

# Does motivation matter? A systematic review and meta-analysis of outcomes following intentional foreign object ingestion.

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## I. ABSTRACT

### Background

Intentional ingestion of foreign objects (IIFO) is clinically distinct from accidental ingestion, yet its outcome profile and drivers of morbidity remain poorly defined. Whether motivation itself alters risk has never been examined systematically.

### Objectives

To synthesise all available evidence on outcomes after intentional foreign-object ingestion, and to determine whether patient motivation, object characteristics, or demographic factors modify those outcomes.

### Methods

A comprehensive search of PubMed, Embase, CENTRAL, Web of Science, Scopus, PsycINFO, and Google Scholar (1906–31 March 2025) combined free-text and controlled-vocabulary terms for foreign bodies, intentional ingestion, and clinical interventions.

**Inclusion:** human studies of any design, any age, reporting non-accidental ingestion of true foreign bodies.

**Exclusion:** accidental or substance ingestion, animal studies, non-English full texts, pre-1906 reports, and studies lacking motivation, object, or outcome data.

**Outcomes:** endoscopy, surgery, conservative management, complications, mortality.

Case reports ( $n = 72$ ; 72 patients) and case series ( $n = 3$ ; 90 patients) were extracted with a prespecified codebook; risk of bias was appraised with JBI checklists augmented by automated logic filters. Effect measures for case reports were odds ratios (ORs) with 95 % confidence intervals (CIs) derived from  $2 \times 2$  tables ( $\chi^2$  or Fisher's exact test). Multivariate case-level associations were explored with logistic regression. To enable valid series-level meta-analysis despite small sample sizes, individual case reports were flattened and grouped alongside other series. Series-level proportions were pooled using random-effects models with restricted maximum likelihood (REML) estimation and Hartung-Knapp adjustments to confidence intervals, appropriate for small-study meta-analysis. DerSimonian-Laird estimates were also computed for comparison. Univariate meta-regression examined study-level modifiers.

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### Results

Across 162 unique individuals, pooled series-level event rates using REML were: endoscopy 47.3 % (95 % CI: 4.3–94.7), surgery 30.6 % (95 % CI: 12.0–58.9), conservative management 41.6 % (95 % CI: 4.4–91.7), complications 34.7 % (95 % CI: 1.8–93.8), mortality 2.5 % (95 % CI: 0.8–7.7).

Heterogeneity was moderate to low for all outcomes except death ( $I^2 < 1\%$ ). DerSimonian-Laird estimates yielded narrower confidence intervals and higher  $I^2$  values, consistent with known limitations in small samples.

Case-level testing showed that “intent to harm” quintupled the odds of surgery ( $OR \approx 5$ ,  $p < 0.05$ ), whereas “other” motives reduced surgical odds by 86 %. Sharp objects increased the likelihood of endoscopy, and long objects trended toward higher surgical rates. Age 41–60 years predicted fewer surgeries ( $OR \approx 0.18$ ,  $p < 0.05$ ). No demographic factor independently altered mortality, although detained status and severe disability exhibited non-significant trends. Meta-regression of series data did not replicate these signals, likely due to small study numbers.

### Limitations

Single-reviewer screening and extraction, high clinical heterogeneity, small cell sizes, and publication bias (particularly for dramatic or anatomically challenging cases). Twenty-five predictors in four case series risked model overfitting and inflated Type I error.

### Conclusions

Intention itself appears to be a key driver of adverse clinical course after foreign-object ingestion, with “intent to harm”, sharp items, and object length portending more invasive management. Age between 41 and 60 years may be protective against surgery. The findings should inform risk stratification but must be interpreted cautiously given methodological limitations and the descriptive nature of much of the evidence.

### Registration and Data

This protocol was not registered with PROSPERO. Full dataset and analysis scripts are openly available at [https://github.com/jackgedge/iifo\\_systematic\\_review](https://github.com/jackgedge/iifo_systematic_review).

## INTRODUCTION

### Rationale

The global displacement crisis has reached unprecedented levels, with over 100 million forcibly displaced individuals reported by the United Nations High Commissioner for Refugees

(UNHCR) as of May 2024 [1]. Refugees and asylum seekers often endure severe hardship—including violence, persecution, and perilous journeys—compounding their vulnerability upon arrival in host countries [2, 3]. This population is at heightened risk of mental health challenges due to trauma, detention, and insecure legal status [4–7].

Self-harm is a particularly concerning manifestation of psychological distress among asylum seekers, with rates significantly exceeding those in the general population—up to 216 times higher in offshore detention settings [8–10]. Common methods include cutting, blunt trauma, hanging, self immolation, poisoning, and intentional ingestion of foreign objects (IIFO) [9, 11], influenced by access to means, cultural norms, and underlying motivations [12].

IIFO is defined as the non-accidental ingestion of non-nutritive foreign bodies [13]. While 80–90% of cases resolve spontaneously, 10–20% require endoscopic intervention and up to 1% require surgery [14, 15]. Timely access to care is essential, but often constrained in refugee contexts by geographic isolation and limited medical infrastructure, increasing the risk of complications [16].

Global rates of IIFO appear to be rising. In the United States, incidence doubled in 2017, with 14% of cases classified as intentional [17]. One review found up to 92% of adult ingestions were intentional among individuals from lower socioeconomic backgrounds, suggesting even higher prevalence in displaced populations [18].

The management of IIFO has evolved significantly since the 17<sup>th</sup> century, from open gastrotomy to rigid esophagoscopy and, more recently, endoscopic techniques [19–23]. Historical case reports illustrate the extremes of this behaviour—including one psychiatric patient who ingested over 2,500 objects weighing 21 kilograms [24], and another who swallowed an item 28 cm in length [25].

Clinical outcomes depend on multiple factors: age, comorbidities, object size and characteristics, location, and time to presentation. Current guidelines recommend intervention strategies based on these variables [14]. However, most literature to date focuses on IIFO in prisons or psychiatric populations, with limited data from refugee or asylum-seeking groups.

In detention settings, ingestion may be used as a protest or distress signal when other forms of communication are blocked [26]. In psychiatric contexts, motivations may include psychosis, personality disorders, pica, malingering, or affective dysregulation [27–32]. Malingering is especially reported in prisons, often as a means to access hospital care [27, 33]. Conversely, in borderline personality disorder, ingestion may serve as an emotional regulation strategy rather than an indication of suicidal intent [27, 32]. In rare cases, repeated IIFO has led to discussions around palliative care approaches, recognising the futility of repeated surgical intervention in treatment-resistant psychiatric illness [34].

Despite increasing prevalence, the heterogeneous motivations behind IIFO—and their potential impact on clinical decision-making—remain poorly understood [35–37]. Motivation likely influences management strategies and outcomes. For instance, protest-driven ingestion may avoid high-risk behaviours, lowering the threshold for conservative management [38, 39].

This systematic review aims to address these gaps by exploring how motivation for IIFO affects clinical outcomes. Specifically, it examines associations between motivation and rates of en-

doscopic and surgical intervention, conservative management, complications, and mortality—toward informing more responsive and appropriate healthcare strategies for vulnerable populations.

### Objectives

The primary object of this systematic review was to quantify the rates of endoscopy, surgery, death, complication and conservative management following intentional ingestion of foreign objects in human populations. The systematic review sought to examine how individual factors such as demographic/population characteristics, object characteristics and motivations for ingestion influence the likelihood of these outcomes.

## METHODS

This study was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [40]. Ethical approval was not required as all analysis was based on published data. Eligibility criteria were structured using the PICOS (Population, Intervention, Comparator, Outcome, Studies) framework.

### Eligibility Criteria

Category	Details
Population	Any human; any age group.
Interventions or exposures	Non-accidental ingestion of a true foreign body (non-nutritive items).
Comparators / Control group	Demographics: Gender, age, detained person, psychiatric inpatient, displaced person, under influence of alcohol, psychiatric history, severely disabled, previous ingestion. Motivation: Intent to harm, psychiatric, psychosocial, protest, other. Object characteristics: Button battery, magnet, long (>5 cm), large diameter (>2.5 cm), multiple, blunt objects, sharp-pointed objects.
Outcomes of interest	Endoscopic intervention, surgical intervention, conservative management, complication rates, mortality.
Setting	Any setting.
Study designs	Any design.

TABLE I: Inclusion criteria structured using the PICOS framework.

A full list of eligibility criteria is shown in Table I. This is reproduced in a larger format for clarity in Appendix A-A. A full list of exclusion criteria is available in Appendix A-B and in the PRISMA diagram shown in Figure 1.

### Information Sources

Relevant articles were identified through a systematic search of PubMed, Web of Science, Embase, Scopus, PsycINFO, CENTRAL and Google Scholar during January 2025, with the assistance of a librarian. Included articles then had their bibliography's searched by the primary author (JGE) on 14th May 2025 to identify any potential additional literature not uncovered in the primary search.

PRISMA 2020 flow diagram for new systematic reviews which included searches of databases, registers and other sources.

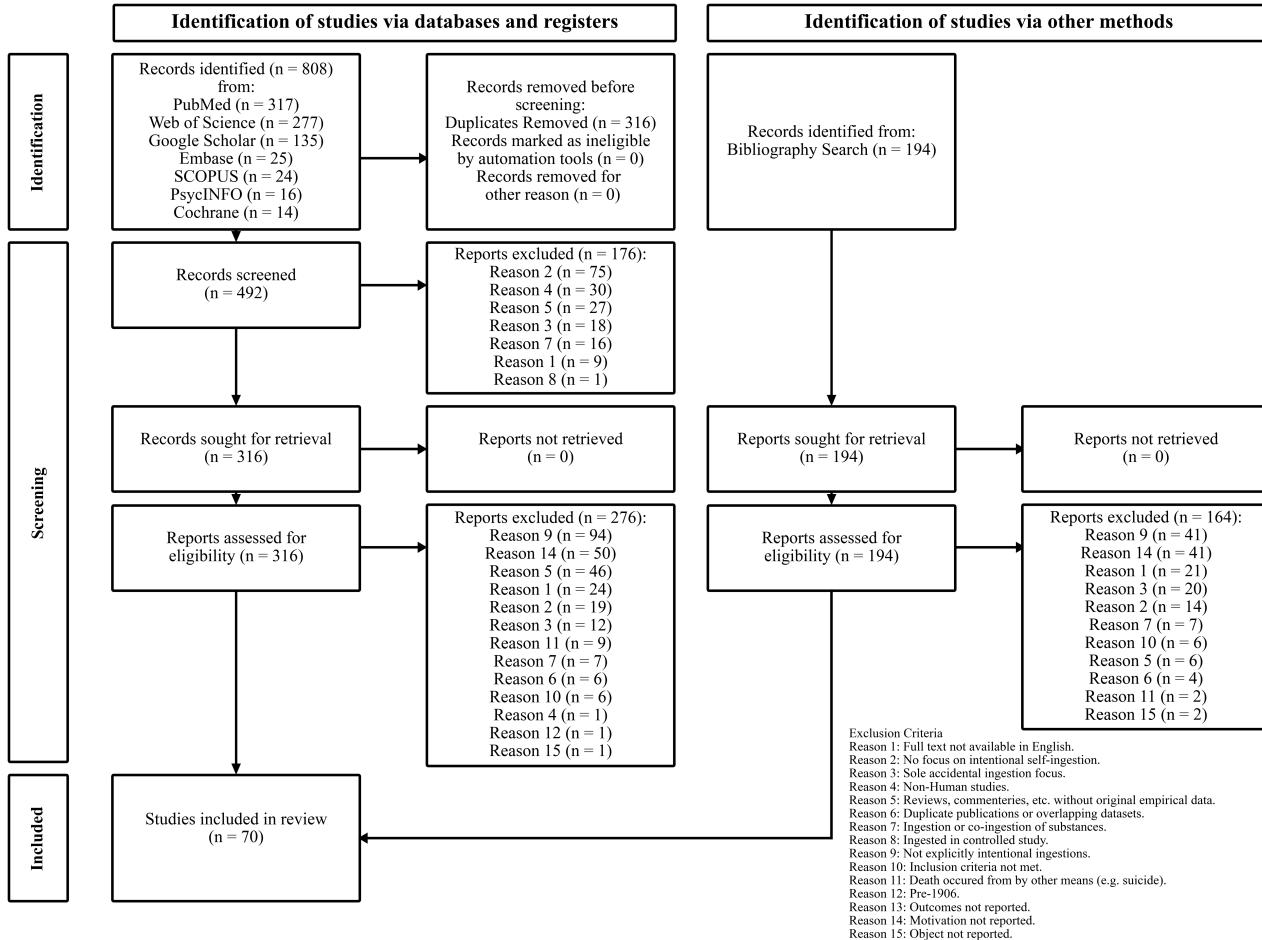


Fig. 1: PRISMA flow diagram summarising the study selection process.

### Search Strategy

The search was conducted using keywords and MeSH terms based on the concepts underpinning this review. The search queries, keywords and MeSH terms used can be found in Appendix B.

### Selection Process

All identified articles were collated and duplicate articles were identified and removed. Remaining articles underwent independent title and abstract screening conducted by the first author (JGE). To ensure consistency, a randomly selected 10% sample of these articles underwent independent screening by a second author (MS). Any discrepancies identified between these two reviewers were resolved by a third reviewer (GC). Inter-reviewer agreement was calculated using Cohen's Kappa [41]. Remaining articles proceeded to full text review, where the same independent screening process was repeated on full text articles.

### Data Collection Process

Data were initially extracted by a single reviewer (JGE) into Microsoft Excel [42]. Variables for extraction were developed iteratively through engagement with the literature and analysis of consistent reporting patterns. A preliminary review of the first 30 case reports informed the development of additional data

categories, which were subsequently applied to the remaining reports.

Following initial extraction, data were imported into Python [43] for further processing and analysis. The Python-based pipeline included data cleaning, validation, and transformation to ensure consistency across heterogeneous study formats. These structured data were then used to guide the extraction of aggregate data from case series. Studies were grouped for extraction based on their classification as case reports or case series. Where case series contained sufficiently granular data, cases were extracted individually and treated as case reports; otherwise, data were extracted at the aggregate level. Case grouping for analysis followed the criteria for inclusion as individual case reports or case series, as defined above. Relevant data from reviews and other literature types were recorded under the case report category.

