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Seizures and epilepsy after bariatric surgery: a systematic review of incidence, mechanisms, and management

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Abstract

Bariatric surgery is increasingly performed worldwide, and postoperative neurological complications can occur. Seizures are clinically important because they carry significant morbidity and are often associated with reversible metabolic triggers. This systematic review synthesized evidence on seizures and epilepsy following bariatric surgery. PubMed, Embase, and Web of Science were searched from inception to January 11, 2025. Nineteen studies were included: three retrospective cohort studies and sixteen case reports. Roux-en-Y gastric bypass accounted for most reported cases, with one case following sleeve gastrectomy. Time from surgery to first seizure ranged from 2 to 180 months. Generalized tonic–clonic seizures were most common. Reported causes were mainly metabolic, particularly hypoglycemia and hyperammonemia, with additional cases linked to hypocalcemia, vitamin deficiencies, and stroke. Cohort data suggest an increased postoperative risk of seizures and epilepsy. Further research is needed to clarify mechanisms and absolute risk.

1. Introduction

Obesity is a global health concern, with a prevalence increasing at an alarming rate -almost tripling since 1975- which poses a significant public health challenge [1, 2].This complex medical condition extends beyond an aesthetic or lifestyle matter; it is a significant risk factor for a multitude of health problems, including cardiovascular diseases, diabetes, and mental health disorders [3]. In response to this epidemic, bariatric surgery has been increasingly adopted as an effective intervention, resulting in a significant weight reduction and management of obesity-related medical conditions [4, 5]. Roux-en-Y gastric bypass and gastric sleeve are two of the most common bariatric surgeries, and they have shown consistent results and successful long-term weight-loss outcomes [6]. Nevertheless, these surgeries are not without potential complications, including effects on neurological health.

The effects of obesity on neurological health have been well documented and explored in the literature [7, 8]. Several studies have assessed the association between neurological complications and bariatric surgery. A review by Zafar et al. reported complications such as encephalopathy, behavioral and psychiatric disorders, myelopathy, and optic neuropathy [9]. A study by Antaya et al. focused on the seizure risk following bariatric surgery and found increased rates of seizures in post-bariatric surgery patients compared to a non-surgical obese cohort [10]. The mechanisms through which bariatric surgery may influence neurological health, particularly the risk of seizures, are complex and multifactorial. Some possible hypotheses include changes in nutrient absorption, hormonal fluctuations, and alterations in gut-brain axis communication, but these pathways have yet to be definitively established [11, 12].

The relationship between bariatric surgery and seizures remains incompletely characterized, and the existing literature is scattered across observational studies and isolated case reports. Important clinical questions remain unanswered, including the magnitude of risk, the timing of onset, the most frequent etiologies, and the effectiveness of medical and procedural management strategies. Therefore, this systematic review aims to synthesize available evidence on seizures and epilepsy following bariatric surgery by summarizing incidence estimates, describing clinical characteristics and attributable causes, and outlining management approaches and outcomes from the available literature.

2. Methodology

This study was conducted according to the Cochrane Handbook for Systematic Reviews and the PRISMA guidelines [13, 14]. The study was registered on PROSPERO.

2.1 Eligibility Criteria

To be considered for inclusion, the following study designs were eligible: case reports, case series, cross-sectional, case-control, cohort, and randomized controlled trials (RCTs) in any language. Our study included patients of any age, gender, or race who underwent any of the following bariatric surgeries: Roux-en-Y gastric bypass, Sleeve gastrectomy, Biliopancreatic diversion with duodenal switch (BPD/DS), or single-anastomosis duodenal-ileal bypass with sleeve gastrectomy (SADI-S). We excluded studies with duplicated data and secondary articles. In addition, studies focusing on measuring the effect of bariatric surgery on pre-diagnosed epileptic participants were excluded.

2.2 Information Sources

We performed a primary search for eligible studies published up to 11 January 2025 selecting studies from three main databases: PubMed, Embase, and Web of Science. Furthermore, we surveyed the reference lists of all included studies and searched Google Scholar to identify any additional eligible records.

