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 a clinically distinct form of self-harm, yet its outcome profile and drivers of morbidity remain poorly defined. Whether patient motivation modifies clinical outcomes has never been systematically evaluated.

Objectives

To synthesise all available evidence on outcomes following intentional foreign-object ingestion, and to determine whether patient motivation, object characteristics, or demographic factors influence the need for intervention, risk of complications, or mortality.

Methods

A comprehensive search of PubMed, Embase, CENTRAL, Web of Science, Scopus, PsycINFO, and Google Scholar (1st January 1906–31st March 2025) identified studies reporting non-accidental ingestion of true foreign bodies in humans.

Human studies of any design, any age, reporting intentional ingestion of non-digestible foreign objects that reported outcomes of endoscopy, surgery, conservative management, complications and mortality were included. Accidental or substance ingestion, animal studies, non-English full texts, pre-1906 reports, and studies lacking motivation, object, or outcome data were excluded.

Titles, abstracts, and full texts were screened by two reviewers. Data were extracted for study-level and case-level characteristics including motivation, object type, demographics, and clinical outcomes. Meta-analysis of proportions (REML with Hartung–Knapp adjustments) was conducted on pooled series data. Univariate meta-regression was used to explore predictors of surgical intervention. Case reports were analysed descriptively and stratified by motivation.

Results

Seventy-one case reports ($n = 71$) and three case series ($n = 90$). Case series populations were entirely male and detained, with pooled protest motivation rates of ≈80% (moderate heterogeneity) and pooled sharp object ingestion rates of ≈90%. Meta-regression suggested protest motivation was associated with significantly reduced odds of surgery ($\beta = -0.021$, $p = 0.003$).

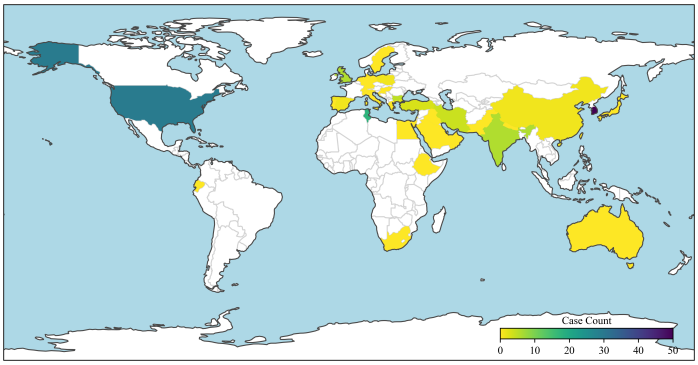

Fig. 1: Heat map of all cases per country.

Intent-to-harm showed a non-significant trend toward increased surgery ($\beta = 0.257$, $p = 0.133$).

Among a more demographically diverse cohort of case reports, intent-to-harm was associated with nearly sixfold increased odds of surgery (OR = 5.68, 95% CI [1.43–22.64], $p = 0.020$), while protest and other motivations were associated with reduced odds. Adults aged 40–64 had lower surgical rates (OR = 0.19, 95% CI [0.04–0.78], $p = 0.020$), but all deaths in this review occured in this age group, in the context of psychiatric comorbidities, suggesting clinically high risk subgroup. Sharp object ingestion was associated with decreased likelihood of endoscopy, likely attributed to publication bias.

Conclusions

Motivation appears to meaningfully influence management and outcomes following IIFO. Protest-driven ingestion, particularly in detained populations, may be more amenable to conservative management. Conversely, intent-to-harm significantly associated with surgical intervention, as does psychiatric comorbidity and middle age with mortality. Age, object type, and psychiatric history also shape clinical decisions. However, interpretation is limited by publication bias, selection, small sample sizes, and incomplete reporting.

These findings underscore the need for standardised, prospective reporting of intentional ingestion cases, with explicit attention to motivation, context, and object characteristics.

Abbreviations and Symbols

A. Abbreviations

- IIFO - Intentional Ingestion of Foreign Object(s)
- REML — Restricted Maximum Likelihood
- HK — Hartung–Knapp adjustment
- CI — Confidence Interval

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- OR — Odds Ratio
- aOR - Adjusted Odds Ratio
- B.B. - Button Battery
- CENTRAL - Cochrane Central Register of Controlled Trials

B. Symbols

- χ^2 — Chi-squared statistic (Cochran's Q)
- β — Regression coefficient
- τ^2 — Between-study variance

II. Introduction

A. Rationale

As of May 2024, over 100 million individuals were forcibly displaced worldwide [1]. Refugees and asylum seekers often endure extreme hardship—including violence, trauma, and detention—leading to elevated rates of mental health disorders [2–7]. Among the most alarming manifestations is self-harm, which is up to 216 times more common in offshore detention settings than in the general population [8–10]. Methods vary and include cutting, poisoning, hanging, self-immolation, and intentional ingestion of foreign objects (IIFO) [9, 11, 12].

IIFO—the non-accidental ingestion of non-nutritive items—is a serious clinical issue, with 10–20% of cases requiring endoscopy and up to 1% needing surgery [13–15]. In displaced populations, delayed access to care increases risks [16]. Rates of IIFO are rising globally; in the U.S., cases doubled in 2017, and intentional ingestion is common in lower socioeconomic groups [17, 18]. While techniques for foreign body removal have advanced—from early gastrotomy to modern endoscopy—clinical outcomes depend on multiple factors including object characteristics, patient comorbidities, and timeliness of intervention [14, 19–25].

IIFO motivations vary widely. In detention, it may be a form of protest or communication [26]; in psychiatric contexts, it may stem from conditions like psychosis, personality disorders, pica, or malingering [27–33]. In borderline personality disorder, it may function as emotional regulation rather than a suicide attempt [27]. Rare cases of repeated IIFO have prompted palliative approaches to care [34].

Despite its growing prevalence, little research explores how these differing motivations affect clinical management and outcomes [35–37]. Understanding motivation is crucial, as it may influence decisions around intervention. For example, ingestion as protest may be less likely to involve high-risk behaviours, supporting conservative treatment [38, 39].

This review aims to examine how motivation shapes IIFO outcomes—specifically rates of endoscopic and surgical intervention, conservative management, complications, and mortality—to better guide care in vulnerable populations.

B. 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 review sought to examine how individual factors such as demographic/population characteristics, object characteristics and motivations for ingestion influence the likelihood of these outcomes.

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.

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.

C. Eligibility Criteria

A full list of eligibility criteria is shown in Table I. This is reproduced in a larger format for clarity in Appendix **??**. A full list of exclusion criteria is available in Appendix **??** and in the PRISMA diagram shown in Figure 2.

D. 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 potentional additional literature not uncovered in the primary search. 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.

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). 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 [40]. Remaining articles proceeded to full text review, where the same independent screening process was repeated on full text articles.