### Data Items

Outcome data were extracted for rates of endoscopy, surgery, conservative management, mortality, and complications. For the purposes of this study, *surgery* was defined as “any operative intervention performed in a sterile operating theatre under general or regional anaesthesia, involving incision or surgical access to body cavities (including laparotomy, laparoscopy, thoracotomy, or cervical exploration) for the purpose of removing an ingested

object or managing complications of ingestion". Procedures performed "solely via flexible or rigid endoscopy through natural orifices" were categorised as *endoscopy* and not considered surgical interventions.

Predictor variables were grouped in five subgroups: *Age Group*, *Gender*, *Demographic*, *Motivation*, *Object*. Full definitions of all variables are provided in Appendix ???. The full dataset of extracted case-level and series-level data (including bias assessments), is available on Github.

### Risk of Bias Assessment

Risk of bias was assessed manually for all included studies by a single reviewer (JGE), using the *Joanna Briggs Institute (JBI) Critical Appraisal Checklists for Case Reports and Case Series* [44]. Studies were first classified as either case reports or case series based on the level of granularity in the data. Each study was then evaluated using the corresponding JBI tool.

### Effects Measures

For case reports, univariate associations between binary predictors and binary outcomes were assessed using unadjusted odds ratios (ORs) with 95% confidence intervals (CIs), calculated via chi-square or Fisher's exact tests [41]. Fisher's exact test was used when any expected cell count was below 5; otherwise, the chi-square test was applied.

Univariate logistic regression was subsequently performed to identify independent predictors. Adjusted odds ratios (aORs) and 95% CIs were estimated from models including age, gender, motivation, and object characteristics. Although the number of cases was anticipated to be insufficient for multivariate analysis, multivariate logistic regression was attempted to confirm this limitation.

For case series, individual case reports were aggregated to produce series-level data. Meta-analyses of proportions were conducted using random-effects models with restricted maximum likelihood (REML) estimation and Hartung-Knapp (HK) adjustment, suitable for small study numbers. DerSimonian-Laird (DL) estimates were also calculated for comparison. Univariate meta-regression was used to assess associations between study-level predictors and pooled outcome rates using inverse-variance weighted models. Due to limited sample size, multivariate meta-regression was not conducted.

Where significant associations were identified, subgroup analyses were conducted using Fisher's exact or chi-square tests, depending on sample size. These analyses were initially descriptive and explored further in the discussion.

All analyses were performed using the *statsmodels* [45] package in *Python* [43].

## RESULTS

### Study Selection

A total of 808 records were identified through initial database searches: PubMed (317), Web of Science (277), Google Scholar (135), Embase (25), SCOPUS (24), PsycINFO (16), and Cochrane (14). 316 duplicates were identified and removed.

Title and abstract screening was undertaken, with JGE reviewing all 492 records. A random sample of 50 records was generated for independent screening MS. Cohen's Kappa was calculated

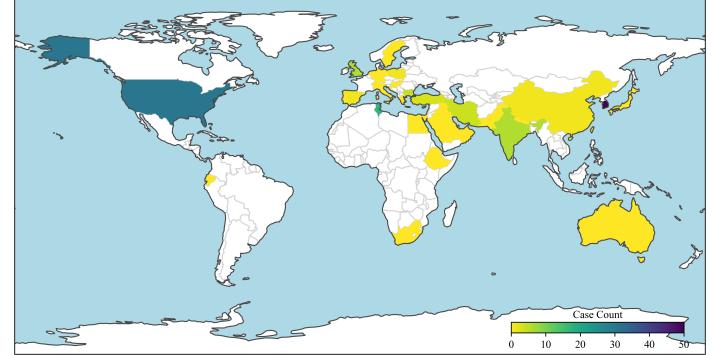


Fig. 2: Heat map of cases per country.

for inter-reviewer agreement between JGE and MS, yielding a value of 0.38, indicating fair agreement. Where JGE and MS disagreed, 16 records were reviewed by GC. In total, 176 records were excluded, leaving 316 for full text review.

During full text review, JGE reviewed all 316 records. A random sample of 32 records was generated for independent review by MS. Inter-reviewer agreement was again calculated using Cohen's Kappa, yielding a value of 0.21, indicating fair agreement. Where JGE and MS disagreed, 5 records were reviewed by GC. In total, 276 records were excluded during full text review. 40 records were included and proceeded to bibliography search.

The bibliographies of the 40 included papers were searched by manually JGE. Relevant bibliography items were identified, collated, and evaluated against the eligibility criteria, yielding 194 results. These 194 results were reviewed by JGE. 164 bibliography search records were excluded, leaving 30 for inclusion.

Therefore, a total of 70 records were included in this study and proceeded to bias assessment. This process is illustrated in Figure 1.

### Risk of Bias

**Case Reports:** 75 cases from 67 studies [33, 38, 46–108, 112, 113] were evaluated using the *JBI Checklist for Case Reports* [44]. 3 cases were excluded. Cases were excluded at this stage if they failed to describe the following domains: patient history and timeline (1 case) [112], current patient condition (2 cases) [112], interventions and treatments (1 case) [113], patient post-intervention condition (2 cases) [112], harms (2 cases) [112], and takeaway lessons (2 cases) [112]. The excluded cases came from the following studies: [112, 113]. Of the remaining 72 cases, all reported interventions and treatments (72 cases, 100%) [33, 38, 46–108]. Most clearly described patient history and timeline (71 cases, 99%) [33, 38, 46–55, 57–108], patient post-intervention condition (70 cases, 97%) [33, 38, 46–66, 69–108], takeaway lessons (70 cases, 97%) [33, 38, 46–55, 57–88, 90–108], patient demographic (69 cases, 96%) [38, 46–52, 54–105, 107, 108], and current patient condition (69 cases, 96%) [33, 38, 46–91, 93–108]. Reporting was also strong for diagnostic assessments (66 cases, 92%) [33, 38, 46–55, 57–61, 63–91, 93–108], and harms (38 cases, 90%) [49, 53–55, 58, 60, 61, 65, 66, 68, 69, 71, 75–80, 84–88, 90, 95, 96, 99, 100, 103, 105–108].

**Case Series:** Separately, 3 studies [109–111] were evaluated using the *JBI Checklist for Case Series* [44]. Reporting quality was generally high across all JBI domains. All included case

TABLE II: Grouped summary of case-level variables and outcomes.

Variable	Count	Percentage	References
<i>Gender</i>			
Male	43	60%	[33, 46–82]
Female	28	39%	[38, 83–107]
Unknown	1	1%	[108]
<i>Age Group</i>			
<18	13	18%	[68, 76, 77, 83, 84, 88, 92, 93, 99, 100, 105]
18–25	18	25%	[33, 46, 49, 52, 57, 65, 69, 70, 74, 81, 87, 95, 96, 101, 104]
26–40	25	35%	[38, 48, 50, 51, 53, 59–62, 64, 67, 69, 71–73, 75, 79, 86, 89–91, 102, 106–108]
41–60	11	15%	[47, 55, 56, 58, 63, 66, 78, 80, 82, 94, 103]
60+	3	4%	[85, 97, 98]
Unknown	2	3%	[54]
<i>Population</i>			
Detained Person	12	17%	[33, 48, 50, 51, 69, 72, 75, 79]
Psychiatric Inpatient	4	6%	[82, 92, 108]
Displaced Person	2	3%	[46, 61]
Under Influence of Alcohol	3	4%	[53, 57, 78]
Psychiatric History	36	50%	[38, 48, 51, 52, 56, 59, 60, 62–68, 70, 71, 75, 76, 82–85, 89, 91, 92, 94, 95, 97, 100–103, 107, 108]
Severely Disabled	7	10%	[52, 68, 82, 97, 100, 101, 107]
Previous Ingestor	19	26%	[48, 51, 54, 57, 58, 62–64, 68, 76, 78, 82, 87, 92, 102, 107, 108]
<i>Motivation</i>			
Intent to harm	21	29%	[33, 47–49, 56, 57, 60, 69, 70, 75, 76, 83, 89, 90, 98, 102, 108]
Protest	9	12%	[33, 55, 61, 69, 104]
Psychiatric	34	47%	[38, 47, 48, 51, 52, 58, 59, 62–68, 71, 75, 76, 81, 82, 84, 86, 87, 91, 92, 94–98, 100, 102, 103]
Psychosocial	17	24%	[46, 53, 65, 72–74, 77, 78, 87, 88, 93, 94, 98, 99, 104–106]
Other	9	12%	[50, 58, 62, 79, 80, 84, 101, 102, 107]
<i>Object</i>			
Button Battery	2	3%	[54, 55]
Magnet	9	12%	[55, 68, 76, 77, 84, 88, 99, 100, 105]
Long (>5cm)	32	44%	[47, 49, 50, 52, 56–58, 60, 61, 64, 65, 67, 70–72, 78, 79, 81–83, 86, 89, 90, 92, 96, 97, 100, 102, 103, 107]
Large (>2.5cm) Diameter	51	71%	[33, 46–52, 54, 56–58, 61–67, 69–73, 76, 78, 79, 82, 83, 86, 88–90, 92, 96, 97, 99–103, 106–108]
Sharp	34	47%	[33, 38, 48, 51, 53, 56–60, 62–65, 67, 69–71, 74, 81–83, 86, 87, 91, 92, 94, 96]
Multiple	44	61%	[38, 51, 52, 55, 56, 58–60, 62–71, 74–78, 80–82, 84, 85, 87, 88, 93–96, 98–100, 103, 105, 108]
<i>Outcome</i>			
Endoscopy	31	43%	[46, 50–56, 61–63, 68, 72, 73, 75, 76, 79, 80, 82, 86, 89, 91, 94, 96, 98, 100–103, 106]
Surgery	44	61%	[33, 47–49, 52, 56, 57, 59–61, 64, 65, 67–71, 74, 76–78, 81, 83–86, 88–92, 96, 97, 99, 104–108]
Death	2	3%	[58, 66]
Conservative	7	10%	[38, 58, 66, 87, 92, 93, 95]
Complication	48	67%	[49, 51–61, 64–71, 74, 76–79, 81, 84–86, 88, 90–93, 96, 97, 99, 100, 102–107]

series fully reported clear inclusion criteria, standard condition measurements, valid patient identification methods, complete inclusion, clear demographic information, clear clinical information, clear outcome and follow-up, and appropriate statistical analysis [109–111]. However, fewer studies (2) reported consecutive inclusion, and clear site demographic information [109, 111].

#### Study Characteristics

A total of 68 studies were included in the synthesis. 65 studies were case reports, yielding 72 cases [33, 38, 46–108]. A full list of group summary case-level characteristics and outcomes is available in Table II. 3 studies were case series, yielding 90 cases [109–111]. A full list of grouped series-level characteristics and outcomes is available in Table III. Geographically, cases of ingestion (case reports and case series) were reported in 35 unique

TABLE III: Grouped aggregate series-level summary.

Variable	Pooled	Case Reports	Case Series	Karp <i>et al.</i> (1991) [109]	Lee <i>et al.</i> (2007) [110]	Elghali <i>et al.</i> (2016) [111]
Total Cases	162	72	90	19	52	19
Gender						
Male	133 (82)	43 (60)	90 (100)	19 (100)	52 (100)	19 (100)
Female	28 (17)	28 (39)	0 (0)	0 (0)	0 (0)	0 (0)
Unknown	1 (1)	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)
Age Group						
Maximum	100	100	50	40	50	27
Mean	28	30	24	24	—	24
Median	27	27	35	—	35	—
Minimum	7	7	17	17	25	19
Demographic						
Detained Person	102 (50)	12 (14)	90 (74)	19 (51)	52 (85)	19 (81)
Psychiatric History	65 (32)	36 (43)	29 (24)	18 (49)	9 (15)	2 (10)
Previous Ingestor	21 (10)	19 (23)	2 (2)	—	—	2 (9)
Severely Disabled	7 (3)	7 (8)	0 (0)	—	0 (0)	—
Psychiatric Inpatient	4 (2)	4 (5)	0 (0)	0 (0)	0 (0)	0 (0)
Under Influence of Alcohol	3 (1)	3 (4)	0 (0)	—	—	—
Displaced Person	2 (1)	2 (2)	0 (0)	—	—	—
Motivation						
Protest	79 (45)	9 (10)	70 (80)	3 (16)	50 (100)	17 (89)
Psychiatric	46 (26)	34 (38)	12 (14)	12 (63)	0 (0)	0 (0)
Intent to harm	27 (15)	21 (23)	6 (7)	4 (21)	0 (0)	2 (11)
Psychosocial	17 (10)	17 (19)	0 (0)	0 (0)	0 (0)	0 (0)
Other	9 (5)	9 (10)	0 (0)	0 (0)	0 (0)	0 (0)
Object						
Sharp	102	34	68	19	33	16
Multiple	69	44	25	—	24	1
Long (>5cm)	64	32	32	—	32	0
Large (>2.5cm) Diameter	51	51	0	—	—	—
Magnet	9	9	0	—	0	0
Button Battery	2	2	0	—	0	0
Outcome						
Endoscopy	78 (34)	31 (23)	47 (48)	—	46 (79)	1 (5)
Surgery	59 (26)	44 (33)	15 (15)	5 (26)	6 (10)	4 (19)
Complication	54 (23)	48 (36)	6 (6)	—	6 (10)	—
Conservative	36 (16)	7 (5)	29 (30)	14 (74)	0 (0)	15 (71)
Death	3 (1)	2 (2)	1 (1)	0 (0)	0 (0)	1 (5)

Key: n (%).

countries, most being from South Korea (n=52, 32.1%), United States of America (n=32, 19.8%), and Tunisia (n=19, 11.7%). A full breakdown of cases per country is shown in Table IV and Figure 2.