2.3 Search Strategy

Our search strategy was based on keywords related to bariatric surgery and seizures. A draft search strategy was developed to identify additional keywords. Applicable studies were identified by searching for keywords in titles, abstracts, and subject indexing. The PubReMiner word-frequency analysis tool was used to expand our keywords. Three relevant studies were selected to validate our search strategy. We tested whether our search strategy could identify the pre-selected studies. The keywords search strategy was then employed in PubMed, Embase, and Web of Science and successfully identified the pre-selected three studies (see Supplementary file 1, Table S1).

2.4 Selection Process

Records retrieved from the three databases were imported into Mendeley, where duplicates were removed using software and manual verification. Study selection was performed in three stages: title screening, abstract screening, and full-text review. Titles and abstracts were double-screened by four reviewers, and full texts were assessed by all reviewers using predefined exclusion criteria (non-bariatric, non-seizure outcomes, pre-existing epilepsy/anti-seizure medication use, non-primary studies, and non-human studies). Disagreements were resolved through discussion, with input from the first and last authors when needed.

2.5 Data Collection Process and Data Items

Data extraction was designed to address the review objectives and covered three domains: (1) study characteristics and participant details (authors, country, design, sample size, age, sex, comorbidities); (2) surgical and perioperative data (procedure type, prior bariatric surgery, and relevant laboratory findings); and (3) postoperative outcomes and complications, with emphasis on seizures/epilepsy and related metabolic or nutritional disturbances (e.g., hypoglycemia, vitamin and mineral deficiencies), as well as other short- and long-term complications. The standardized extraction sheet was piloted on three eligible studies and refined before independent data extraction from the remaining included studies.

2.6 Risk of Bias Assessment

To assess the risk of bias in the included studies, the Joanna Briggs Institute (JBI) risk of bias assessment tool was used [15, 16]. By using the appraisal checklists, we aimed to assess the methodological rigor of each included study and determine how effectively it addressed potential bias in its planning, execution, and analytical processes. Then, studies were further classified according to the JBI checklist evaluation as low-, intermediate-, or high-risk of bias, based on positive answers of ≥ 75%, < 75%, ≥ 50%, and < 50%, respectively. Two reviewers independently appraised all included studies in a blind manner; any disagreements were resolved by discussion or consultation with the first author when necessary.

2.7 Data synthesis plan

Due to expected clinical and methodological heterogeneity, we performed a narrative synthesis supported by descriptive analyses [13]. Cohort studies were summarized using the most adjusted effect estimates, including hazard ratios (HRs), risk ratios (RRs), or odds ratios (ORs), with 95% confidence intervals (95% CIs) and absolute measures (e.g., incidence) when available. Case reports were synthesized by tabulating surgery type, time to seizure, seizure phenotype, suspected cause, key laboratory findings, and management, and reporting results as counts and proportions, along with appropriate summary statistics. Meta-analysis was not feasible because comparative studies were insufficiently homogeneous, and publication bias assessment was not performed, given the limited number of comparative studies and the inclusion of case reports [13].

3. Results

3.1 Study Selection

Figure 1 outlines the search and selection process using a PRISMA flow diagram. This process focused on identifying studies examining the association between bariatric surgery and seizure outcomes, using 3 databases. Initially, 10,507 records were identified; only 19 studies met the inclusion criteria and were included in our review [10, 17–34].

3.2 Risk of Bias

Risk of bias varied across included studies. Among 16 case reports, 12 were judged low risk, 3 intermediate risk, and 1 high risk, mainly due to incomplete reporting of clinical details and interventions, and to unclear causality (Fig. 2A). For the three cohort studies, one was low risk, one intermediate, and one high risk, largely related to limited clarity in exposure and outcome measurement (Fig. 2B). For details of the risk of bias for each study, see (Supplementary File A, Table S2, S3).

3.3 Study Characteristics

Table 1 summarizes the baseline characteristics of the 19 included studies (3 retrospective cohorts and 16 case reports), reporting study design, country, demographics, and sample size. Studies were conducted across multiple countries (including Canada, Sweden, Ireland, Germany, the UK, Belgium, Qatar, Brazil, and the USA), with variable age reporting and a predominance of female participants in both cohorts and case reports. Sample sizes ranged from large population-based cohorts (e.g., 16,958 cases) to single-patient case reports.