E. Data Extraction

Data were initially extracted by a single reviewer (JGE) into *Microsoft Excel* [41] and processed in *Python* [42] using *Pandas* [43]. This process is outlined in Appendix E.

Data was first extracted from case reports. Predictors were grouped into five subgroups: gender; age group; demographic characteristics, motivation; object characteristics. These are shortened hereafter to: gender, age, demographic, object and motivation. Ages were grouped into age groups based on clinical relevance. Outcome data were extracted for rates of endoscopy, surgery, conservative management, mortality, and complications. All outcomes were binary and coded per event, rather than per individual. Predictor variables and outcome variables were not mutually exclusive, nor were outcomes. For example, patients, or ingestors – hereafter referred to as the latter – could have multiple outcomes (e.g. endoscopy and surgery) and multiple predictors from each group (e.g. intent-to-harm and other, and detained and displaced person).

After case report data extraction, data was collapsed and aggregated to form a "series". This data was used as a template for case series data extraction to homogenise data and reduce heterogeneity.

Full definitions of all variables (predictors and outcomes) are provided in Appendix E. The full dataset of extracted case-level and series-level data (including bias assesments), is available on Github.

F. 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. A novel computational risk of bias filter was then applied in *Pandas* [43]. That process is outlined in Appendix D

G. Synthesis Methods

For case-level associations between binary predictors and outcomes were assessed using χ^2 Test and Fisher's Exact Test, reporting odds ratios (ORs), 95% confidence intervals, and p-values. Where appropriate, further χ^2 tests were also used to evaluate differences in outcome proportions between groups [40].

Univariate logistic regression was considered but ultimately not used, as the primary aim was to explore associations without assuming a specific functional relationship between predictors and outcomes. Given the binary nature of most predictors and the categorical outcomes, chi-squared tests offered a more transparent and assumption-light approach. This choice also avoided complications from sparse data and convergence issues that can arise with logistic models in small exploratory datasets.

Multivariable logistic regression was not performed due to the limited sample size, high collinearity between predictors (e.g., overlapping motivations), and the exploratory nature of the analysis.

For series-level data, univariate meta-regression will be conducted to assess associations between binary series-level predictors and pooled outcome proportions, where sufficient data are available. Each predictor will be entered separately to account for incomplete reporting across studies and to avoid overfitting. Effect estimates will be reported as odds ratios (ORs) with 95% confidence intervals, using a random-effects model with restricted maximum likelihood (REML) estimation [45].

Initially, a meta-analysis of outcome proportions was conducted using a random-effects model to estimate pooled outcome rates across included studies. The random-effects approach was chosen due to the anticipated heterogeneity in study populations, motivations, and object types.

Restricted Maximum Likelihood (REML) estimation was used to compute between-study variance (τ^2), while Hartung–Knapp adjustments were applied to produce more accurate confidence intervals, particularly in the presence of small sample sizes.

Heterogeneity was quantified using the I^2 statistic, which describes the percentage of total variation across studies that is due to true between-study differences rather than chance. I^2 values above 50% were interpreted as moderate-to-high heterogeneity, suggesting that the underlying true effect varied substantially across studies. In such cases, pooled estimates were interpreted cautiously and subgroup analysis was used to explore possible modifiers.

Heterogeneity between studies was quantified using the I^2 statistic, which represents the proportion of total variation in effect estimates attributable to between-study heterogeneity rather than chance. Following the Cochrane Handbook's guidelines, I^2 values were interpreted as follows: 0–40% may not be important; 30–60% may indicate moderate heterogeneity; 50–90% may represent substantial heterogeneity; and 75–100% may reflect considerable heterogeneity [46]. These thresholds are intended as general guidance rather than strict rules and were interpreted in the context of the number of studies, consistency of effect sizes, and confidence interval overlap.

First, meta-analysis was undertaken on case series alone, and then on case series with pooled case report data. This method was given in anticipation of the case reports introducing heterogeneity into the case series meta-analysis.

Due to the inclusion of primarily case reports and small case series, formal assessment of reporting bias (e.g., via funnel plots or statistical tests for asymmetry) was not feasible.

Confidence in the body of evidence was not formally graded but was considered low to very low due to reliance on uncontrolled observational designs, small sample sizes, and incomplete reporting.

III. Results

A. Study Selection

Details on the screening and selection process are demonstrated in Figure 2. Details on independent inter-reviewer agreement and third author review can be found in Appendix C.

B. Risk of Bias

Case Reports: 75 cases from 67 studies [33, 38, 47–111] 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) [84], current patient condition (2 cases) [84], interventions and treatments (1 case) [96], patient post-intervention condition (2 cases) [84], harms (2 cases) [84], and takeaway lessons (2 cases) [84]. The excluded cases came from the following studies: [84, 96]. Of the remaining 71 cases, all reported interventions and treatments (71 cases, 100%) [33, 38, 47–83, 85–95, 97–103, 105–111]. Most clearly described patient history and timeline (70