### Synthesis

#### Key Associations Between Motivations and Outcomes:

**Psychiatric Motivation:** Pooled prevalence was 50.4% (95% CI: 40.2–60.6%). Psychiatric motivation was more common in females (45.7% vs 32.7%,  $p < 0.001$ ) and associated with psychiatric inpatient status, which increased the likelihood of surgery (OR 1.40,  $p = 0.044$ ).

**Intent to Harm Motivation:** Pooled prevalence was 25.5% (95% CI: 10.0–51.6%). This motivation was more common in psychiatric inpatients (25.0% vs 23.3%,  $p < 0.001$ ), but no direct associations with outcomes were observed in meta-regression.

**Psychosocial Motivation:** Associated with an increased likelihood of surgery (OR 1.08,  $p = 0.044$ ). Case examples included ingestion for weight loss, dares, or games. Psychosocial motivation was associated with lower intent-to-harm (4.3% vs 29.9%,  $p < 0.001$ ).

**Protest Motivation:** Pooled prevalence was 60.3% (95% CI: 2.0–99.1%). Protest motivation was less common in females (2.9% vs 14.5%,  $p = 0.045$ ) and showed no direct outcome associations.

**Other Motivation:** Associated with an increased likelihood of surgery (OR 1.16,  $p = 0.044$ ).

#### Outcome-Specific Findings:

**Methodological Notes:** Meta-analyses used restricted maximum likelihood (REML) estimation with Hartung-Knapp adjustments due to small study sizes. Heterogeneity was moderate to high ( $I^2$  up to 51.2%), and insufficient data precluded some sub-

TABLE IV: Case counts per country.

Country	Case Count	Percentage	References
South Korea	52	32	[110]
United States of America	32	20	[38, 48, 55, 60, 62, 63, 66, 68, 75, 77, 94, 97, 104, 109]
Tunisia	19	12	[111]
United Kingdom	7	4	[54, 61, 72, 85, 88, 90]
India	7	4	[67, 71, 80, 86, 87, 95, 96]
Bulgaria	6	4	[33, 69]
Iran	5	3	[58, 59, 92]
Turkey	4	2	[46, 52, 76, 107]
Spain	2	1	[56, 108]
Poland	2	1	[65, 106]
China	2	1	[64, 98]
Pakistan	1	1	[81]
Switzerland	1	1	[105]
Taiwan	1	1	[89]
South Africa	1	1	[74]
Saudi Arabia	1	1	[103]
Qatar	1	1	[49]
Portugal	1	1	[101]
Sweden	1	1	[99]
Australia	1	1	[51]
Oman	1	1	[83]
Netherlands	1	1	[53]
United Arab Emirates	1	1	[84]
Japan	1	1	[100]
Italy	1	1	[73]
Israel	1	1	[93]
Iraq	1	1	[47]
Hungary	1	1	[57]
Greece	1	1	[102]
Germany	1	1	[82]
Ethiopia	1	1	[70]
Egypt	1	1	[50]
Ecuador	1	1	[91]
Croatia	1	1	[79]
Nepal	1	1	[78]

group analyses. The findings should be interpreted with caution due to descriptive nature and high heterogeneity.

**Conclusion:** Psychiatric and psychosocial motivations were most strongly associated with surgical interventions, while protest and intent-to-harm motivations showed no direct links to outcomes. Female gender and psychiatric inpatient status were important confounders. The high heterogeneity across studies limits the strength of conclusions and highlights the need for further research.

#### Sensitivity Analyses

Formal sensitivity analyses were not performed due to limited study numbers and heterogeneity; meta-analyses were primarily descriptive, with aggregate case reports included to enhance robustness.

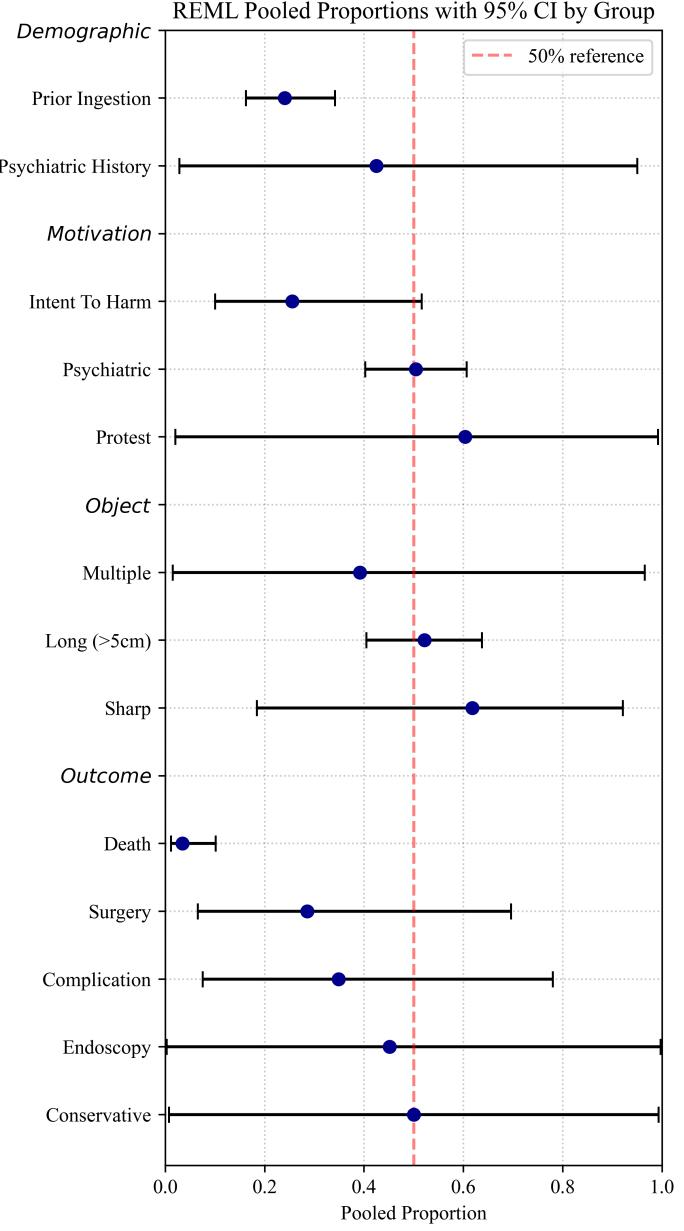


Fig. 3: Meta-analyses of proportions using random-effects models with restricted maximum likelihood (REML) estimation and Hartung-Knapp (HK) adjustments for confidence intervals.

#### Assessment of Reporting Bias

Risk of bias due to missing results was not formally assessed with funnel plots or quantitative tests (e.g., Egger's) for outcomes with fewer than 10 series, due to low power and high heterogeneity [114, 115]; for eligible variables, funnel plots were produced using standard error as the y-axis, with heterogeneity ( $I^2$ ) reported separately in Figure 3.

#### Certainty of Evidence

A formal GRADE assessment was not applicable due to the descriptive nature of the evidence, but risk of bias was explored using the *JBI critical appraisal checklists for case reports and case series* [44].

TABLE V: Grouped univariate meta-regression results for series-level data.

Variable	Conservative	Endoscopy	Surgery	Death	Complication
<i>Gender</i>					
Female	0.96 [0.88, 1.04] (p=0.201)	0.98 [0.91, 1.06] (p=0.529)	<b>1.05 [1.00, 1.10]</b> <b>(p=0.044)*</b>	1.00 [0.89, 1.11] (p=0.904)	1.08 [0.91, 1.28] (p=0.202)
Unknown	0.31 [0.03, 3.08] (p=0.201)	0.61 [0.07, 5.45] (p=0.529)	<b>3.81 [1.06, 13.68]</b> <b>(p=0.044)*</b>	0.91 [0.04, 20.06] (p=0.904)	8.00 [0.07, 954.88] (p=0.202)
Male	0.99 [0.96, 1.02] (p=0.398)	1.00 [0.97, 1.03] (p=0.916)	1.00 [0.97, 1.02] (p=0.881)	0.99 [0.97, 1.01] (p=0.277)	0.99 [0.93, 1.06] (p=0.679)
<i>Demographic</i>					
Psychiatric Inpatient	0.74 [0.42, 1.32] (p=0.201)	0.89 [0.51, 1.53] (p=0.529)	<b>1.40 [1.01, 1.92]</b> <b>(p=0.044)*</b>	0.98 [0.45, 2.12] (p=0.904)	1.68 [0.51, 5.56] (p=0.202)
Severely Disabled	0.91 [0.29, 2.83] (p=0.470)	0.92 [0.61, 1.39] (p=0.466)	1.24 [0.81, 1.89] (p=0.161)	1.10 [0.45, 2.71] (p=0.399)	1.35 [0.68, 2.67] (p=0.202)
Detained Person	0.99 [0.95, 1.04] (p=0.660)	1.00 [0.97, 1.03] (p=0.890)	0.99 [0.97, 1.02] (p=0.442)	0.99 [0.97, 1.01] (p=0.244)	0.99 [0.92, 1.05] (p=0.419)
Psychiatric History	0.97 [0.92, 1.03] (p=0.258)	0.99 [0.94, 1.05] (p=0.606)	1.01 [0.97, 1.06] (p=0.463)	0.99 [0.94, 1.04] (p=0.415)	1.01 [0.86, 1.18] (p=0.835)
Previous Ingestor	0.95 [0.79, 1.14] (p=0.364)	1.00 [0.88, 1.12] (p=0.879)	1.07 [0.89, 1.29] (p=0.274)	0.99 [0.84, 1.17] (p=0.867)	1.11 [0.22, 5.74] (p=0.556)
Displaced Person	0.71 [0.01, 37.98] (p=0.470)	0.89 [0.29, 2.79] (p=0.427)	1.98 [0.00, 1949.23] (p=0.427)	1.41 [0.06, 32.70] (p=0.399)	3.27 [0.00, 1502880.33] (p=0.454)
Under Influence of Alcohol	0.79 [0.06, 11.30] (p=0.470)	0.93 [0.43, 1.98] (p=0.427)	1.58 [0.02, 156.04] (p=0.427)	1.26 [0.15, 10.22] (p=0.399)	2.21 [0.00, 13120.48] (p=0.454)
<i>Motivation</i>					
Psychosocial	0.93 [0.81, 1.07] (p=0.201)	0.97 [0.85, 1.10] (p=0.529)	<b>1.08 [1.00, 1.17]</b> <b>(p=0.044)*</b>	0.99 [0.83, 1.19] (p=0.904)	1.13 [0.85, 1.50] (p=0.202)
Other	0.88 [0.68, 1.13] (p=0.201)	0.95 [0.74, 1.21] (p=0.529)	<b>1.16 [1.01, 1.34]</b> <b>(p=0.044)*</b>	0.99 [0.70, 1.40] (p=0.904)	1.26 [0.74, 2.14] (p=0.202)
Intent to harm	0.95 [0.85, 1.06] (p=0.214)	0.98 [0.88, 1.08] (p=0.486)	1.05 [0.98, 1.13] (p=0.130)	0.99 [0.86, 1.13] (p=0.710)	1.07 [0.81, 1.41] (p=0.430)
Psychiatric	0.97 [0.90, 1.04] (p=0.223)	0.99 [0.93, 1.05] (p=0.498)	1.03 [0.98, 1.08] (p=0.159)	0.99 [0.92, 1.07] (p=0.625)	1.04 [0.87, 1.23] (p=0.484)
Protest	0.99 [0.94, 1.05] (p=0.620)	1.00 [0.96, 1.04] (p=0.800)	0.99 [0.96, 1.02] (p=0.404)	0.99 [0.96, 1.02] (p=0.255)	0.98 [0.91, 1.06] (p=0.369)
<i>Object</i>					
Button Battery	0.61 [0.12, 3.26] (p=0.336)	0.78 [0.26, 2.33] (p=0.529)	2.05 [0.87, 4.81] (p=0.076)	0.95 [0.20, 4.48] (p=0.904)	2.83 [0.26, 30.90] (p=0.202)
Magnet	0.90 [0.62, 1.30] (p=0.336)	0.95 [0.74, 1.21] (p=0.529)	1.17 [0.97, 1.42] (p=0.076)	0.99 [0.70, 1.40] (p=0.904)	1.26 [0.74, 2.14] (p=0.202)
Sharp	0.99 [0.94, 1.03] (p=0.406)	1.00 [0.96, 1.04] (p=0.847)	1.00 [0.97, 1.03] (p=0.935)	0.99 [0.96, 1.02] (p=0.287)	0.99 [0.90, 1.09] (p=0.726)
Long (>5cm)	0.98 [0.89, 1.08] (p=0.456)	1.00 [0.93, 1.07] (p=0.943)	1.01 [0.93, 1.09] (p=0.802)	0.99 [0.94, 1.04] (p=0.357)	1.00 [0.82, 1.20] (p=0.922)
Multiple	0.98 [0.91, 1.06] (p=0.382)	0.99 [0.94, 1.05] (p=0.734)	1.02 [0.96, 1.08] (p=0.444)	0.99 [0.94, 1.04] (p=0.510)	1.02 [0.86, 1.20] (p=0.719)
Large (>2.5cm) Diameter	0.99 [0.84, 1.15] (p=0.470)	1.00 [0.95, 1.04] (p=0.427)	1.03 [0.78, 1.35] (p=0.427)	1.01 [0.90, 1.15] (p=0.399)	1.05 [0.63, 1.75] (p=0.454)

OR: Odds Ratio; CI: Confidence Interval; p: p-value. \* indicates  $p < 0.05$ . Bold = statistically significant. — = missing or unstable estimate.

## DISCUSSION

### Interpretation of Results

**Strengths:** The present review represents, to the author's knowledge, this is the first review of IIFO that focuses on motivations for ingestion, aggregating evidence from 162 ingestion cases with documented motivations.

The main strength of this review lies in its methodology. Where motivation was unclear, cases were excluded—ensuring that the

effects measured were genuinely reflective of intentionality. This strict inclusion criterion helps isolate intentional ingestion as an independent clinical phenomenon. Additionally, by avoiding age restrictions, this review includes a wide age range (from 7 to 100 years), improving the generalisability of its findings across the lifespan.

