgery
Ingestion of multiple magnets in children	Han et al.	Retrospective study	2004-2018	Korea	9	0.64	Endoscopy or surgery
Magnet ingestion by children: A retrospective study in a medical center in Taiwan	Lai et al.	Retrospective study	2009 - 2018	Taiwan	13	1.4	Endoscopy or surgery
Ball magnet ingestion in children: a stronger and more dangerous attraction?	Price et al.	Multicentre survey	2020	UK	53	53	Serial plain radiographs, endoscopy or surgery
Magnet and button battery ingestion in children: multicentre observational study of management and outcomes	Paediatric Surgery Trainee Research Network	Retrospective observational study	2019-2020	UK	263	263	Endoscopy or surgery
Multicentre study of magnet ingestion in Spanish paediatric emergency departments	Miranda et al.	Prospective observational multicentre study	2016-2019	Spain	72	24	Endoscopy
Foreign Bodies Ingestion in Children: Experience of 61 Cases in a Pediatric Gastroenterology Unit from Romania	Diaconescu et al.	Descriptive Retrospective Study	2009-2014	Romania	61	12.2	X-ray or endoscopy
Endoscopic extraction of digestive foreign bodies	Rios et al.	Prospective Cohort Study	2007-2011	Chile	170	42.5	X-ray or endoscopy
Gastrointestinal foreign body in children	Paz Muñoz F et al.	Retrospective Study	2007-2013	Chile	51	6	Direct endoscopy or endoscopically assisted extraction
Ingestion of foreign bodies in children	Fernando Córdova-Neira & Belén Dávila Tapia	Case Series	2017-2021	Ecuador	71	17.75	X-rays, endoscopy, or surgery
Magnet ingestions in children: a French multicenter study	Talvard et al.	Retrospective multicentric study	2008-2013	France	40	8	Endoscopy or surgery
Decade of the dangers of multiple magnet ingestion in children: A retrospective review	Chang et al.	Retrospective review	2011-2022	Australia	23	2.09	Endoscopy or surgery
Multiple magnet ingestion in children: A problem on the rise After the Recall: Reexamining Multiple Magnet Ingestion at a Large Pediatric Hospital.	Seguier-Lipszyc et al.	Retrospective Case Review	2009-2020	Israel	13	1.18	Endoscopy or laparotomy
Magnetic foreign body injuries: a large pediatric hospital experience	Rosenfield et al.	Retrospective Chart Review	2002-2015	Canada	100	7.69	Esophagogastroduodenoscopy, rigid esophagoscopy, or surgical removal
High-Powered Magnet Exposures in Children: A Multi-Center Cohort Study	Strickland et al.	Retrospective study	2002-2012	Canada	94	9.4	Esophagogastroduodenoscopy, colonoscopy, rigid sigmoidoscopy, rigid esophagoscopy, or laparotomy
Magnet Injuries in Children: An Analysis of the National Poison Data System from 2008 to 2019	Middelberg et al.	Retrospective cohort study	2017-2019	US	596	298	Endoscopy or surgical removal
Inhalation and ingestion of magnetic foreign bodies in a toddler with persistent cough—a case report	Middelberg et al.	Retrospective study	2008-2019	US	5738	521.6	Endoscopy or surgical removal
	Tong et al.	Case series	2010-2015	US	14586	2917.2	Laryngoscopy, bronchoscopy or oesophagoscopy (LBO)

National Policies			
Country	Year Instituted	Description of Policy	Type
European Union	2008	All toys with magnets have mandatory labelling requirements with some countries adding additional policies.	Labelling
Canada	2018	Small magnets that may be ingested may not be stronger than 0.5 T2mm2. This applies to lose small magnets and magnets that can get released during play. The potential release of magnets is checked by performing use and abuse tests	Restriction of Strength
Taiwan	2019	Toys with magnets are regulated, although a recent probe found that many neodymium balls are still sold online.	Restriction of Sales
Australia	2020	Toys with loose small high powered magnets limited to only magnetic/electrical experimental sets intended for children eight years and over and these toys must be accompanied by a warning label for parents.	Restriction of Sales & Labelling
UAE	2021	Small magnetic balls are completely banned	Banned
UK	2022	Magnetic Balls officially banned in April 2022 due to choking hazards with recall from end users and removal from online marketplace	Banned
USA	2014/2022	Initial 2014 ban was overturned in the courts due to insufficient data. As of 2022, adult products (excluding educational products) limit the flux to <50kG2mm2. Strong magnets are banned from toys that are small enough to be swallowed and intended for < 14 years old.	Restriction of Strength
France	Unknown	Additional labelling of products with small magnets are not intended for children and should be kept out of reach.	Labelling



Map 1: Incidence per year per country



Map 2: Number of studies found per country

## Conclusion

- ❖ Many countries throughout the world have reported pediatric magnet ingestion cases with the subsequent medical treatment required, including countries from 5 continents.
- ❖ There is a lack of published research documenting such ingestions in many countries
- ❖ Of those with documented magnet ingestions requiring intervention, many countries still lack national policies to limit access to small, ingestible magnets

## Discussion/ Limitations

- ❖ No data available in Africa
- ❖ Incidence/ year is variable given the location/ number of hospitals the data captures
- ❖ Further research is needed to track the efficacy of these policies and to decide whether aspects of these policies need to be modified or improved
- ❖ United States has strong evidence on incidence rates before, during and after magnet restriction policies have been in place, suggesting that stricter policies may be helpful in reducing magnet ingestion-related morbidity
- ❖ Most ingestions occurred in homes or at daycare, suggesting the need for restrictive recommendations in these settings

## References

❖ Eliason, M. J., Ricca, R. L., & Gallagher, T. Q. (2017). Button battery ingestion in children. Current opinion in otolaryngology & head and neck surgery, 25(6), 520-526. <https://doi.org/10.1097/MCO.0000000000000410>

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❖ Middelberg, L. K., Leonard, J. C., Shi, J., Aranda, A., Brown, J. C., Cochran, C. L., Eastep, K., Gonzalez, R., Haasz, M., Herskovitz, S., Hoffmann, J. A., Koral, A., Lamoshi, A., Levitte, S., Lo, Y., Montminy, T., Novak, I., Ng, K., Novotny, N. M., Parrado, R. H., ... Rudolph, B. (2022). High-Powered Magnet Exposures in Children: A Multi-Center Cohort Study. Pediatrics, 149(3), e2021054543. <https://doi.org/10.1542/peds.2021-054543>