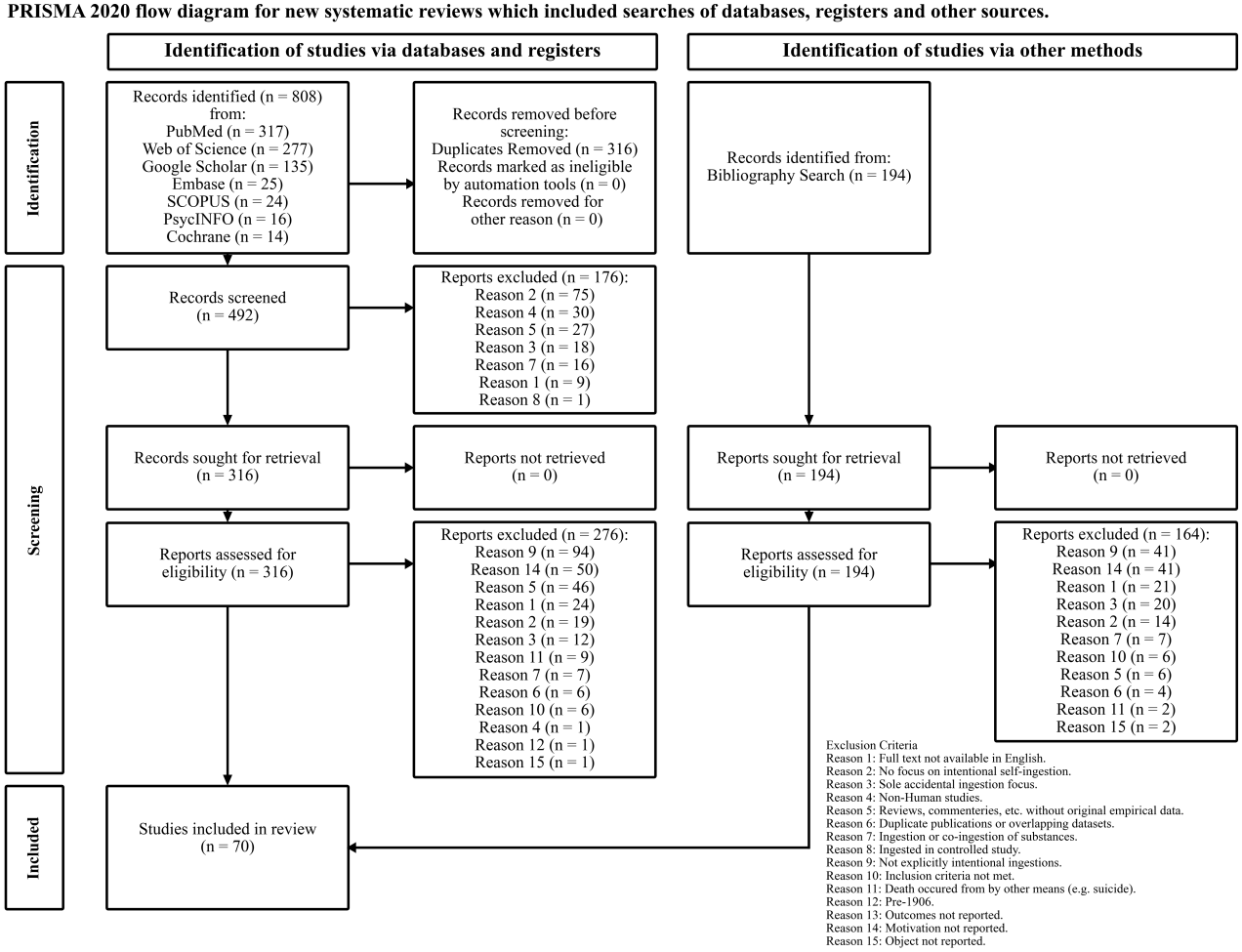

Fig. 2: PRISMA flow diagram summarising the study selection process.

cases, 99%) [33, 38, 47–61, 63–83, 85–95, 97–103, 105–111], patient post-intervention condition (69 cases, 97%) [33, 38, 47–82, 85, 87–95, 97–103, 105–111], takeaway lessons (69 cases, 97%) [33, 38, 47–61, 63, 65–83, 85–95, 97–103, 105–111], patient demographic (68 cases, 96%) [38, 47–56, 58–83, 85–95, 97–103, 105, 106, 108–111], and current patient condition (68 cases, 96%) [33, 38, 47–67, 69–83, 85–95, 97–103, 105–111]. Reporting was also strong for harms (38 cases, 93%) [51, 52, 56–61, 63, 65, 69, 71, 72, 78, 79, 81, 82, 86, 87, 89–91, 98–103, 105–107, 109, 110], and diagnostic assessments (65 cases, 92%) [33, 38, 47–61, 63–67, 69–73, 75–83, 85–95, 97–103, 105–111].

Case Series: Seperately, 3 studies [112–114] were evaluated using the *JBI Checklist for Case Series* [44]. Reporting quality was generally high across all JBI domains. All included case 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 approprate statistical analysis [112–114]. However, fewer studies (2) reported consecutive inclusion, and clear site demographic information [112, 113].

1) Case Reports: A total of 71 cases were reported 33 countries [33, 38, 47–83, 85–95, 97–103, 105–111].

The top three countries represented were the United States of America (n = 12), India (n = 7), and the United Kingdom (n = 7). The median number of case reports per country was 1.0 (IQR = 1.0[range 1-12].

Cases were present from a wide age range (7 to 100 years) with a median age of 28 year [IQR = 18].

The majority of cases were reported in males (60% vs 39%), with 1 case of unknown gender.

Half of cases had a psychiatric history and over a quarter (26%) had ingested previously. 17% were detained, 6% were psychiatric inpatients, 10% had a severe disability and 3% (n = 2) were displaced persons.

Psychiatric motivation was reported in nearly half of cases (48%), with intent-to-harm and psychosocial reported in 29% and 23% of cases respectively. Protest was reported in 11% of cases and other in 12%.

Most ingestions involved large (> 2.5cm) diameter (72%), sharp (62%) objects and multiple object ingestion (62%). Almost 50% of cases (48%) involved sharp and sharp (45%) object ingestion. Fewer ingestions involved magnets (12%) and button batteries (2%)

Complication rates were high (66%), as were rates of endoscopy and surgery (61% and 44% respectively). Cases were only managed conservatively 10% of the time. The mortality rate in case reports was 2.8%.

A table of case-level characteristics is shown in Table II

2) Case Series: 3 studies were case series, yielding 90 cases [112–114]. Case series were present from the United States of

America [113] ($n = 19$), South Korea [114] ($n = 52$) and Tunisia [112] ($n = 19$).

Values reported herein are mean averages across all case series. Unreported variables are treated as 0.

All cases were male, aged 17–50 years and detained 33% had a psychiatric history (range 82-95%) - no psychiatric inpatients.

Demographic predictors were poorly recorded. Previous ingestion rates were only reported in one series at 11%. There was no severe disability (not reporting in two series). Data on displaced person and alcohol influence were not reported at all.

Motivations were predominantly protest (78%, range 16-97%); psychiatric in 13% (63.2% in one series, 0% in the other two); intent-to-harm in 7% (range 0-21%). There were no reports of other motivation or psychosocial motivation.

One series only report sharp object ingestion and no other object characteristics [113]. In the other two series, overall ingestion involed a sharp object in most cases (76%, range 64-100%). Long objects were ingested 37% of cases (36%, 0-67%), multiple objects were ingested in (27.8%, range 0-67%)

In terms of outcomes, complications were only reported in one series [114], data was absent from the other two. Endoscopy occuring in 52% (range 5-89%), although it was unreported in one series [113]. Surgery occured following 17% of ingestions (range 12-26%), conservative management following 32% (0% in one case and above 70% in the other two).

A full list of grouped series-level characteristics and outcomes is available in Table IV.

C. Sythesis

D. Study Characteristics

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A full list of grouped series-level characteristics and outcomes is available in Table IV.

3) Univariate Association Testing: In case reports, middle-age (40–64 years) was associated with significantly reduced odds of surgery (OR = 0.19, 95% CI: 0.04–0.78, $p = 0.020$). Further analysis of this subgroup ($n = 11$ vs $n = 60$) revealed a significantly higher proportion of males and individuals ingesting multiple objects (+25% and +8%, respectively). There was a non-significant tendency toward higher rates of psychiatric motivation (+13.5%) and history of prior ingestion (+9.3%). Conversely, fewer individuals in this age group were detained, and intent-to-harm motivation appeared less common.

Two deaths occured in this age group, outside of a detention context: one from metal ingestion in the context of pica in schizophrenia [82] and another from drug-induced acuphagia [69].

There were no other observed statistical relationships in any of the age groups.