A broad search strategy was implemented, covering multiple databases, bibliographies, and grey literature sources. This increases the likelihood that the findings reflect a wide cross-section

Outcome	Pooled Prevalence	Key Influencers
Conservative	34.8% Endoscopy	pen in protest of an asylum decision and developed a double duodenal perforation, requiring surgery; the other involved a man who swallowed \$1000 wrapped in foil with psychosocial/other motivation and psychiatric inpatient status.
Reduced in ages 18–25 (OR 0.29) and with sharp object ingestion (OR 0.34)	24.5% (95% CI: 0.2–99.7%)	
Surgery	28.5% Who swallowed \$1000 wrapped in foil with psychosocial/other motivation and psychiatric inpatient status.	
Death	3.1% \$1000 wrapped in foil with psychosocial/other motivation and psychiatric inpatient status.	
Complications	34.7% CI 1.8%–93.8%	The 305 examples illustrate how both motivation and object characteristics can drive clinical outcomes and why both should be considered in future analysis.

TABLE VI: Summary of pooled outcome prevalence and key influencing factors.

of the literature and reduces the impact of publication bias due to indexing alone.

Despite substantial heterogeneity in the review population, outcome proportions were pooled using random-effects meta-analysis with restricted maximum likelihood estimation and Hartung–Knapp adjustments—techniques appropriate for small numbers of studies and high between-study variance. Following IIFO, patients underwent endoscopy in 47.3% of cases (95% CI 4.3%–94.7%), surgery in 30.6% (95% CI 12.0%–58.9%), and conservative management in 41.6% (95% CI 4.4%–91.7%). Complications occurred in 34.7% of cases (95% CI 1.8%–93.8%), and 2.5% of patients died (95% CI 0.8%–7.7%). These figures are substantially higher than previously reported in the literature [14, 15].

Given the methodological rigour of this review—including strict exclusion of non-intentional cases—and despite the wide uncertainty intervals, the findings strongly suggest that *intentionality alone* is a key driver of morbidity and mortality following foreign body ingestion.

**Associations Between Motivation and Outcome:** While the univariate meta-regression (predominantly conducted on detained males) didn't show statistically significant correlations between motivations and outcomes, signals did emerge in the univariate association testing conducted on the more varied population represented in the case reports. This population was more diverse—39% female, 17% detained individuals, and 50% with a psychiatric history—and included a wider range of object types (e.g., magnets, multiple items, long objects).

In this context, “intent to harm” was associated with a fivefold increase in the odds of surgery, whereas “other” motivations were associated with an 86% decrease in the odds of surgery. These findings suggest that motivations likely influence clinical outcomes, particularly in more heterogeneous and less institutionalised populations.

**Subgroup Findings:** Interestingly, among severely disabled people (defined here as individuals with reduced levels of consciousness or severe learning disabilities), univariate meta-regression showed a 41% decrease in the odds of death. While this cohort was small ( $n=7$ ), and all cases were published as case reports, this may reflect publication bias—authors may be more likely to report complex or anatomically challenging cases [116]. However, it might also reflect the diligence of carers, earlier access to intervention, and perhaps the success of public health campaigns aimed at recognising and addressing disproportionate harms in this population.

Also noteworthy, displaced individuals had reduced odds of death (OR 0.22, 95% CI 0.08–0.61,  $p = 0.034$ ) in the meta-regression. This is unlikely to be solely due to their displacement status. The two cases underpinning this result [46, 117] are strikingly different. One involved a person who swallowed a

### Limitations of the Review Process

Several limitations of the review process should be acknowledged.

**Selection and Screening:** Many studies were excluded because intentionality was not clearly stated. Given the nuanced and inconsistent language often used in clinical reporting, some relevant cases may have been omitted. This likely introduced selection bias, especially in a single-author review, where subjective judgment plays a larger role.

Although the search strategy was broad, relevant studies may still have been missed—particularly unpublished material or reports not indexed in major databases. This is a recognised limitation in rare-event research.

Screening and data extraction were carried out by a single reviewer. While detailed protocols and reproducible scripts were used to minimise error, the absence of a second full-text reviewer and data extractor increases the risk of human error and subjective bias, particularly when interpreting ambiguous descriptions of intent and motivation. Manually reviewing over 480 full texts and extracting detailed case-level data from almost half is a substantial undertaking and a recognised limitation.

**Motivation Classification:** The motivation categories were author-defined and applied post hoc following preliminary analysis. While this was necessary due to the lack of standardised classifications, it introduces classification bias, especially in a field as complex and subjective as IIFO. Motivational constructs such as “intent to harm”, “protest”, or “other” may overlap or be poorly described in reports, affecting how cases are grouped and interpreted.

**Statistical Limitations:** The analytical approach may have been overly complex given the volume and quality of the available literature. Conducting regression on 25 variables across only four case series risks overfitting, reducing the reliability of these models. A more parsimonious strategy might have involved collapsing object variables into a binary “high-risk vs low-risk” classification, informed by existing literature on object characteristics and classification [14, 15].

Similarly, psychiatric history was treated as a binary variable, but as noted in the introduction, psychiatric presentations associated with IIFO are varied and complex. The binary coding limits the ability to identify nuanced associations. A more granular analysis of psychiatric subtypes could provide deeper insight but would further complicate models already stretched by sample size constraints.

**Other Gaps:** This review did not examine the types or effectiveness of conservative management strategies, despite their prevalence and clinical relevance. Nor did it consider object location, which is known to be a critical determinant of clinical risk. Both factors are likely to affect outcomes and should be included in future studies.

It is possible that collapsing the case report data into a series introduced heterogeneity into the series level data. In the series', all cases were males and most were detained individuals.

The psychiatric motivation component may have been underestimated. In psychiatric case reports, authors frequently report diagnoses and lengthy case timelines, but not explicit motivations for individual motivations.

### Takeaway points

Ultimately, the literature on motivations in IIFO remains sparse, and clinical outcomes remain highly heterogeneous. The evidence base is not yet strong enough to draw definitive conclusions. As with many rare and complex presentations, prospective, randomised studies are needed—but these must be preceded by expert consensus on motivation frameworks.

IIFO is a nuanced and multifaceted form of self-harm. Motivation is rarely reported, and intentionality itself is often assumed rather than stated. Following this review, authors should heed the advice of experts in the field: a multidisciplinary approach is essential. Psychiatric and psychological input is needed not just for treatment, but also for accurate classification and understanding of patient motivations.

With more precise reporting of motivational and clinical variables, future reviews will be better placed to inform evidence-based guidance, ultimately improving care for this complex patient group.

### Data Availability

Data collection, manipulation and analysis in this review were conducted using Python [43] in *Visual Studio Code* [118] and *Jupyter Notebooks* [119]. The manuscript was compiled using *LaTeX* [120]. Specific Python packages used include: *Pandas* [121], *scikit-learn* [122], *statsmodel* [45], *seaborn* [123], *matplotlib* [124] and *Cartopy* [125].

The data and code used in this systematic review are available on Github at [http://github.com/jackedge/iifo\\_systematic\\_review](http://github.com/jackedge/iifo_systematic_review).

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**APPENDIX A**  
**ELIGIBILITY CRITERIA**

**A. Inclusion Criteria**

Category	Details
Population	Any human. Any age group.
Interventions or exposures	Humans that have: – Non-accidental ingestion – Ingestion of a true foreign body (non-nutritive items)
Comparators / Control group	Demographic: – Gender – Age – Detained Person – Psychiatric Inpatient – Displaced Person – Under Influence of Alcohol – Psychiatric History – Severely Disabled – Previous Ingestion Motivation: – Intent to harm – Psychiatric – Psychosocial – Protest – Other Object characteristics: – Button battery – Magnet – Long (>5 cm) – Large diameter (>2.5 cm) – Multiple – Blunt objects – Sharp-pointed objects
Outcomes of interest	– Endoscopic intervention – Surgical intervention – Conservative management – Complication rates – Mortality rates
Setting	Any setting.
Study designs	Any design.

TABLE VII: Inclusion criteria structured using the PICO framework.

**B. Exclusion Criteria**

#	Exclusion Criterion
1	Full text not available in English.
2	Studies not focusing on intentional self-ingestion (into the gastrointestinal tract) of a foreign object via the oral cavity (mouth), or where it is unclear if ingestion occurred.
3	Studies focusing solely on accidental ingestion.
4	Non-human or animal studies.
5	Reviews, editorials, commentaries, and opinion pieces without original empirical data.
6	Duplicate publications or studies with overlapping datasets (only the most comprehensive or recent study was included).
7	Studies focusing on ingestion or co-ingestion of substances (e.g., poisons, medications) rather than physical foreign objects.
8	Ingestions undertaken in controlled environments as part of a voluntary study.
9	Ingestions not explicitly stated to be intentional and not suggestive of deliberate ingestion.
10	Does not meet inclusion criteria.
11	Ingestions where death resulted from other means (e.g., suicide by other method).
12	Studies published before the advent of endoscopy (1906).
13	Outcomes not reported.
14	Motivation not reported.
15	Object characteristics not reported

TABLE VIII: Exclusion criteria for study selection.

**APPENDIX B**  
**KEYWORDS AND MESH TERMS**

**A. PubMed**

Concept	Keywords	MeSH Terms
Foreign Bodies	"foreign obj*" "foreign bod*"	Foreign Bodies [MeSH]
Intentional Ingestion / Self-harm	"intent*" "deliberate*" "purpose*" "self-injur*" "selfharm*" "self-harm*" "ingest*" "swallow*"	Self-Injurious Behavior [MeSH]
Ingestion Behavior		—
Interventions	"surg*" "endoscop*" "EGD" "OGD" "Esophagogastroduodenoscopy" "Oesophagogastroduodenoscopy" "manag*"	Endoscopy [MeSH] Surgical Procedures, Operative [MeSH] Conservative Treatment [MeSH] Drug Therapy [MeSH]

TABLE IX: Concepts with associated keywords and MeSH terms used in PubMed search strategy.

**B. Embase**

Concept	Keywords	EMTREE Terms
Foreign Bodies	"foreign obj*" "foreign bod*"	"foreign body"/exp
Intentional Ingestion / Self-harm	"intent*" "deliberate*" "purpose*" "self-injur*" "selfharm*" "self-harm*" "ingest*" "swallow*"	"automutilation"/exp
Ingestion Behavior		"swallowing"/exp
Interventions	"surg*" "endoscop*" "EGD" "OGD" "Esophagogastroduodenoscopy" "Oesophagogastroduodenoscopy" "manag*"	"endoscopy"/exp "surgery"/exp "conservative treatment'/exp 'drug therapy"/exp

TABLE X: Concepts with associated keywords and EMTREE terms used in Embase search strategy.

*C. Cochrane (CENTRAL)*

Concept	Keywords	Cochrane MeSH Terms
Foreign Bodies	"foreign obj*" "foreign bod*" (foreign NEXT obj*) (foreign NEXT bod*) intent* deliberate*	[mh foreign bodies]
Intentional Ingestion / Self-harm	purpose* (self NEXT injur*) (self NEXT harm*) ingest*	[mh self-injurious behavior]
Ingestion Behavior	swallow* surg* endoscop*	-
Interventions	EGD Esophagogastrroduodenoscopy Oesophagogastrroduodenoscopy manag*	[mh endoscopy] [mh surgical procedures, operative] [mh conservative treatment] [mh drug therapy]

TABLE XI: Concepts with associated keywords and Cochrane MeSH terms used in CENTRAL search strategy.

*D. Web of Science*

Concept	Keywords	Search Field
Foreign Bodies	foreign obj* foreign bod* automutilation intent* deliberate*	ALL=
Intentional Ingestion / Self-harm	purpose* self-injur* selfharm* self-harm* swallowing	ALL=
Ingestion Behavior	ingest* swallow* endoscopy surgery conservative treatment drug therapy	ALL=
Interventions	surg* endoscop* EGD Esophagogastrroduodenoscopy Oesophagogastrroduodenoscopy manag*	ALL=

TABLE XII: Concepts with associated keywords and Web of Science fields used in the search strategy.

*E. Scopus*

Concept	Keywords	Search Field / Syntax
Foreign Bodies	foreign PRE/0 obj* foreign PRE/0 bod* intent* deliberate* purpose* self PRE/0 injur* self PRE/0 harm*	ALL()
Intentional Ingestion / Self-harm	ingest* swallow* endoscopy surgery 'conservative' 'treatment' 'drug' 'therapy' surg* endoscop*	ALL()
Ingestion Behavior	egd esophagogastroduodenoscopy oesophagogastroduodenoscopy manag*	ALL()
Interventions		ALL()

TABLE XIII: Concepts with associated keywords and Scopus syntax used in the search strategy.

*F. PsycINFO*

Concept	Keywords	PsycINFO Descriptors
Foreign Bodies	foreign obj* foreign bod* automutilation intent* deliberate* purpose* self injur* self harm*	—
Intentional Ingestion / Self-harm	ingest* swallow* endoscop* conservative treatment drug therapy	DE "Nonsuicidal Self-Injury"
Ingestion Behavior	surg* egd esophagogastroduodenoscopy oesophagogastroduodenoscopy manag*	DE "Ingestion"
Interventions		DE "Surgery"

TABLE XIV: Concepts with associated keywords and controlled vocabulary (Descriptors) used in PsycINFO search strategy.

*G. Google Scholar*

Concept	Keywords	Search Field
Foreign Bodies	"foreign obj*" "foreign bod*" "intent*" "deliberate*" "purpose*" "self-injur*" "selfharm*" "self-harm*" "ingest*" "swallow*"	—
Intentional Ingestion / Self-harm		—
Ingestion Behavior		—

TABLE XV: Concepts with associated keywords used in Google Scholar search strategy.