Table 1
Baseline characteristics of included studies and reported management

Author (Year)	Country	Study design	Age (years)	Sex / Male %	Sample size (Control; Cases)	Management / definitive treatment (reported)
Antaya (2022) [10]	Canada	Retrospective cohort	≥ 18	NA	(622,514; 16,958)	Not reported
Woods et al. (2011) [17]	Ireland	Retrospective cohort	NA	31.7%	(0; 163)	Surgical reversal and conversion to sleeve gastrectomy (n = 2)
Marsk et al. (2010) [18]	Sweden	Retrospective cohort	41.0 ± 10.1	(23.5%; 23.5%)	(50,400; 5,040)	Not reported
Holländer (2023) [19]	Germany	Case report	38	Male	NA	Laparoscopic restoration of normal food passage (complex reconstructive procedure)
Kim et al. (2022) [20]	UK	Case report	49	Female	NA	Distal pancreatectomy + splenectomy; small bowel resection of blind Roux limb; acarbose 50 mg with meals; reversal/modification discussed but refused
Sedano et al. (2022) [21]	Belgium	Case report	39	Female	NA	Parenteral nutritional supplementation + antiseizure meds (ASM); ASM stopped after 10 months
McManus et al. (2021) [22]	USA	Case report	45	Female	NA	Dietary modification + acarbose 100 mg TID
Farahmand (2020) [23]	USA	Case report	39	Female	NA	Dietary modification + acarbose + diazoxide
El Sheikh (2020) [24]	Qatar	Case report	23	Female	NA	Seizure control (sedation/intubation/antiepileptics) + lactulose + normal saline infusion
Conaty et al. (2019) [25]	USA	Case report	NA	Female	NA	Endoscopic gastrojejunal revision (EGJR)
Tornincasa et al. (2018) [26]	Brazil	Case report	28	Female	NA	Gastric bypass reversal + calcium replacement
Brown (2018) [27]	USA	Case report	45	Female	NA	Acarbose + octreotide + diazoxide ± exenatide
Grogg (2018) [28]	USA	Case report	45	Female	NA	Lactulose + rifaximin + low-protein parenteral diet; lorazepam
Atla (2015) [29]	USA	Case report	46	Male	NA	Diazoxide
Hahn (2015) [30]	USA	Case report	41	Female	NA	Specialized diet (Cyclinex-2 + citrulline), phenobarbital, dialysis,

NA: Not available; USA: United States of America

Author (Year)	Country	Study design	Age (years)	Sex / Male %	Sample size (Control; Cases)	Management / definitive treatment (reported)
						sodium benzoate/phenylacetate (Ammonul)
Rao et al. (2014) [31]	**USA**	**Case report**	**58**	**Male**	**NA**	**Stepwise escalation: diet → acarbose/octreotide/diazoxide → endoscopic stomal reduction → laparoscopic RYGB reversal (resolved symptoms)**
Lee et al. (2011) [32]	**USA**	**Case report (2 subjects)**	**35**	**Female**	**NA**	**Subject 1: diet failed → RYGB reversal (7 yrs). Subject 2: diet/meds failed → distal pancreatectomy (3 yrs) → RYGB reversal (5 yrs) with improvement**
Choi (2004) [33]	**USA**	**Case report**	**18**	**Female**	**NA**	**Antiplatelet therapy + rehabilitation (post-bariatric stroke context)**
Salvado et al. (2000) [34]	**Spain**	**Case report**	**31**	**Female**	**NA**	**Intramuscular thiamine**

NA: Not available; USA: United States of America

3.4 Results of Individual Studies

Table 2 provides a comprehensive summary of surgical outcomes, seizure characteristics, and relevant lab results from 16 included case reports and 3 cohort studies. The majority of cases (15 out of 16) are associated with Roux-en-Y gastric bypass (RYGB) surgery, with one report linked to gastric sleeve surgery. Interestingly, one case reported a seizure resulting from RYGB after sleeve gastrectomy, highlighting a unique scenario (post-gastric sleeve RYGB seizure).