Intent-to-harm motivation was associated with increased odds of surgery (OR = 5.68, 95% CI: 1.43–22.64, $p = 0.020$). This subgroup ($n = 21$ vs $n = 50$) included significantly more young adults (+20%), males (+16%), and individuals ingesting large-diameter objects (+6%) and sharp objects (+4%). A significant reduction in psychosocial co-motivation was observed in this group (–25%).

The presence of other motivation was associated with significantly reduced odds of surgery (OR = 0.15, 95% CI: 0.03–0.77, $p = 0.024$). Although no statistically significant demographic differences were observed in this subgroup ($n = 9$ vs $n = 62$), there was a non-significant tendency toward more adults (+22%), individuals with prior ingestion history (+9%), those ingesting long objects (+9%), and those with severe disability (+8%). This group also showed lower prevalence of intent-to-harm motivation

(–20%), fewer sharp object ingestions (–10%), and reduced psychiatric history and psychiatric motivation.

Sharp object ingestion was associated with decreased odds of endoscopy. Subgroup analysis ($n = 34$ vs $n = 37$) revealed a significant reduction in large-diameter object ingestion (–11%) and magnet ingestion (–13%).

All subgroup comparisons were conducted within the overall case-level dataset ($n = 71$). While observed differences may reflect genuine patterns in clinical behavior, they should be interpreted with caution due to the small sample sizes and potential for unmeasured confounding.

Subgroup population characteristics analysis is shown graphically in Figure 5.

4) Meta-Analysis of Proportions: Pooled outcome rates for the three included case series were first examined using meta-analysis of proportions, employing REML estimation with HK-adjusted 95% CIs. Results are presented in Figure **??**.

All patients in the included case series were male and detained, resulting in a demographically homogenous cohort with respect to gender and detention status.

The pooled prevalence of psychiatric history was ≈40% (range: 0.1–99.8% across three studies), with moderate heterogeneity (I^2 = 37.8%). Motivational subgroups showed moderate to high heterogeneity (I^2: 33–69%, τ^2: 3.6). Protest motivation was reported in ≈78% of patients (range: 0–100%), with moderate heterogeneity (I^2 = 32.7%, τ^2: 4.3). Intent-to-harm motivation was present in ≈4% of cases (range: 0–98%), with moderate heterogeneity (I^2 = 40%, τ^2: 4). Psychiatric motivation was reported in ≈2% of cases (range: 0–100%), with high heterogeneity (I^2 = 69%, τ^2: 3.6).

Meta-analysis was not feasible for several predictors—namely, displaced person status, alcohol use, severe disability, history of prior ingestion, large-diameter objects, and complications—as each was reported in only a single study. Similarly, meta-analysis of complication rates was not possible due to insufficient data.

Cases from case reports were collapsed and pooled for meta-analysis alongside the case series data. The results are shown in Fig **??**.

Substantial heterogeneity was introduced in this process. Heterogeneity in detention status rose (I^2: 69%, τ^2: 5), is did gender heterogeneity.

Heterogeneity was only low in; psychiatric inpatient pooled proportions between 0–10% (I^2: 10, τ^2 3); other motivation pooled proportion between 0–30% (I^2: 13, τ^2: 4.8); and surgery pooled proportion of 10–60% ((I^2: 17.5, τ^2 0.8).

These findings should be interpreted cautiously, as the wide confidence intervals and substantial heterogeneity likely reflect limited and inconsistent reporting across the small number of included studies.

5) Meta-Regression: Univariate meta-regression revealed exploratory associations between several predictors and the likelihood of surgical intervention across the three included studies. With this heterogeneity in mind, it was decided not to pool case series for univariate meta-regression, to examine detained case series as a subgroup against the more heterogenous case reports.

Protest motivation was associated with a significantly lower likelihood of surgery ($\beta = -0.021$, $p = 0.003$, 95% CI [–0.023, –0.020]). However, this result must be interpreted with caution due to the extremely small standard error and the limited number of studies. It is possible that this reflects reflects quasi-complete separation (i.e., the outcome is nearly perfectly predicted by one variable) or instability in the regression estimates due to sparse data or model instability rather than a reliable effect.

Intent-to-harm motivation showed a positive association with surgery ($\beta = 0.257$, $p = 0.133$, 95% CI [–0.434, 0.947]), though this was not statistically significant, and the confidence interval was wide, indicating substantial uncertainty in the estimate.

Male gender and prisoner status were both associated with a non-significant trend toward lower odds of surgery ($\beta = -0.026$, $p = 0.157$ for both), with overlapping estimates and identical confidence intervals (95% CI [–0.111, 0.058]). Presence of a sharp object also trended toward reduced odds of surgery ($\beta = -0.053$, $p = 0.250$), but this was not statistically significant. Neither psychiatric motivation ($\beta = 0.062$, $p = 0.448$) nor a history of psychiatric illness ($\beta = 0.027$, $p = 0.771$) showed a meaningful association with surgical intervention.

Given the limited number of series ($n = 3$), these findings should be regarded as exploratory, and interpreted with caution.

E. Discussion

1) Protest and intent-to-harm in detention could modulate outcomes: Motivations differ in custodial settings and with this, so do outcomes. Among the detained persons reported in case reports ($n = 71$) there was a pooled surgery rate of 58%.

Intent-to-harm motivation was dominant (80%) (associated with a near six-fold in surgery rates in this review), with protest motivation rates of 55%. Sharp objects were ingested in 67% of ingestions. Alongside this, meta-regression of three, all male case series ($n = 90$) prison populations in three countries suggests that protest motivation was associated with a near 80% reduction in the odds of undergoing surgery, despite a pooled estimate of ≈90% of ingested objects being sharp (wide confidence intervals with moderate heterogeneity).

In one series [114] with higher rates protest motivation(97% of $n = 52$) and lower rates of intent-to-harm (0%), with 64% of objects ingested being sharp, there was a surgery rate of 12%. Whereas, in another [113] ($n = 19$) with lower rates of protest motivation (16%) and higher (12%) intent-to-harm rate, surgery rates rose to 26% ($n = 6$). One caveat to this is that endoscopy rates were not reported in the latter series [113] and there were 16 years separating the two publications. However, the third series, published in 2016 – 9 years after the later study and 25 years after the earlier – where rates of protest were 90% with 84% sharp object ingestion, 10% intent-to-harm rate and 0% psychiatric motivation rate, the surgery rate was between the rates of the other two series at 21%, conservative rates 79%, with one death (out of 3 reported in this review).

Publication bias likely skews this result. Including one outstanding series [87] and an accompanying case report of $5 + 1$ [33] cases of "gastrointestinal cross" ingestion. Five inmates in one prison in Bulgaria ingested a total of 20 crosses underwent laparotomy for a similar number of perforations.