## DATABASE SEARCHES

*PubMed Query*

(“Foreign Bodies”[MeSH] OR “foreign obj\*” OR “foreign bod\*”)  
AND  
(“Self-Injurious Behavior”[MeSH] OR “intent\*” OR “deliberate\*” OR “purpose\*” OR “self-injur\*” OR “selfharm\*” OR “self-harm\*”)  
AND  
(“ingest\*” OR “swallow\*”)  
AND  
(“Endoscopy”[MeSH] OR “Surgical Procedures, Operative”[MeSH] OR “Conservative Treatment”[MeSH] OR “Drug Therapy”[MeSH] OR “surg\*” OR “endoscop\*” OR “EGD” OR “OGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag\*”)

*Embase Query (All Fields)*

(‘foreign body’/exp OR “foreign obj\*” OR “foreign bod\*”)  
AND  
(‘automutilation’/exp OR “intent\*” OR “deliberate\*” OR “purpose\*” OR “self-injur\*” OR “selfharm\*” OR “self-harm\*”)  
AND  
(‘swallowing’/exp OR “ingest\*” OR “swallow\*”)  
AND  
(‘endoscopy’/exp OR ‘surgery’/exp OR ‘conservative treatment’/exp OR ‘drug therapy’/exp OR “surg\*” OR “endoscop\*” OR “EGD” OR “OGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag\*”)

*CENTRAL (Cochrane) Query (All Fields)*

([mh “foreign bodies”] OR (“foreign” NEXT “obj\*”) OR (“foreign” NEXT “bod\*”))  
AND  
([mh “self-injurious behavior”] OR “intent\*” OR “deliberate\*” OR “purpose\*” OR (“self” NEXT “injur\*”) OR (“self” NEXT “harm\*”))  
AND  
(“ingest\*” OR “swallow\*”)  
AND  
([mh “endoscopy”] OR [mh “surgical procedures, operative”] OR [mh “conservative treatment”] OR [mh “drug therapy”]  
OR “surg\*” OR “endoscop\*” OR “EGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR  
“manag\*”)

*Web of Science Query*

**Link:** <https://www.webofscience.com/wos/woscc/summary/4da44d48-3e09-4a94-a3bd-ff8139e94859-01387ccd63/relevance/1>  
ALL=(“foreign obj\*” OR “foreign bod\*”)  
AND  
ALL=(“automutilation” OR “intent\*” OR “deliberate\*” OR “purpose\*” OR “self-injur\*” OR “selfharm\*” OR “self-harm\*”)  
AND  
ALL=(“swallowing” OR “ingest\*” OR “swallow\*”)  
AND  
ALL=(“endoscopy” OR “surgery” OR “conservative treatment” OR “drug therapy” OR “surg\*” OR “endoscop\*” OR “EGD”  
OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag\*”)

*Scopus Query*

ALL (“foreign PRE/0 obj\*” OR “foreign PRE/0 bod\*”)  
AND  
ALL (“intent\*” OR “deliberate\*” OR “purpose\*” OR “self PRE/0 injur\*” OR “self PRE/0 harm\*”)  
AND  
ALL (“ingest\*” OR “swallow\*”)  
AND  
ALL (“endoscopy” OR “surgery” OR “conservative” OR “treatment” OR “drug” OR “therapy” OR “surg\*” OR “endoscop\*”  
OR “EGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag\*”)

*PsycINFO Query*

**Link:** [https://search-ebscohost-com.ezproxy.library.qmul.ac.uk/login.aspx?direct=true&db=psyh&bquery=\(foreign+obj\\*+OR+foreign+bod\\*\)+AND+\(DE+%26quot%3bNonsuicidal+Self-Injury%26quot%3b+OR+automutilation+OR+intent\\*+OR+deliberate\\*+OR+purpose\\*+OR+self+injur\\*+OR+self+harm\\*\)+AND+\(DE+%26quot%3bIngestion%26quot%3b+OR+ingest\\*+OR+swallow\\*\)+AND+\(DE+%26quot%3bSurgery%26quot%3b+OR+endoscop\\*+OR+conservative+treatment+OR+drug+therapy+surg\\*+OR+endoscop\\*+OR+egd+OR+esophagogastroduodenoscopy+OR+oesophagogastroduodenoscopy+OR+manag\\*\)&type=0&searchMode=Standard&site=ehost-live](https://search-ebscohost-com.ezproxy.library.qmul.ac.uk/login.aspx?direct=true&db=psyh&bquery=(foreign+obj*+OR+foreign+bod*)+AND+(DE+%26quot%3bNonsuicidal+Self-Injury%26quot%3b+OR+automutilation+OR+intent*+OR+deliberate*+OR+purpose*+OR+self+injur*+OR+self+harm*)+AND+(DE+%26quot%3bIngestion%26quot%3b+OR+ingest*+OR+swallow*)+AND+(DE+%26quot%3bSurgery%26quot%3b+OR+endoscop*+OR+conservative+treatment+OR+drug+therapy+surg*+OR+endoscop*+OR+egd+OR+esophagogastroduodenoscopy+OR+oesophagogastroduodenoscopy+OR+manag*)&type=0&searchMode=Standard&site=ehost-live)

(“foreign obj\*” OR “foreign bod\*”)

AND

(DE “Nonsuicidal Self-Injury” OR “automutilation” OR “intent\*” OR “deliberate\*” OR “purpose\*” OR “self injur\*” OR “self harm\*”)

AND

(DE “Ingestion” OR “ingest\*” OR “swallow\*”)

AND

(DE “Surgery” OR “endoscop\*” OR “conservative treatment” OR “drug therapy” OR “surg\*” OR “endoscop\*” OR “EGD” OR “Esophagogastroduodenoscopy” OR “Oesophagogastroduodenoscopy” OR “manag\*”)

## GREY LITERATURE

*Google Scholar*

(“foreign obj\*” OR “foreign bod\*”)

AND

(“intent\*” OR “deliberate\*” OR “purpose\*” OR “self-injur\*” OR “selfharm\*” OR “self-harm\*”)

AND

(“ingest\*” OR “swallow\*”)

**APPENDIX C**  
**COMPUTATIONAL VARIABLE DEFINITIONS**

TABLE XVI: Variables used for case report data extraction. Aggregates of which were used to create Variable\_Rate and Variable\_Cases.

Variable	Definition
Is_Prisoner	Documented in prison, police custody, or detained (including immigration detention) at the time of the encounter; 'N' if not detained; 'UK' if unknown.
Psych_Hx	Documented DSM-V mental disorder (including substance-related disorders) [126]; 'N' if no diagnosis; 'UK' if data unavailable.
Is_Displaced_Person	'Y' if: meets the UN General Assembly [127] definition of 'Refugee'; or meets UNHCR [128] definition of an 'internally displaced person'; or meets the UNHCR [129] definition for 'asylum seeker'; 'N' if not displaced; 'UK' if unknown.
Under_Influence_Alcohol	Evidence, suspicion, or self-report of alcohol influence at presentation; 'N' if no indication; 'UK' if unknown.
Is_Psych_Inpat	Admitted (voluntarily or involuntarily) to a psychiatric facility/ward at encounter; 'N' if not admitted; 'UK' if unknown.
Severe_Disability_Hx	History of severe learning disability or impaired consciousness; 'N' if absent; 'UK' if unknown.
Previous_Ingestions	Prior episode of foreign-body ingestion documented; 'N' if first ingestion; 'UK' if history unknown.
Motivation_Intent_To_Harm	Ingestion intended for self-harm, self-injury, or suicide; 'N' if other motive; 'UK' if unclear.
Motivation_Protest	Ingestion as protest, demonstration, or manipulation (e.g., objection to detention conditions); 'N' if not protest-related; 'UK' if unclear.
Motivation_Psychiatric	Ingestion driven primarily by an underlying psychiatric condition (psychosis, impulsivity, etc.); 'N' if not psychiatric; 'UK' if unclear.
Motivation_Psychosocial	Ingestion motivated by social or interpersonal factors (imitative acts, shock value, body-image, safekeeping, etc.); 'N' if not psychosocial; 'UK' if unclear.
Motivation_Uncertain	No clear motivation identified in documentation; 'N' if specific motive recorded; 'UK' if ambiguous.
Object_Button_Battery	Button battery ingested; 'N' if not; 'UK' if object type not recorded.
Object_Magnet	Magnet ingested; 'N' if none; 'UK' if unknown.
Object_Long	Ingested object length > 5 cm; 'N' if $\leq$ 5 cm; 'UK' if dimensions unknown.
Object_Sharp	Object described as sharp or pointed (e.g., blades, nails, needles); 'N' if not sharp; 'UK' if unclear.
Object_Multiple	More than one object ingested in same episode; 'N' for single object; 'UK' if number unspecified.
Object_Uncertain	Where object characteristics are unknown. 'N' if known; 'UK' if Unknown.
Outcome_Endoscopy	Endoscopic intervention performed during episode; 'N' if not; 'UK' if unavailable.
Outcome_Surgery	Surgical intervention performed (operative procedure under anaesthesia); 'N' if not; 'UK' if not documented.
Outcome_Conservative	'Y' if managed without endoscopy or surgery; 'N' if either procedure performed.
Outcome_Death	Death causally related to ingestion complications; 'N' if survived; 'UK' if outcome unknown.
Outcome_Complication	'Y' if any complication directly related to ingestion or resulting from management strategy; 'N' if no complication; 'UK' if unknown.
Outcome_Uncertain	Where no outcome identified; 'N' if outcome identified; 'UK' if Unknown.

## APPENDIX D

### COMPUTATIONAL RISK OF BIAS ASSESSMENT

**Case Reports:** For case reports, the *JKI Checklist for Case Reports* [44] was used. This tool assesses eight domains of reporting quality, including whether patient demographics were clearly described, a timeline of clinical history was provided, the presenting condition and diagnostic assessment were outlined, and whether the intervention, post-intervention condition, and any adverse events were reported. The final domain evaluates whether the case provides meaningful takeaway lessons.

In addition to manual JBI appraisal, a logic-based validation filter was applied to all case reports using *Python Pandas* [121]. This secondary filter assessed whether key variables — specifically, outcomes, object characteristics, and motivation — were completely unreported. For each domain, a binary flag was generated:

- *Outcome\_Unknown* was marked 1 if all outcome-related fields were either missing or marked as unknown.
- *Object\_Unknown* was marked 1 if all object-related fields (excluding *Object\_Other\_Long*) were missing or unknown.
- *Motivation\_Unknown* was predefined in the dataset and indicated absence of motivational information.

If any of these flags were triggered, the corresponding JBI item most affected by the missing domain was marked as not reported (e.g., *Post Intervention Condition Described* or *History Timeline* set to N). Finally, an *Overall Appraisal* score of *Exclude* was assigned, indicating high risk of bias and exclusion from analysis. This ensured that only case reports with sufficient information to meaningfully contribute to the review question were retained.

**Case Series:** For case series, the *JKI Checklist for Case Series* [44] was applied. The JKI Checklist for Case Series assesses 10 domains of methodological and reporting quality. These include whether the case series defined clear inclusion criteria, applied valid and consistent methods to identify the condition, and included participants consecutively and completely. The checklist also evaluates whether participant demographics and clinical information were clearly reported, whether outcomes or follow-up results were adequately described, and whether the study setting was detailed. Finally, it considers whether the statistical analysis used was appropriate for the data presented.

In addition to manual JBI appraisal, a logic-based exclusion filter was applied using *Pandas* [121]. This filter assessed whether key variables — specifically, motivation, object characteristics, and outcomes — were unreported for the entire study population. For each of these domains, a derived rate variable was calculated:

- *Outcome\_Unknown\_Rate* was marked as 1 if all outcome-related fields were missing or marked as unknown (i.e. the entire population had an unknown outcome).
- *Motivation\_Unknown\_Rate* indicated whether motivation was absent or only partially reported across cases within the study.
- *Object\_Unknown\_Rate* was derived if all object-related fields were missing or unknown.

If any of these indicators were flagged, the corresponding JBI checklist item (e.g., *Clear\_Outcome\_Followup\_Reported*, *Clear\_Demographic\_Reported*, or *Clear\_Clinical\_Info\_Reported*) was marked as N, and the study received an *Overall Appraisal* of *Exclude*. This logic-based validation ensured that case series lacking essential variables could be systematically excluded from the final analysis, maintaining consistency with the review question and minimising risk of bias in the dataset.

**APPENDIX E**  
**SYNTHESIS EXPANDED**

### Univariate Association Testing

A full table of case-level univariate association testing results for is available in Table XVII.

In the *Age Group* subgroup, being between 41 and 60 years of age was significantly associated with reduced odds of undergoing surgery ( $OR = 0.18$ , 95% CI [0.04, 0.76],  $p = 0.019$ ). Subgroup analysis ( $n = 61$  vs ( $n = 11$ )) revealed several distinguishing characteristics. Notably, there was a significant increase in the proportion of male patients (82% vs 56%,  $p = 0.020$ ), and a higher likelihood of ingesting multiple objects (32% vs 24%,  $p = 0.002$ ). Psychiatric motivation and previous ingestion were more common in this subgroup, though not statistically significant. There were also numerical trends toward higher rates of psychiatric inpatient status and psychiatric history, though these did not reach statistical significance. Fewer cases involved sharp or large-diameter objects, and no individuals in this group were detained, but these differences were also non-significant.

*Intent to harm* motivation was significantly associated with increased odds of undergoing surgery ( $OR = 5.40$ , 95% CI [1.36, 21.43],  $p = 0.024$ ), while another documented motivation was associated with decreased odds ( $OR = 0.14$ , 95% CI [0.03, 0.75],  $p = 0.023$ ). Subgroup analysis ( $n = 21$  vs  $n = 51$ ) revealed higher proportions of large-diameter object ingestions (34%), sharp object ingestions (23%), and male patients (71%). Psychosocial motivation was markedly underrepresented (3%) compared to the broader population.

*Other* motivation was significantly associated with reduced odds of undergoing surgery ( $OR = 0.14$ , 95% CI [0.03, 0.75],  $p = 0.023$ ). Among cases in this “other” motivation subgroup ( $n = 9$  vs  $n = 63$ ), there were significantly fewer instances of *intent to harm*, *protest*, or *psychosocial* motivations—each underrepresented by approximately 20%. This group included a higher proportion of female patients (44%) and individuals with a history of prior ingestion (31%), as well as a greater presence of severe disability (15%).