Table 2
Surgery and seizure characteristics in the included case reports

Type of surgery	Time since surgery (months)	Seizure type	Frequency	Attributable cause	Related lab results
Sleeve gastrectomy converted to RYGB	NA	NA	Daily	Postprandial hyperinsulinemic hypoglycemia	NA
RYGB	55.2	Generalized seizure	Once	Stroke	NA
RYGB	5.5	NA	Once	Nesidioblastosis	Glucose 39 mg/dL; Insulin 298.64 pmol/L
RYGB	124.2	NA	Once	Postprandial hyperinsulinemic hypoglycemia	Glucose 54 mg/dL
NA	121.5	Generalized tonic-clonic seizure	Once	Pyridoxine, cobalamin, niacin deficiency	Zinc 35 mg/dL; Copper 51 mg/dL; Iron (TIBC) 33 mg/dL; Vitamin D 18 mg/L
Sleeve gastrectomy	2.0	NA	Multiple	Hypoglycemia	CGM hypoglycemia 20% of time; HbA1c 4.9–5.1%
RYGB	NA	NA	Multiple	Hypocalcemia	Calcium 5.2 mg/dL
RYGB	55.2	NA	Biweekly for one year	Hypoglycemia	Glucose 40 mg/dL
RYGB	NA	Generalized tonic-clonic seizure	Multiple over 3 weeks	Endogenous hyperinsulinemic hypoglycemia	Glucose 30–80 mg/dL
RYGB	180.1	NA	NA	Hypoglycemia	Glucose 46 mg/dL
RYGB	60.0	Generalized tonic-clonic seizure	Once	Hyperammonemia	Ammonia 140 mcg/dL
RYGB	132.0	Status epilepticus	Once	Hyperammonemia	Ammonia 446 µmol/L
RYGB	12.4	Generalized seizure	Multiple times (frequency not specified)	Nesidioblastosis	Glucose 50–80 mg/dL
RYGB	22.0	Generalized seizure	Multiple times (frequency not specified)	Hyperammonemic encephalopathy	Ammonia not reported
RYGB	2.5	NA	Multiple times (frequency not specified)	Hypoglycemia	Glucose 18 mg/dL

Type of surgery	Time since surgery (months)	Seizure type	Frequency	Attributable cause	Related lab results
RYGB	12.0	Generalized tonic-clonic seizure	Two times	Thiamine deficiency	Total serum protein 48.9 g/L; Albumin 25.3 g/L; Zinc 60 mg/dL; Low thiamine

Abbreviations: RYGB, Roux-en-Y gastric bypass; CGM, continuous glucose monitoring; HbA1c, glycated hemoglobin; TIBC, total iron-binding capacity; NA, not available.

The time elapsed from surgery to the onset of the first seizure episode varies widely, ranging from 2 to 180.1 months, with an average duration of 59.3 months. This wide range is a possible reflection of surgery and patient factors that need to be investigated and have a high potential to affect the course of developing a seizure

Regarding seizure characteristics, 8 studies detailed both the type and frequency, while 7 reports focused solely on frequency. One report did not provide information on either the type or frequency. Generalized tonic-clonic seizures were the predominant type reported, with one case resulting in status epilepticus. Additionally, episodes ranged from single occurrences to multiple episodes occurring every 2 weeks over a year.

The causes of post-bariatric seizures were diverse, with 56% attributed to hypoglycemia, 19% to hyperammonemia, and the remaining cases linked to hypocalcemia, vitamin deficiency, and post-bariatric stroke. All case reports presented corresponding lab results, indicating elevated ammonia levels and low glucose, calcium, and vitamin levels, consistent with potential causes of seizures. These findings underscore the importance of understanding the multifaceted factors contributing to post-bariatric seizures.

Table 3 includes 3 cohort studies. Only one cohort study focuses solely on assessing the epilepsy risk following bariatric surgery. The study concluded an epilepsy rate of 50.1 per 100,000 person-years among those who did bariatric surgery. The hazard ratio HR was 1.45 (95% CI = 1.35, 1.56), which is considered statistically significant. Another cohort study included 5040 Swedish participants who underwent RYGB. The aim was to determine the risk of hypoglycemia and associated conditions (confusion, syncope, epilepsy, seizure, and pancreatic surgery) after RYGB, and an adjusted HR was calculated for each. The HRs were 3 (95% CI: 2.1, 4.3) and 7.3 (95% CI: 5, 10.8) for epilepsy and seizures, respectively, both of which were significant. An additional cohort study reviewed the incidence of hyperinsulinemic hypoglycemia among 129 patients who underwent RYGB. The diagnosis was based on reporting neuroglycopenic symptoms. This study compared several parameters, e.g., BMI, to identify risk factors for recurrent hypoglycemic episodes. However, one woman was reported to have tonic clonic seizure secondary to hypoglycemia.