2) Middle-age, psychiatric history, recurrent ingestion reduce the odds of surgery, but increase mortality: Two deaths occured in this age group, outside of detention settings, but with psychiatric motivation and history. One 54 year old man with 15 year history of ingestion who died after repeatedly refusing surgery [82], who died after ingesting metal secondary to acuphagia from 3,4-Methylenedioxymethamphetamine use [69].

This likely indicates a cohort significant psychiatric comorbidities, indicated by higher rates of recurrent ingestion, but present late or refuse treatment.

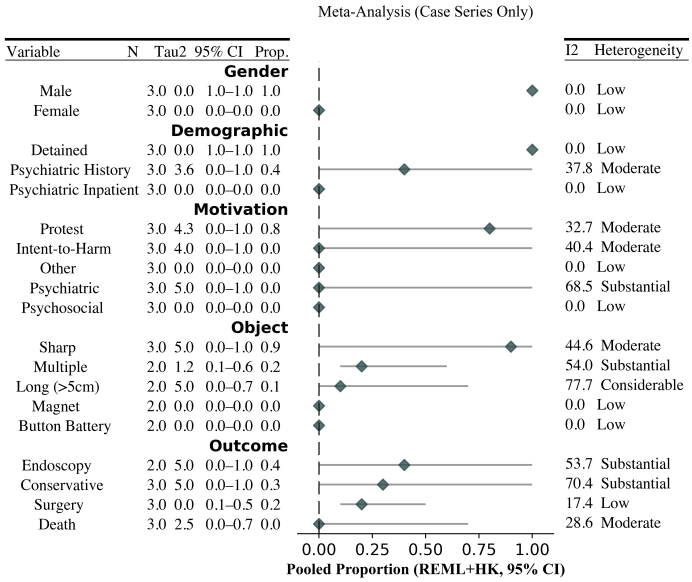

Fig. 3: Meta-analysis of case series. Prop = Pooled Proportion; Tau2 = τ^2; N = n; I2 = I^2; REML and HK estimated 95% Confidence Intervals

F. Limitations

1) Publication bias, funny titles and countertransference anger: Both of the above effects could be explained by publication bias, but deaths were outstanding cases.

Elsewhere, there appears to be a competition amongst authors (unbeknowst to this one) to publish case reports with the wittiest title. Examples include: “Loose Screws”, in reference to a female with an extensive psychiatric history who – as advised by her rastafarian – ingested nails in a milkshake [75]; *Ingested Magnets: the force within* [101]; *Now You See It, Endo You Don’t: Case of the Disappearing Knife* [115]; and *A Jackass And A Fish* [57]. The list goes on. Joking aside, extreme cases of IIFO are remarkable, publication-worthy and interesting to read, likely leading to publication bias.

Furthermore, extreme cases of recurrent intentional ingestion cause ’countertransference anger’ [116] among clinicians who have to endure sometimes years of repeat encounters with prolific recurrent ingestors, who are often complex patients with complex mental health needs. This is well described by Gitlin *et al.* [27] who describes how clinicians are “held hostage” by ingestors “in the midst of their self-harming process” after an initiating an “ongoing injurous sequence”.

2) Selection Bias: This review was conducted by a single reviewer (JGE), which introduces the potential for selection bias and inconsistent application of eligibility criteria. Although inclusion decisions were guided by a predefined protocol and supervision by an experienced reviewer (GC), dual independent screening was not performed due to resource limitations. This may have affected reproducibility and sensitivity of the search and screening processes.

3) Unmeasured confounding: The review did not record item location. This could have led to a reduced perception of ingestion risk from underestimation of high-risk object rates and introduced an unmeasured confounding factor. This reduced rates of perceived high risk ingestions.

Time to presentation was not recorded. Ingestors that present early have increased endoscopy rates. This may have skewed endoscopy rates in some cases reports and case series, but the effect cannot be quantified in this review.

Also, this review did not record any alteration of objects that ingestors may have undertaken. Although, in clinical practice, this is likely difficult to assess practically. Items may appear radiopaque and sharp imaging, but wrapped by the ingestor to reduce morbidity [38, 39]. Perhaps one day motivation could serve as a surrogate marker.

4) Information Bias: Information bias from missing data in studies likely distorted true effects in the case series analysis. This is particularly in age group and object characteristics analysis, but also endoscopic outcomes and demographic characteristics.

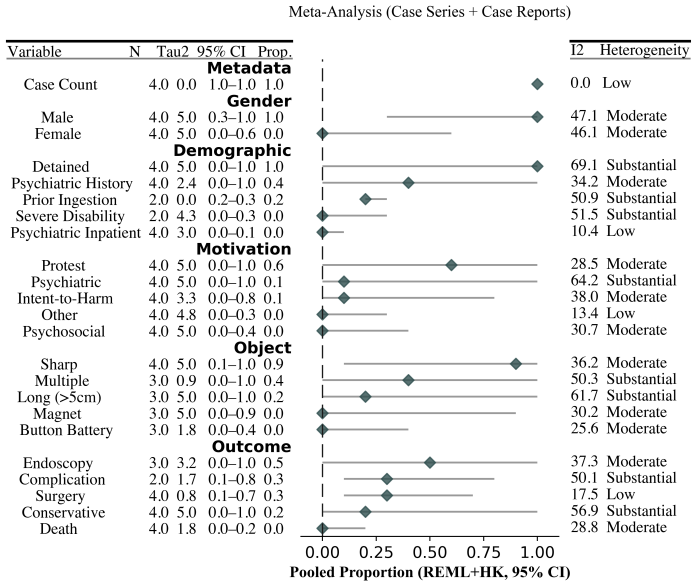

Fig. 4: Meta-analysis of case series and pooled case reports. Meta-analysis of case series. Prop = Pooled Proportion; Tau2 = τ^2; N = n; I2 = I^2; REML and HK estimated 95% Confidence Intervals

G. Conclusion

This review represents the first systematic synthesis of outcomes following intentional ingestion of foreign objects (IIFO) with a focus on patient motivation. Across both case reports and case series, the nature of the ingestion—particularly protest versus intent-to-harm—appears to modulate clinical decision-making, especially in detained populations. While protest-motivated ingestions were often managed conservatively, intent-to-harm cases were associated with significantly increased rates of surgical intervention.

Middle-aged adults (40–64 years) were significantly less likely to undergo surgery, and subgroup analysis suggests that psychiatric history, prior ingestion, and multiple object ingestion may contribute to more conservative management strategies and refusal of treatment, modulating this effect. Sharp object ingestion, traditionally viewed as high-risk, was not uniformly associated with surgical outcomes, particularly in the context of protest motivations and detention settings. However, outside of protest

motivations in this age group, those with psychiatric comorbidities had a tendency towards increased mortality.

Findings must be interpreted in light of limitations including small sample sizes, publication bias, selection bias, missing data, and unmeasured confounding factors such as object location, wrapping, and timing of presentation. Nonetheless, this review highlights the complexity of IIFO and the influence of both psychosocial context and clinical framing on treatment decisions.