Sharp object ingestion was significantly associated with reduced odds of undergoing endoscopy ( $OR = 0.34$ , 95% CI [0.13, 0.90],  $p = 0.048$ ). Subgroup analysis ( $n = 34$  vs  $n = 38$ ) revealed markedly lower proportions of cases involving large-diameter objects and magnets—both typically considered more suitable for endoscopic retrieval. There was also a lower proportion of female patients, and a 15% lower incidence of severe disability.

No other significant associations were identified among demographic or gender characteristics. This subgroup comparison is visualised in Figure 4.

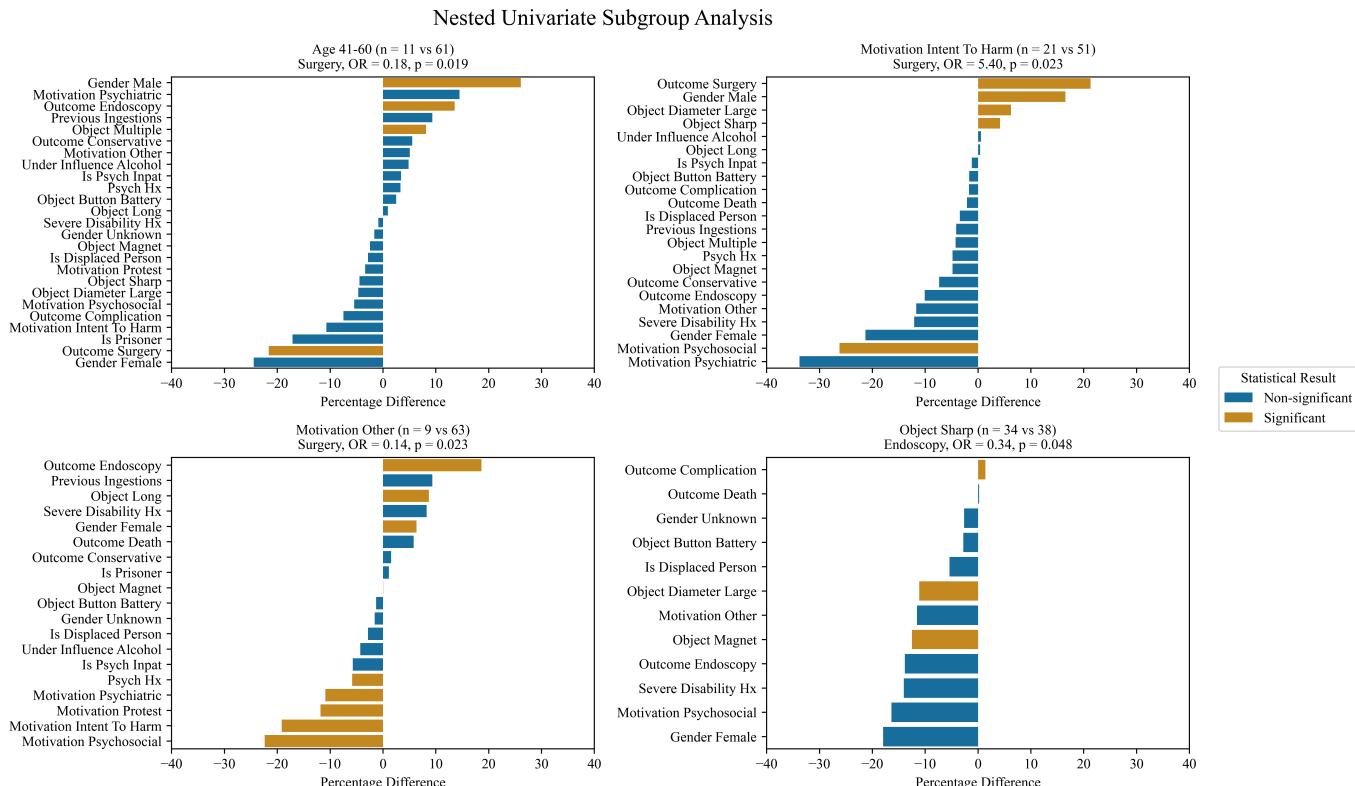


Fig. 4: Nested bar plots showing percentage differences in population characteristics between key subgroups and the comparison group. Each subplot visualises the relative increase or decrease of specific variables within a given subgroup, highlighting significant deviations ( $p < 0.05$ ) from the broader case report population.

TABLE XVII: Univariate association test results.

Variable	Conservative	Endoscopy	Surgery	Death	Complication
<i>Gender</i>					
Male	0.23 [0.04, 1.30] (p=0.110)	1.42 [0.54, 3.72] (p=0.632)	0.93 [0.36, 2.46] (p=1.000)	—	1.41 [0.52, 3.81] (p=0.671)
Female	4.57 [0.82, 25.41] (p=0.101)	0.78 [0.30, 2.03] (p=0.786)	0.97 [0.37, 2.57] (p=1.000)	—	0.84 [0.31, 2.28] (p=0.932)
Unknown	—	—	—	—	—
<i>Age Group</i>					
<18	1.96 [0.34, 11.45] (p=0.602)	0.33 [0.08, 1.33] (p=0.194)	2.45 [0.61, 9.84] (p=0.328)	—	1.84 [0.46, 7.44] (p=0.522)
18–25	1.23 [0.22, 6.94] (p=1.000)	0.29 [0.08, 0.98] (p=0.074)	2.80 [0.82, 9.62] (p=0.163)	—	1.41 [0.44, 4.56] (p=0.773)
26–40	0.28 [0.03, 2.51] (p=0.409)	2.25 [0.84, 6.04] (p=0.171)	0.93 [0.34, 2.51] (p=1.000)	—	0.83 [0.30, 2.31] (p=0.930)
41–60	2.49 [0.42, 14.83] (p=0.289)	2.70 [0.71, 10.22] (p=0.188)	<b>0.18 [0.04, 0.76]</b> <b>(p=0.019)*</b>	—	0.54 [0.15, 2.00] (p=0.488)
60+	— (p=1.000)	0.65 [0.06, 7.51] (p=1.000)	1.29 [0.11, 14.88] (p=1.000)	—	1.00 [0.09, 11.61] (p=1.000)
Unknown	—	—	—	—	0.49 [0.03, 8.18] (p=1.000)
<i>Demographic</i>					
Detained Person	—	0.99 [0.28, 3.53] (p=1.000)	0.86 [0.24, 3.08] (p=1.000)	—	0.63 [0.17, 2.26] (p=0.510)
Psychiatric Inpatient	—	0.44 [0.04, 4.54] (p=0.634)	2.25 [0.22, 22.99] (p=0.634)	—	0.15 [0.01, 1.50] (p=0.103)
Displaced Person	—	—	0.67 [0.03, 12.84] (p=1.000)	—	0.50 [0.03, 9.77] (p=1.000)
Under Influence of Alcohol	—	0.88 [0.07, 10.69] (p=1.000)	1.00 [0.08, 12.27] (p=1.000)	—	—
Psychiatric History	0.96 [0.20, 4.70] (p=1.000)	0.80 [0.29, 2.20] (p=0.861)	1.35 [0.48, 3.74] (p=0.756)	0.71 [0.04, 11.97] (p=1.000)	0.70 [0.24, 2.03] (p=0.696)
Severely Disabled	—	4.13 [0.74, 23.06] (p=0.115)	0.81 [0.17, 3.93] (p=1.000)	—	1.31 [0.23, 7.35] (p=1.000)
Previous Ingestor	1.69 [0.30, 9.38] (p=0.665)	0.83 [0.26, 2.65] (p=0.986)	0.74 [0.23, 2.36] (p=0.832)	1.61 [0.09, 27.40] (p=1.000)	0.34 [0.10, 1.23] (p=0.179)
<i>Motivation</i>					
Intent to harm	—	0.49 [0.16, 1.55] (p=0.347)	<b>5.40 [1.36, 21.43]</b> <b>(p=0.024)*</b>	—	0.84 [0.28, 2.56] (p=0.988)
Protest	—	0.33 [0.06, 1.74] (p=0.279)	5.50 [0.64, 47.15] (p=0.137)	—	4.71 [0.55, 40.44] (p=0.251)
Psychiatric	7.07 [0.80, 62.31] (p=0.105)	1.44 [0.55, 3.77] (p=0.624)	0.47 [0.17, 1.27] (p=0.212)	—	0.67 [0.24, 1.85] (p=0.608)
Psychosocial	1.20 [0.21, 6.84] (p=1.000)	0.89 [0.29, 2.72] (p=1.000)	0.63 [0.21, 1.93] (p=0.603)	—	0.94 [0.30, 2.99] (p=1.000)
Other	1.19 [0.13, 11.18] (p=1.000)	3.04 [0.70, 13.29] (p=0.161)	<b>0.14 [0.03, 0.75]</b> <b>(p=0.023)*</b>	7.75 [0.44, 136.41] (p=0.236)	0.58 [0.14, 2.40] (p=0.469)
<i>Object</i>					
Button Battery	—	—	—	—	—
Magnet	—	1.07 [0.26, 4.35] (p=1.000)	2.46 [0.47, 12.80] (p=0.467)	—	—
Long (>5cm)	0.45 [0.08, 2.51] (p=0.446)	0.80 [0.31, 2.05] (p=0.820)	2.43 [0.90, 6.56] (p=0.128)	1.23 [0.07, 20.40] (p=1.000)	1.88 [0.67, 5.24] (p=0.342)
Large (>2.5cm) Diameter	0.23 [0.05, 1.17] (p=0.081)	1.41 [0.48, 4.16] (p=0.727)	1.65 [0.57, 4.80] (p=0.518)	—	0.92 [0.30, 2.85] (p=1.000)
Sharp	1.56 [0.32, 7.51] (p=0.700)	<b>0.34 [0.13, 0.90]</b> <b>(p=0.048)*</b>	2.16 [0.82, 5.72] (p=0.187)	1.12 [0.07, 18.65] (p=1.000)	1.09 [0.41, 2.90] (p=1.000)
Multiple	4.26 [0.48, 37.48] (p=0.235)	0.50 [0.19, 1.30] (p=0.233)	1.03 [0.39, 2.71] (p=1.000)	—	2.60 [0.95, 7.13] (p=0.104)

OR: Odds Ratio; CI: Confidence Interval; p: p-value. \* indicates  $p < 0.05$ . Bold = statistically significant. — = missing or unstable estimate.

### Logistic Regression

Grouped univariate linear regression results are shown in XVIII.

In univariate logistic regression, being the 18–25 years age group was significantly associated with reduced odds of undergoing endoscopy ( $OR = 0.29$ , 95% CI [0.08, 0.98],  $p = 0.046$ ). Subgroup analysis ( $n = 18$  vs  $n = 54$ ) revealed that several features were significantly underrepresented in the younger group: psychiatric history (31% vs 46%,  $p < 0.001$ ), psychiatric motivation (23% vs 44%,  $p < 0.001$ ), previous ingestions (13% vs 25%,  $p < 0.001$ ), and magnetic object ingestion (0% vs 7%,  $p = 0.003$ ). The proportion of female patients was also lower (28% vs 43%,  $p = 0.004$ ).

The 41–60 years was significantly associated with reduced odds of undergoing surgery ( $aOR = 0.18$ , 95% CI [0.04, 0.76],  $p = 0.020$ ). Subgroup analysis ( $n = 11$  vs  $n = 61$ ) revealed the subgroup had higher rates of psychiatric motivation (50% vs 36%), previous ingestions (31% vs 21%), and long-object ingestion (19% vs 18%, all  $p < 0.001$ ). In contrast, they were significantly less likely to have *intent to harm* motivation (14% vs 25%), be prisoners (0% vs 17%), or report *protest* motivation (7% vs 11%). Magnet ingestion was also lower in this group (3% vs 6%,  $p = 0.045$ ). Intent to harm was significantly associated with increased odds of undergoing surgery ( $OR = 5.77$ , 95% CI [1.51, 22.03],  $p = 0.010$ ). The same subgroup analysis undertaken on the univariate association tests analysis ( $n = 21$  vs  $n = 51$ ) revealed higher proportions of large-diameter object ingestions (34%), sharp object ingestions (23%), and male patients (71%). Psychosocial motivation was markedly underrepresented (3%) compared to the broader population.

As in the univariate association testing, *other* documented motivation was significantly associated with reduced odds of undergoing surgery ( $OR = 0.14$ , 95% CI [0.03, 0.75],  $p = 0.021$ ).

In the object subgroup, sharp object ingestion was significantly associated with reduced odds of undergoing endoscopy ( $OR = 0.34$ , 95% CI [0.13, 0.90],  $p = 0.029$ ).

To further explore this finding, we descriptively compared individuals who ingested sharp objects ( $n = 34$ ) with those who did not ( $n = 38$ ). Magnet ingestion was more common in the non-sharp group (12.5% vs 0%). The sharp object group also had a higher proportion of males (71% vs 50%) and more individuals with psychiatric motivation (46% vs 30%). Previous ingestions and prisoner status were more frequently documented among those with sharp object ingestion. Other variables such as female gender, psychosocial motivation, and severe disability history were less common in the sharp object group.

Subgroup comparison is presented visually in Figure 5 in Appendix ??.