Future research should focus on prospective, standardised reporting of IIFO cases to better understand how patient characteristics and motivations influence management. Greater clarity around risk stratification may help clinicians provide safer, more consistent care for this often-marginalised population.

Data Availability

Data collection, maniplation and analysis in this review were conducted using Python [42] in *Visual Studio Code* [117] and *Jupyter Notebooks* [118]. The manuscript was compiled using *LaTeX* [119]. Specific Python packages used include: *Pandas* [43], *scikit-learn* [120], *statsmodel* [121], *seaborn* [122], matplotlib [123], Cartopy [124], Forestplot [125].

The data and code used in this systematic review are available on Github at http://github.com/jackgedge/iifo_systematic_review.

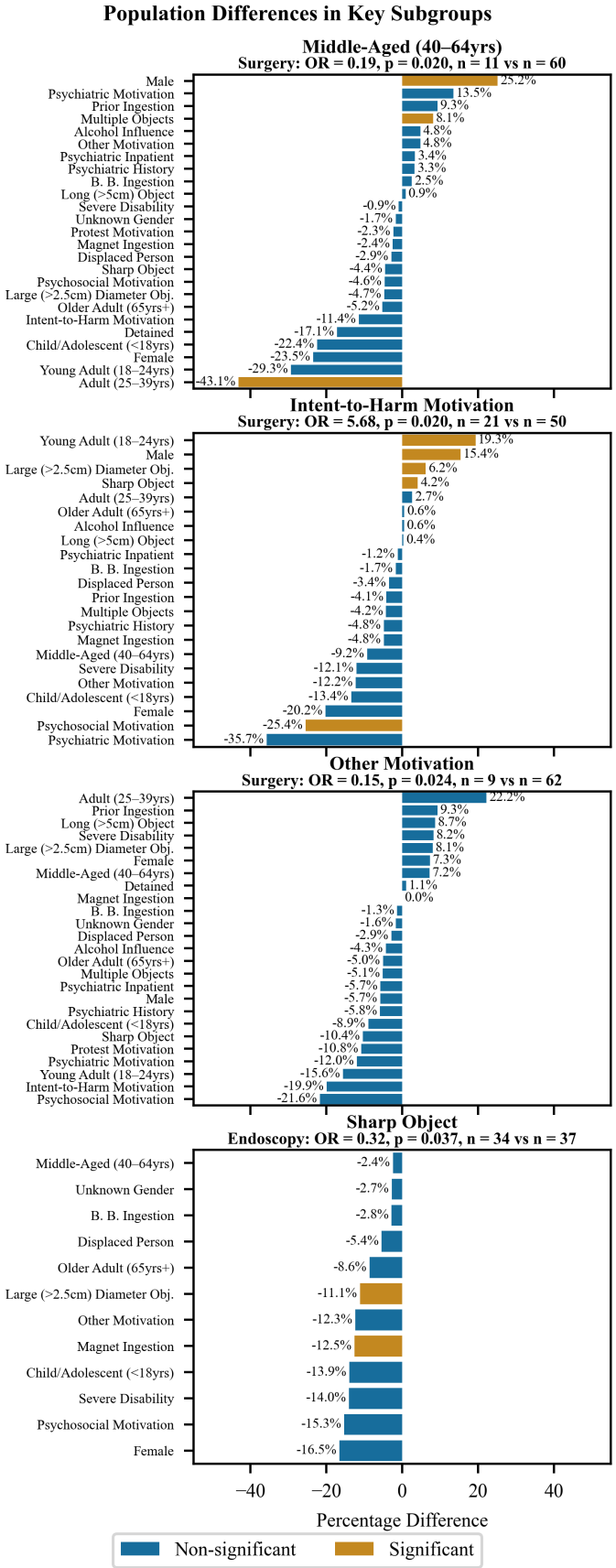

Fig. 5: Significant associated predictors from univarariate analysis.

TABLE II: Case-level summary statistics.

Variable	Count	Percentage	References
Age			
Age (Years)	2108	2969%	[**<empty citation>**]
Max	100		[85]
Mean	30		
Median	28		
IQR	18		
Min	7		[86, 91]
Age Group			
Adult (25–39)	25	35%	[38, 50, 53, 54, 57, 59, 64, 65, 67, 70–72, 74, 77, 83, 87, 89, 93–95, 99, 103, 107, 109, 110]
Young Adult (18–24)	17	24%	[33, 47, 51, 55, 60, 66, 78, 79, 81, 87, 88, 92, 97, 108]
Child/Adolescent (<18)	13	18%	[49, 52, 63, 68, 73, 86, 90, 91, 100, 101, 106]
Middle-Aged (40–64)	11	16%	[48, 61, 62, 69, 75, 76, 82, 98, 102, 105, 111]
Older Adult (65+)	3	4%	[56, 80, 85]
Gender			
Male	43	61%	[33, 47, 48, 50, 51, 53–55, 57, 58, 61, 62, 66, 69–72, 74, 76, 77, 81–83, 86–89, 93, 94, 97, 99–103, 105, 108, 111]
Female	27	38%	[38, 49, 52, 56, 59, 60, 63–65, 67, 68, 73, 75, 78–80, 85, 90–92, 95, 98, 106, 107, 109]
Unknown	1	1%	[110]
Demographic			
Psychiatric History	36	51%	[38, 49, 50, 52, 54–56, 62, 64, 67, 68, 70, 71, 74–78, 80–83, 86, 88, 89, 91, 92, 95, 98–100, 109–111]
Prior Ingestion	19	27%	[50, 54, 58, 60, 66, 68, 69, 74, 76, 77, 86, 95, 100, 102, 109–111]
Detained	12	17%	[33, 50, 53, 54, 87, 93, 99, 103]
Severe Disability	7	10%	[55, 80, 86, 91, 92, 109, 111]
Psychiatric Inpatient	4	6%	[68, 110, 111]
Alcohol Influence	3	4%	[57, 66, 102]
Displaced Person	2	3%	[47, 72]
Motivation			
Psychiatric	34	48%	[38, 48, 50, 52, 54, 55, 59, 60, 67–70, 74–83, 85, 86, 89, 91, 95, 98–100, 108, 111]
Intent-to-Harm	21	30%	[33, 48–51, 62, 64–66, 71, 85, 87, 88, 95, 99, 100, 110]
Psychosocial	16	22%	[47, 57, 60, 63, 73, 75, 81, 85, 90, 93, 94, 97, 101, 102, 106, 107]
Other	9	13%	[52, 53, 69, 74, 92, 95, 103, 105, 109]
Protest	8	11%	[33, 61, 72, 87]
Object			
Large (>2.5cm) Diameter	51	72%	[33, 47–51, 53–55, 58, 59, 62–66, 68, 69, 72, 74, 76, 77, 79–83, 87–95, 98, 100, 102, 103, 107, 109–111]
Multiple	44	62%	[38, 52, 54–56, 60–63, 69–71, 73–79, 81–83, 85–91, 97–102, 105, 106, 108, 110, 111]
Sharp	34	48%	[33, 38, 49, 50, 54, 57, 59, 60, 62, 66–71, 74–77, 79, 81, 83, 87–89, 97, 108, 111]
Long (>5cm)	32	45%	[48, 49, 51, 53, 55, 59, 62, 64–66, 68, 69, 71, 72, 77, 79–81, 83, 88, 89, 91, 93, 95, 98, 102, 103, 108, 109, 111]
Magnet	9	13%	[52, 61, 63, 86, 90, 91, 100, 101, 106]
Button Battery	2	3%	[58, 61]
Outcome			
Complication	47	66%	
Surgery	43	61%	
Endoscopy	31	44%	
Conservative	7	10%	
Death	2	3%	

TABLE III: Case counts per country.

Country	Case Count	Percentage	References
South Korea	52.000000	32.3%	[114]
United States of America	31.000000	19.3%	[38, 50, 61, 71, 74–76, 80, 82, 86, 99, 101, 113]
Tunisia	19.000000	11.8%	[112]
United Kingdom	7.000000	4.3%	[56, 58, 63, 65, 72, 93]
India	7.000000	4.3%	[59, 60, 78, 79, 83, 89, 105]
Bulgaria	6.000000	3.7%	[33, 87]
Iran	5.000000	3.1%	[68–70]
Turkey	4.000000	2.5%	[47, 55, 100, 109]
Spain	2.000000	1.2%	[62, 110]
Poland	2.000000	1.2%	[81, 107]
China	2.000000	1.2%	[77, 85]
Pakistan	1.000000	0.6%	[108]
Switzerland	1.000000	0.6%	[106]
Taiwan	1.000000	0.6%	[64]
South Africa	1.000000	0.6%	[97]
Saudi Arabia	1.000000	0.6%	[98]
Qatar	1.000000	0.6%	[51]
Portugal	1.000000	0.6%	[92]
Sweden	1.000000	0.6%	[90]
Australia	1.000000	0.6%	[54]
Oman	1.000000	0.6%	[49]
Netherlands	1.000000	0.6%	[57]
United Arab Emirates	1.000000	0.6%	[52]
Japan	1.000000	0.6%	[91]
Italy	1.000000	0.6%	[94]
Israel	1.000000	0.6%	[73]
Iraq	1.000000	0.6%	[48]
Hungary	1.000000	0.6%	[66]
Greece	1.000000	0.6%	[95]
Germany	1.000000	0.6%	[111]
Ethiopia	1.000000	0.6%	[88]
Egypt	1.000000	0.6%	[53]
Ecuador	1.000000	0.6%	[67]
Croatia	1.000000	0.6%	[103]
Nepal	1.000000	0.6%	[102]

Note: Percentages are rounded to one decimal place. Some references include multiple cases.

TABLE IV: Grouped aggregate series-level summary.

Variable	**Pooled**	**Karp *et al.* (1991) [113]**	**Lee *et al.* (2007) [114]**	**Elghali *et al.* (2016) [112]**
Total Cases	90	19	52	19
Gender				
Male	90 (100%)	19 (100%)	52 (100%)	19 (100%)
Female	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Unknown	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Demographic				
Detained	90 (100%)	19 (100%)	52 (100%)	19 (100%)
Psychiatric History	30 (33%)	18 (95%)	9 (18%)	2 (12%)
Prior Ingestion	2 (2%)	—	—	2 (10%)
Psychiatric Inpatient	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Displaced Person	0 (0%)	—	—	—
Alcohol Influence	0 (0%)	—	—	—
Severe Disability	0 (0%)	—	0 (0%)	—
Motivation				
Protest	70 (78%)	3 (16%)	50 (97%)	17 (90%)
Psychiatric	12 (13%)	12 (63%)	0 (0%)	0 (0%)
Intent-to-Harm	6 (7%)	4 (21%)	0 (0%)	2 (10%)
Psychosocial	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Other	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Object				
Sharp	68 (76%)	19 (100%)	33 (64%)	16 (84%)
Long (>5cm)	32 (36%)	—	32 (62%)	0 (0%)
Multiple	25 (28%)	—	24 (46%)	1 (5%)
Button Battery	0 (0%)	—	0 (0%)	0 (0%)
Magnet	0 (0%)	—	0 (0%)	0 (0%)
Large (>2.5cm) Diameter	0 (0%)	—	—	—
Outcome				
Endoscopy	47 (52%)	—	46 (88%)	1 (5%)
Conservative	29 (32%)	14 (74%)	0 (0%)	15 (79%)
Surgery	15 (17%)	5 (26%)	6 (12%)	4 (21%)
Complication	6 (7%)	—	6 (12%)	—
Death	1 (1%)	0 (0%)	0 (0%)	1 (5%)
Age				
Mean	24	24	—	24
Min	17	17	25	19
Median	35	—	35	—
Max	50	40	50	27

Key: *n* (%).

TABLE V: Univariate associations between predictors and outcomes.