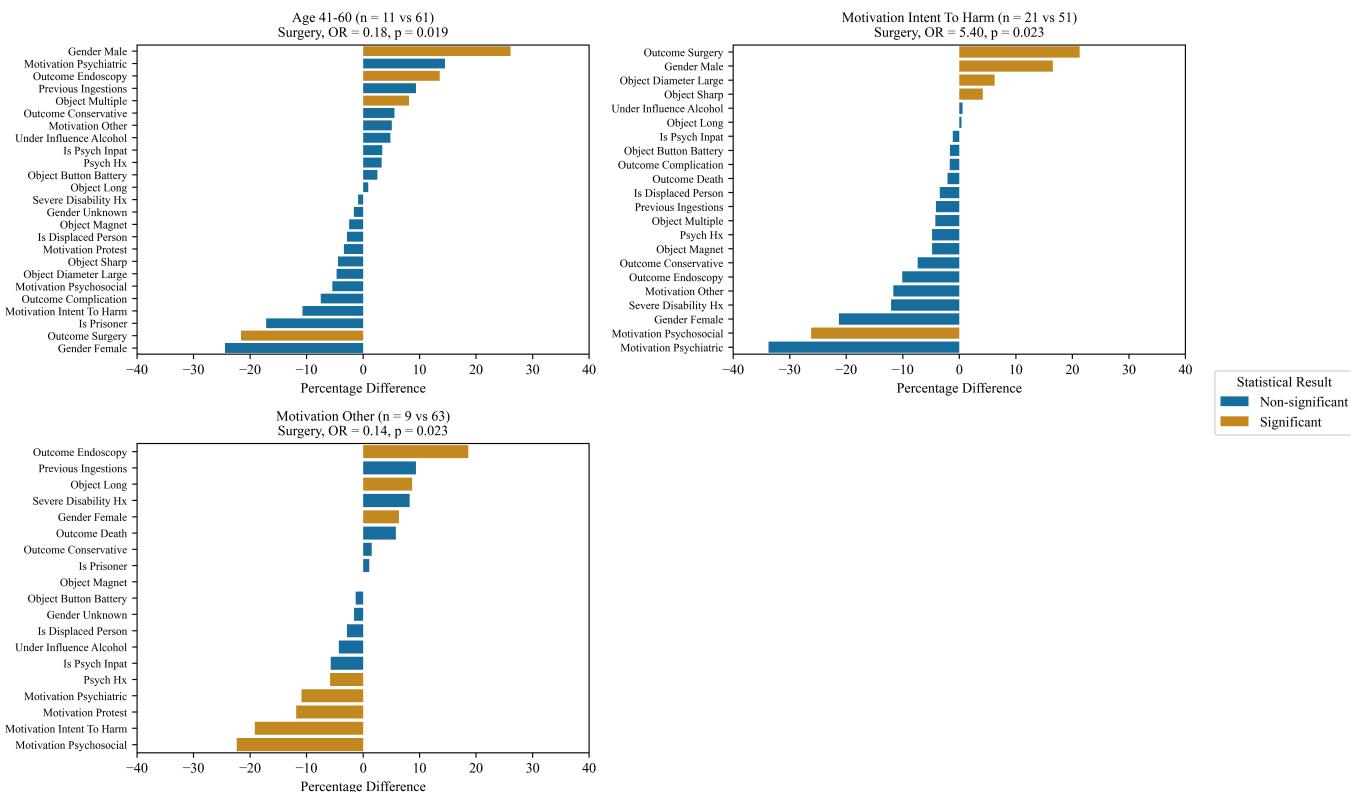


Fig. 5: Nested bar plots showing percentage differences in population characteristics between significant subgroups and the comparison group from univariate logistic regression. Each subplot visualises the relative increase or decrease of specific variables within a given subgroup, highlighting significant deviations ( $p < 0.05$ ) from the broader case report population.

TABLE XVIII: Grouped case-level univariate logistic regression results.

Variable	Conservative	Endoscopy	Surgery	Death	Complication
<i>Gender</i>					
Male	0.23 [0.04, 1.30] (p=0.097)	1.42 [0.54, 3.72] (p=0.471)	0.93 [0.36, 2.46] (p=0.891)	—	1.41 [0.52, 3.81] (p=0.497)
Female	4.57 [0.82, 25.41] (p=0.083)	0.78 [0.30, 2.03] (p=0.607)	0.97 [0.37, 2.57] (p=0.956)	—	0.84 [0.31, 2.28] (p=0.733)
Unknown	—	—	—	—	—
<i>Age Group</i>					
<18	1.96 [0.34, 11.45] (p=0.453)	0.33 [0.08, 1.33] (p=0.120)	2.45 [0.61, 9.84] (p=0.206)	—	1.84 [0.46, 7.44] (p=0.391)
18–25	1.22 [0.22, 6.94] (p=0.819)	<b>0.29 [0.08, 0.98]</b> <b>(p=0.046)*</b>	2.80 [0.82, 9.62] (p=0.102)	—	1.41 [0.44, 4.56] (p=0.565)
26–40	0.28 [0.03, 2.51] (p=0.258)	2.25 [0.84, 6.04] (p=0.109)	0.93 [0.34, 2.51] (p=0.888)	—	0.83 [0.30, 2.31] (p=0.726)
41–60	2.49 [0.42, 14.83] (p=0.317)	2.70 [0.71, 10.22] (p=0.144)	<b>0.18 [0.04, 0.76]</b> <b>(p=0.020)*</b>	—	0.54 [0.15, 2.00] (p=0.359)
60+	—	0.65 [0.06, 7.51] (p=0.730)	1.29 [0.11, 14.88] (p=0.841)	—	1.00 [0.09, 11.61] (p=1.000)
Unknown	—	—	—	—	0.49 [0.03, 8.18] (p=0.619)
<i>Demographic</i>					
Detained Person	—	0.93 [0.27, 3.28] (p=0.915)	0.87 [0.25, 3.07] (p=0.829)	—	0.65 [0.18, 2.31] (p=0.504)
Psychiatric Inpatient	—	0.42 [0.04, 4.27] (p=0.465)	1.98 [0.20, 20.00] (p=0.564)	—	0.15 [0.01, 1.52] (p=0.108)
Displaced Person	—	—	0.63 [0.04, 10.46] (p=0.746)	—	0.49 [0.03, 8.18] (p=0.619)
Under Influence of Alcohol	—	0.65 [0.06, 7.51] (p=0.730)	1.29 [0.11, 14.88] (p=0.841)	—	—
Psychiatric History	1.37 [0.28, 6.64] (p=0.692)	1.12 [0.44, 2.85] (p=0.812)	1.00 [0.39, 2.58] (p=1.000)	1.00 [0.06, 16.63] (p=1.000)	0.60 [0.22, 1.63] (p=0.319)
Severely Disabled	—	3.75 [0.68, 20.80] (p=0.131)	0.83 [0.17, 4.04] (p=0.821)	—	1.28 [0.23, 7.13] (p=0.779)
Previous Ingestor	2.30 [0.46, 11.37] (p=0.308)	0.95 [0.33, 2.74] (p=0.922)	0.62 [0.21, 1.79] (p=0.379)	2.89 [0.17, 48.62] (p=0.461)	0.59 [0.20, 1.76] (p=0.347)
<i>Motivation</i>					
Intent to harm	—	0.42 [0.14, 1.24] (p=0.116)	<b>5.77 [1.51, 22.03]</b> <b>(p=0.010)*</b>	—	0.74 [0.26, 2.15] (p=0.583)
Protest	—	0.33 [0.06, 1.74] (p=0.193)	6.00 [0.71, 50.89] (p=0.100)	—	4.60 [0.54, 39.14] (p=0.162)
Psychiatric	7.93 [0.90, 69.66] (p=0.062)	1.36 [0.53, 3.48] (p=0.517)	0.52 [0.20, 1.36] (p=0.181)	—	0.66 [0.25, 1.76] (p=0.405)
Psychosocial	1.33 [0.23, 7.58] (p=0.746)	0.90 [0.30, 2.72] (p=0.858)	0.64 [0.21, 1.93] (p=0.431)	—	0.89 [0.28, 2.80] (p=0.844)
Other	1.19 [0.13, 11.18] (p=0.881)	3.04 [0.70, 13.29] (p=0.140)	<b>0.14 [0.03, 0.75]</b> <b>(p=0.021)*</b>	7.75 [0.44, 136.41] (p=0.162)	0.58 [0.14, 2.40] (p=0.453)
<i>Object</i>					
Button Battery	—	—	—	—	—
Magnet	—	1.07 [0.26, 4.35] (p=0.928)	2.46 [0.47, 12.80] (p=0.285)	—	—
Long (>5cm)	0.47 [0.08, 2.58] (p=0.383)	0.84 [0.33, 2.14] (p=0.710)	2.31 [0.86, 6.22] (p=0.097)	1.26 [0.08, 20.93] (p=0.873)	2.00 [0.72, 5.55] (p=0.183)
Large (>2.5cm) Diameter	0.27 [0.05, 1.31] (p=0.104)	1.33 [0.47, 3.77] (p=0.586)	1.67 [0.59, 4.67] (p=0.332)	—	1.00 [0.34, 2.94] (p=1.000)
Sharp	1.56 [0.32, 7.51] (p=0.582)	<b>0.34 [0.13, 0.90]</b> <b>(p=0.029)*</b>	2.16 [0.82, 5.72] (p=0.121)	1.12 [0.07, 18.65] (p=0.936)	1.09 [0.41, 2.90] (p=0.867)
Multiple	4.26 [0.48, 37.48] (p=0.191)	0.50 [0.19, 1.30] (p=0.153)	1.03 [0.39, 2.71] (p=0.956)	—	2.60 [0.95, 7.13] (p=0.063)

OR: Odds Ratio; CI: Confidence Interval; p: p-value. \* indicates  $p < 0.05$ . Bold = statistically significant. — = missing or unstable estimate.

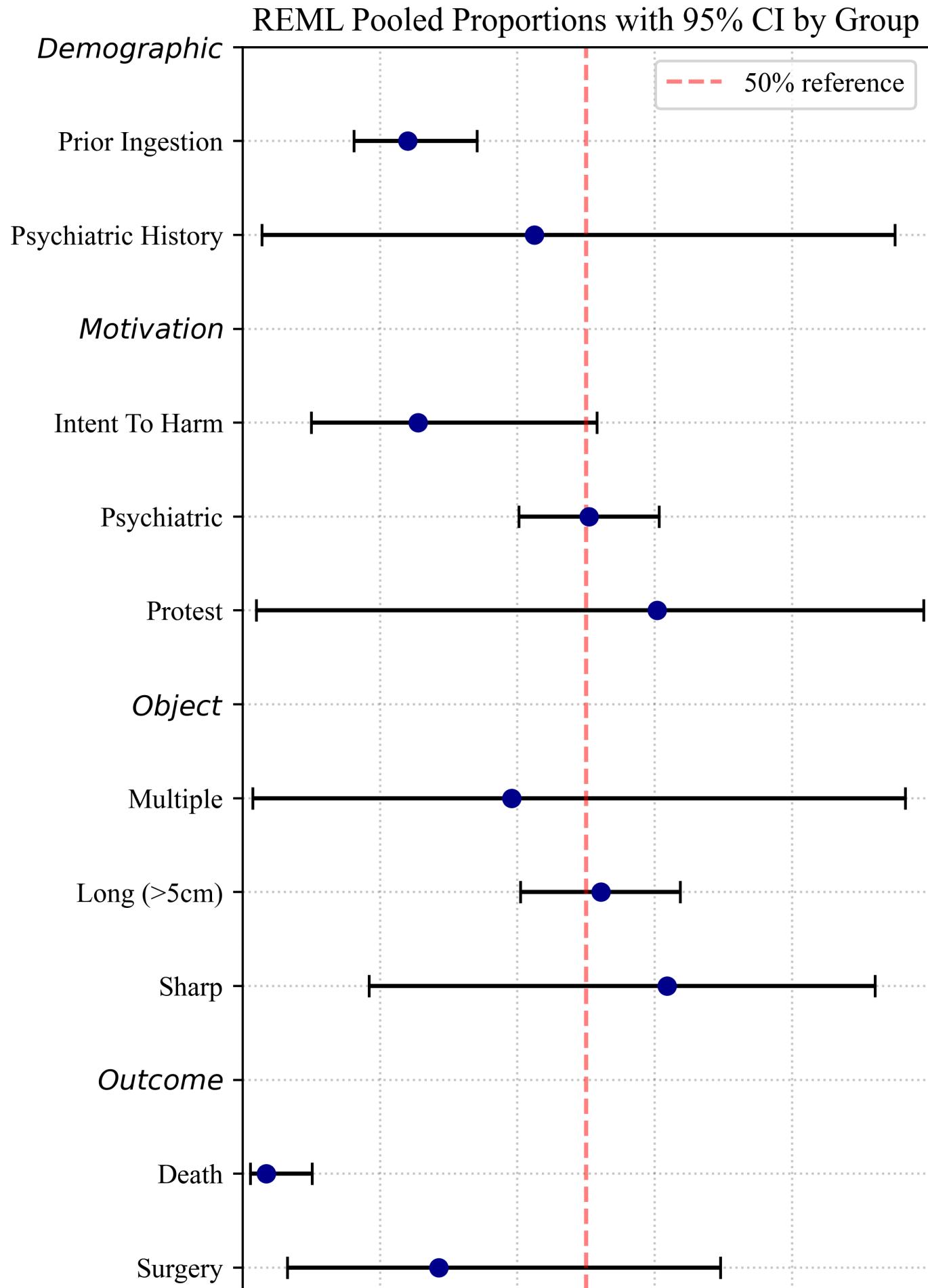
*Meta-analysis*

Given that series numbers were small, case reports were flattened into a series and presented alongside other case series. This is demonstrated in Table III.

Meta-analyses of proportions were then performed on all series-data – including collapsed case reports – using random-effects models with restricted maximum likelihood (REML) estimation and Hartung-Knapp (HK) adjustments for confidence intervals, appropriate for small numbers of studies [130]. In general, REML yielded wider confidence intervals and lower heterogeneity estimates than the DerSimonian & Laird (DL) method, reflecting greater uncertainty in pooled estimates from small samples.

Herein, where cases in subgroups were present as cases in case reports, case-level analysis was undertaken, as outlined in the methodology and similarly to previous rounds of analysis shown above.

A plot of aggregate series-level meta-analysis of pooled variable and outcome proportions is shown in Figure 3. For comparison, DL estimates were also calculated for outcomes, yielding narrower confidence intervals and higher  $I^2$  values. These are included in Figure 6.