Variable	Conservative	Endoscopy	Surgery	Death	Complication
Gender					
Male	0.22 [0.04, 1.25] (p=0.104)	1.34 [0.51, 3.53] (p=0.722)	0.99 [0.37, 2.62] (p=1.000)	—	1.49 [0.55, 4.06] (p=0.595)
Female	4.77 [0.86, 26.63] (p=0.097)	0.82 [0.31, 2.18] (p=0.887)	0.92 [0.34, 2.44] (p=1.000)	—	0.79 [0.29, 2.17] (p=0.847)
Age Group					
Child/Adolescent (<18)	1.93 [0.33, 11.24] (p=0.604)	0.32 [0.08, 1.29] (p=0.178)	2.53 [0.63, 10.15] (p=0.307)	—	1.89 [0.47, 7.65] (p=0.521)
Young Adult (18–24)	1.31 [0.23, 7.44] (p=0.670)	0.31 [0.09, 1.06] (p=0.101)	2.60 [0.75, 9.01] (p=0.210)	—	1.30 [0.40, 4.25] (p=0.885)
Adult (25–39)	0.28 [0.03, 2.45] (p=0.409)	2.17 [0.81, 5.85] (p=0.195)	0.96 [0.36, 2.61] (p=1.000)	—	0.86 [0.31, 2.39] (p=0.979)
Middle-Aged (40–64)	2.44 [0.41, 14.57] (p=0.295)	2.62 [0.69, 9.95] (p=0.192)	**0.19 [0.04, 0.78] (p=0.020)***	—	0.56 [0.15, 2.05] (p=0.490)
Older Adult (65+)	—	0.63 [0.05, 7.32] (p=1.000)	1.32 [0.11, 15.25] (p=1.000)	—	1.02 [0.09, 11.88] (p=1.000)
Demographic					
Detained	—	0.96 [0.27, 3.42] (p=1.000)	0.89 [0.25, 3.18] (p=1.000)	—	0.64 [0.18, 2.32] (p=0.515)
Psychiatric Inpatient	—	0.43 [0.04, 4.40] (p=0.630)	2.32 [0.23, 23.75] (p=0.630)	—	0.15 [0.01, 1.54] (p=0.108)
Displaced Person	—	—	0.67 [0.03, 12.84] (p=1.000)	—	0.50 [0.03, 9.77] (p=1.000)
Alcohol Influence	—	0.83 [0.07, 10.20] (p=1.000)	1.05 [0.09, 12.88] (p=1.000)	—	—
Psychiatric History	0.92 [0.19, 4.51] (p=1.000)	0.74 [0.27, 2.06] (p=0.749)	1.45 [0.52, 4.07] (p=0.657)	0.69 [0.04, 11.51] (p=1.000)	0.74 [0.25, 2.17] (p=0.780)
Severe Disability	—	4.02 [0.72, 22.47] (p=0.120)	0.83 [0.17, 4.04] (p=1.000)	—	1.35 [0.24, 7.54] (p=1.000)
Prior Ingestion	1.62 [0.29, 9.05] (p=0.669)	0.78 [0.24, 2.50] (p=0.902)	0.78 [0.24, 2.51] (p=0.911)	1.56 [0.09, 26.48] (p=1.000)	0.36 [0.10, 1.29] (p=0.203)
Motivation					
Protest	—	0.39 [0.07, 2.09] (p=0.447)	4.81 [0.55, 41.92] (p=0.239)	—	4.12 [0.47, 35.95] (p=0.247)
Psychiatric	6.86 [0.78, 60.48] (p=0.105)	1.37 [0.52, 3.61] (p=0.699)	0.49 [0.18, 1.33] (p=0.248)	—	0.70 [0.25, 1.94] (p=0.670)
Psychosocial	1.29 [0.22, 7.37] (p=1.000)	0.99 [0.32, 3.08] (p=1.000)	0.56 [0.18, 1.75] (p=0.482)	—	0.86 [0.27, 2.76] (p=1.000)
Intent-to-Harm	—	0.47 [0.15, 1.48] (p=0.307)	**5.68 [1.43, 22.64] (p=0.020)***	—	0.88 [0.29, 2.67] (p=1.000)
Other	1.17 [0.12, 10.99] (p=1.000)	2.96 [0.68, 12.95] (p=0.165)	**0.15 [0.03, 0.77] (p=0.024)***	7.62 [0.43, 134.24] (p=0.239)	0.60 [0.14, 2.46] (p=0.475)
Object					
Sharp	1.51 [0.31, 7.30] (p=0.703)	**0.32 [0.12, 0.85] (p=0.037)***	2.27 [0.85, 6.06] (p=0.157)	1.09 [0.07, 18.15] (p=1.000)	1.13 [0.42, 3.04] (p=1.000)
Long (>5cm)	0.44 [0.08, 2.44] (p=0.442)	0.76 [0.29, 1.97] (p=0.746)	2.56 [0.94, 6.94] (p=0.106)	1.19 [0.07, 19.88] (p=1.000)	1.96 [0.70, 5.49] (p=0.304)
Multiple	4.11 [0.47, 36.14] (p=0.240)	0.46 [0.17, 1.21] (p=0.181)	1.09 [0.41, 2.91] (p=1.000)	—	2.79 [1.01, 7.71] (p=0.081)
Button Battery	—	—	—	—	—
Magnet	—	1.04 [0.25, 4.24] (p=1.000)	2.53 [0.49, 13.17] (p=0.467)	—	—
Large (>2.5cm) Diameter	0.22 [0.04, 1.10] (p=0.070)	1.29 [0.43, 3.86] (p=0.857)	1.83 [0.62, 5.44] (p=0.413)	—	1.00 [0.32, 3.13] (p=1.000)

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

TABLE VI: Univariate meta-regression results (series-level).

Variable	**Surgery**
Demographic	
Detained	-0.03 [-0.11, 0.06] (p=0.157)
Psychiatric History	0.03 [-0.88, 0.93] (p=0.771)
Gender	
Male	-0.03 [-0.11, 0.06] (p=0.157)
Motivation	
Intent-to-Harm	0.26 [-0.43, 0.95] (p=0.133)
Protest	**-0.02 [-0.02, -0.02] (p=0.003)***
Psychiatric	0.06 [-0.60, 0.73] (p=0.448)
Object	
Long (>5cm)	—
Multiple	—
Sharp	-0.05 [-0.34, 0.23] (p=0.250)

β = regression coefficient; CI = 95% confidence interval.
* indicates $p < 0.05$; — = missing or unstable estimate.

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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
SEARCH STRATEGY

1) Keywords and MeSH Term:

2) 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*"	Self-Injurious Behavior [MeSH]
Ingestion Behavior	"ingest*" "swallow*"	–
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.

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*"	"automutilation"/exp
Ingestion Behavior	"ingest*" "swallow*"	"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.

3) Embase:

Concept	Keywords	Cochrane MeSH Terms
Foreign Bodies	"foreign obj*" "foreign bod*" (foreign NEXT obj*) (foreign NEXT bod*)	[mh foreign bodies]
Intentional Ingestion / Self-harm	intent* deliberate* purpose* (self NEXT injur*) (self NEXT harm*)	[mh self-injurious behavior]
Ingestion Behavior	ingest* swallow*	–
Interventions	surg* endoscop* EGD Esophagogastroduodenoscopy Oesophagogastroduodenoscopy 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.

4) Cochrane (CENTRAL):

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

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

5) Web of Science:

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

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

6) Scopus:

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

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

7) PsycINFO:

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

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

8) Google Scholar:

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

("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
SCREENING PROCESS

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 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 2.

APPENDIX D
COMPUTATIONAL RISK OF BIAS ASSESSMENT

To reduce bias dilution of intentionality effect, a novel computation risk of bias assessment was undertaken, using a combination of human review followed by computional risk of bias assessment. First, the author (JGE) extracted data into Microsoft Excel [41]. Then, a computation risk of bias filter was applied to extracted case report and case series data. That process is outlined in this appendix.

Case Reports

For case reports, the JBI Checklist for Case Reports 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* [43]. 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 JBI Checklist for Case Series was applied. The JBI 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 *Python Pandas* [43]. 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 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_Reporting*, or *Clear_Clinical_Info_Reporting*) 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
DATA EXTRACTION

A. Process

Data were initially extracted by a single reviewer (JGE) into *Microsoft Excel* [41]. 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* [42] 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.

B. Variables

C. Definitions

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.