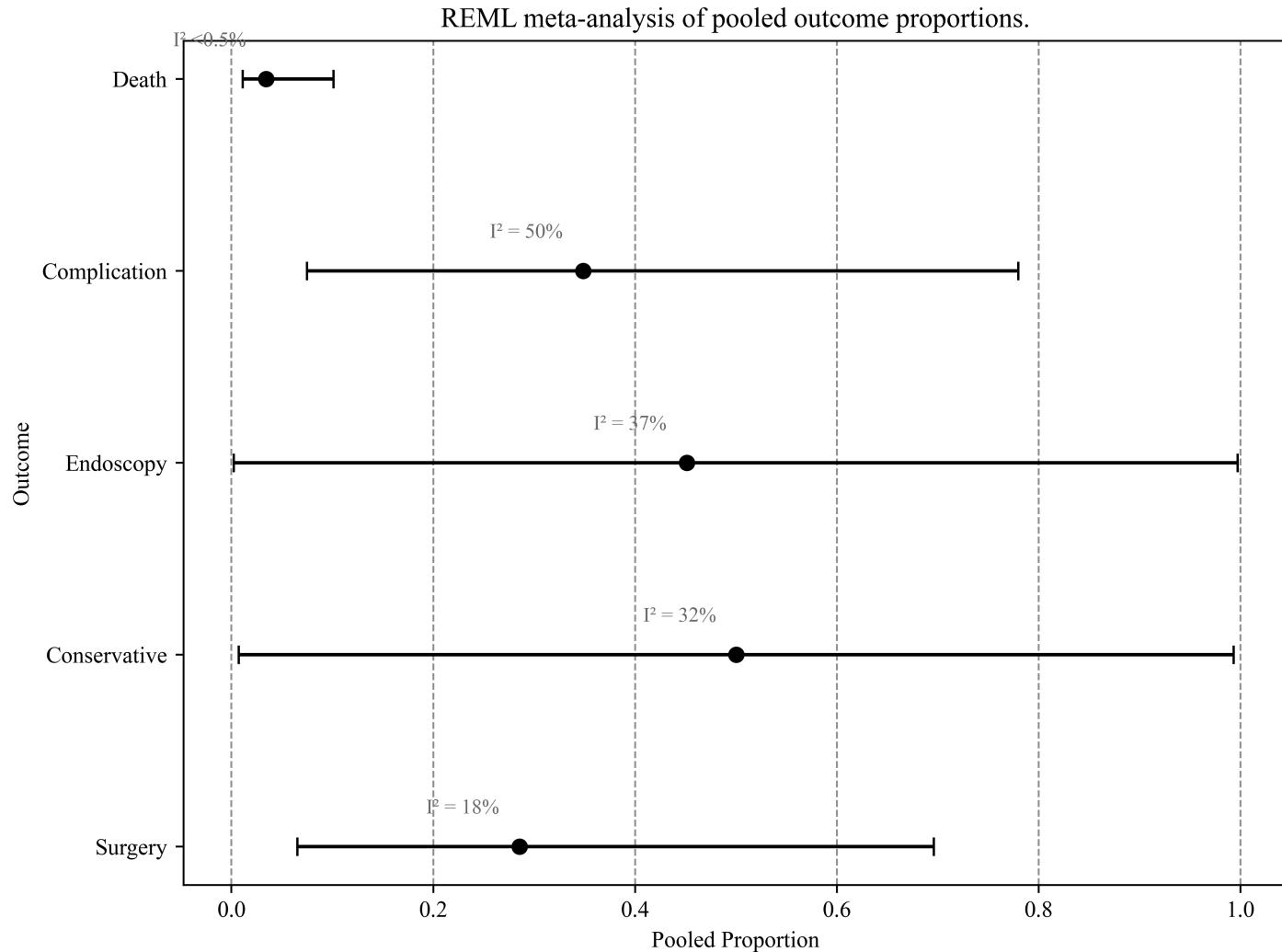


Fig. 7: Meta-analyses of proportions using random-effects models with restricted maximum likelihood (REML) estimation and Hartung-Knapp (HK) adjustments for confidence intervals.

In the demographic subgroup, meta-analyses of proportions were performed for psychiatric history and prior ingestion. The pooled proportion of patients with a psychiatric history was 42.5% (95% CI 2.8%–95.0%), with moderate heterogeneity ( $I^2 = 34.3\%$ ). For prior ingestion, the pooled proportion was 24.0% (95% CI 16.2%–34.1%), with moderate heterogeneity ( $I^2 = 49.2\%$ ). Meta-analysis could not be performed for other demographic variables due to insufficient data.

In the motivation subgroup, pooled estimates were available for intent to harm, protest, and psychiatric motivation. The proportion of patients with intent to harm was 25.5% (95% CI 10.0%–51.6%), with moderate heterogeneity ( $I^2 = 27.2\%$ ). Protest motivation was reported in 60.3% (95% CI 2.0%–99.1%) of cases, and psychiatric motivation in 50.4% (95% CI 40.2%–60.6%), both with moderate heterogeneity ( $I^2 = 26.6\%$  and  $33.3\%$ , respectively).

For the object subgroup, meta-analyses were conducted for long objects, sharp objects, and multiple object ingestion. The pooled proportion was 52.2% (95% CI 40.4%–63.7%) for long objects, 61.8% (95% CI 18.4%–92.1%) for sharp objects, and 39.2% (95% CI 1.5%–96.5%) for multiple objects. Heterogeneity was substantial for long and multiple objects ( $I^2 = 50.6\%$  and  $51.2\%$ , respectively), and moderate for sharp objects ( $I^2 = 45.3\%$ ).

In terms of outcomes, proportions were pooled for endoscopy, surgery, death, complications, and conservative management. Endoscopy was performed in 45.1% of cases (95% CI 0.2%–99.7%), surgery in 28.5% (95% CI 6.5%–69.6%), death occurred in 3.4% (95% CI 1.1%–10.1%), complications were reported in 34.8% (95% CI 7.5%–78.0%), and conservative management was used in 50.0% of cases (95% CI 0.7%–99.3%). Heterogeneity was moderate for endoscopy, complications, and conservative management ( $I^2 = 37.2\%$ ,  $50.1\%$ , and  $32.3\%$ , respectively), and low for surgery and death ( $I^2 = 17.6\%$  and  $<0.5\%$ ).

Meta-analysis could not be performed for the *gender* subgroup or for other variables not mentioned above due to insufficient series-level data.

#### Meta Regression

A full table of grouped aggregate series-level results for univariate meta-regression is available in Table V. In the gender subgroup, female gender was associated with an increased likelihood of surgery (OR = 1.05, 95% CI [1.00, 1.10],  $p = 0.044$ ). As all female

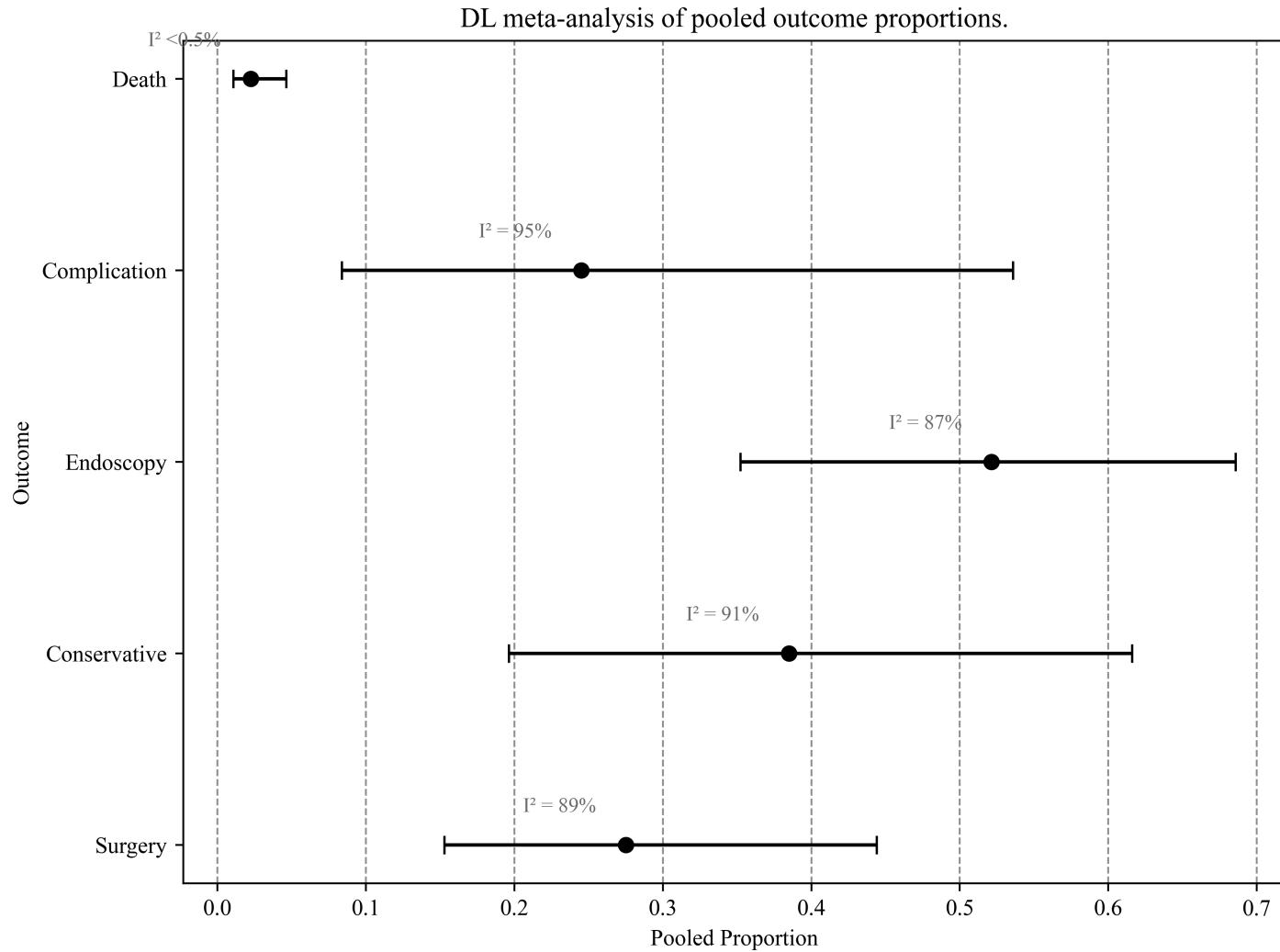


Fig. 8: Meta-analyses of proportions using DerSimonian–Laird (DL) estimates.

cases were drawn from case reports, further case-level subgroup analysis was conducted comparing females ( $n = 28$ ) with non-females ( $n = 54$ ).

Females were significantly more likely to have a positive psychiatric history (58.6% vs 35.2%,  $p = 0.000006$ ) and psychiatric motivation (45.7% vs 32.7%,  $p = 0.000025$ ). They were also less likely to be prisoners (0% vs 22.2%,  $p = 0.000053$ ) and less likely to report protest (2.9% vs 14.5%,  $p = 0.045$ ). Trends toward lower prevalence of intent to harm (14.3% vs 29.1%,  $p = 0.111$ ) and alcohol use (0% vs 5.6%,  $p = 0.232$ ) among females were noted, although these did not reach statistical significance.

Unknown gender was associated with an increased likelihood of surgery (OR = 3.81, 95% CI [1.06, 13.68],  $p = 0.044$ ). This is likely a finding as a result of publication bias. The single female cases in this review is from a 29 year old female with borderline personality disorder and 6 documented laparotomies for repeated IIFO. [108]. All other comparisons in this subgroup were non-significant. In the demographic subgroup, psychiatric inpatient status was associated with an increased likelihood of surgery (OR = 1.40, 95% CI [1.01, 1.92],  $p = 0.044$ ).

All four psychiatric inpatients were cases from case reports, so case-level analysis was undertaken on psychiatric inpatients ( $n = 4$ ) vs non-psychiatric inpatients ( $n = 68$ ). Psychiatric inpatients were significantly more likely to exhibit intent to harm (25.0% vs 23.3%,  $p < 0.00001$ ), although the absolute difference was small. They were also significantly less likely to have psychosocial (0% vs 19.8%,  $p < 0.00001$ ), protest (0% vs 10.5%,  $p = 0.001$ ), or other motivations (0% vs 10.5%,  $p = 0.001$ ). No psychiatric inpatients were prisoners (vs 17.1% among non-inpatients,  $p < 0.001$ ) or ingested magnets (0% vs 5.6%,  $p = 0.001$ ). All other comparisons in this subgroup were non-significant.

In the motivation subgroup, psychosocial motivation was associated with an increased likelihood of surgery (OR = 1.08, 95% CI [1.00, 1.17],  $p = 0.044$ ). All cases that were motivated in this manner came from case reports, so case-level analysis was pursued.

Several illustrative cases reflected the diverse contexts and consequences of psychosocially motivated ingestion. These included: “a jackass and a fish” (a 28 year old male) in the Netherlands who drunkenly ingested a catfish, which preceeded to erect and lock the spines of its pectoral in the man’s hypopharynx, leading to laryngeal oedema, intubation, endoscopy and a prolonged intensive care stay [53]; 16 year old female in Israel who ingested toilet roll “as a means of weightloss” (managed conservatively) [93]; a 19

year old male in New Zealand who underwent a median sternotomy and pericardiotomy for a penetrating left ventricular injury after ingested 8 sewing needles “in an attempt to impress his friends” [74]; a 12 year old girl in Sweden who underwent laparoscopy for a double colonic perforation after swallowing multiple magnetic balls whilst “playing a game with her brother” [99]; and a 33 year old female in Poland who, “motivated by the aim to induce weight loss”, ingested a water-filled balloon, resulting in bowel obstruction and laparotomy [106].

Statistical comparison ( $n = 17$  vs  $n = 55$ ) showed that psychosocially motivated cases were significantly less likely to present with intent to harm (4.3% vs 29.9%,  $p < 0.00001$ ), and had lower rates of protest and other motivations. They also had lower prevalence of severe disability ( $p = 0.009$ ) and psychiatric inpatient status ( $p = 0.107$ ), though these did not all remain significant after correction. Interestingly, previous ingestion history was slightly more common among psychosocial cases (25.0% vs 22.7%,  $p < 0.0001$ ), though the clinical relevance of this difference is unclear.