Table 3
Summary of cohort study findings on seizures/epilepsy after bariatric surgery

Study (Author, Year)	Surgery exposure group	Outcome assessed	Main finding / suspected mechanism	Effect size (95% CI)
Antaya (2022)	All bariatric surgeries	Seizures	Seizures reported secondary to nutritional deficiencies	Not reported
Marsk et al. (2010)	Bariatric surgery (any) vs control	Epilepsy	Increased epilepsy risk after bariatric surgery	**HR 1.45 (95% CI 1.35–1.56)**
Woods et al. (2011)	RYGB	Seizures and epilepsy	Increased risk after RYGB, largely attributed to hypoglycemia	Epilepsy: **HR 3.0 (95% CI 2.1–4.3)**; Seizures: **HR 7.3 (95% CI 5.0–10.8)**

Abbreviations: CI, confidence interval; HR, hazard ratio; RYGB, Roux-en-Y gastric bypass.

Table 1 shows that definitive management was done in all the included studies. It is highly variable and encompasses a range of medical and surgical approaches. One cohort and six case reports mentioned surgical definitive management. One out of the 3 cohort studies with 163 participants reported that two patients underwent reversal and conversion to sleeve gastrectomy. The other two cohort studies did not mention the management. Moreover, four case reports also reported reversal of RYGB. One of these patients underwent laparoscopic restoration, utilizing a Roux limb as a Henley-Longmire interposition between the gastric pouch and remnant sleeve, with a side-to-side gastrojejunostomy. This approach successfully restored standard food passage without compromising the blood supply to the gastric pouch. Subsequent resection of the remaining Roux limb was performed. The remaining two case reports involving surgical management described different approaches, including endoscopic gastrojejunal revision (EGJR) and extended distal pancreatectomy with splenectomy, small bowel resection, and intraoperative pancreatic ultrasonography.

On the other hand, the other cases were mainly managed medically. Acarbose-based treatment was reported in three cases, accompanied by dietary modifications to avoid hypoglycemia. Also, Diazoxide was the primary anti-hypoglycemic agent in three studies. Using these agents was the primary way to control the seizure episodes.

Nevertheless, three cases that underwent surgical therapy as definitive treatment initially tried these agents without an effective response. Furthermore, two cases were treated with long-term antiseizure treatment. Finally, two cases of post-bariatric seizure that are mainly attributed to high ammonia levels received mainly acute hyperammonemia treatment.

4. Discussion

Weight loss surgeries have increased in recent years, and like other surgeries, it has the potential for acute and long-term complications [35]. Post-bariatric Neurological complications are a significant concern. Systematic reviews found several neurosurgical complications attributed to bariatric surgeries, such as alterations in intracranial pressure, intracranial hypertension, and myelo-encephalopathy [36, 37]. One of the significant neurological complications that this review examines is seizures. A retrospective study stated that there is a 45% increased risk of developing seizures after bariatric surgery [10].

Moreover, many case reports have demonstrated episodes of seizures that are directly and indirectly attributed to bariatric surgery. This review aims to assess the increased risk of developing post-bariatric seizures. The link between bariatric procedures per se and seizures is controversial. One case report has shown control of epilepsy after bariatric surgery [38]. Also, another case was diagnosed with insulinoma after losing 20 pounds in 6 months for bariatric surgery preparation.

The results of this systematic review suggest a link between bariatric surgeries and a higher likelihood of experiencing seizures or developing epilepsy through variable mechanisms. Among the three cohort studies included in the review, one study observed that epilepsy, along with various other late neurological complications, was explicitly associated with bariatric surgeries. A particular study did not identify any specific factors associated with the development of epilepsy (5). Moreover, the other two studies devoted to examining post-bariatric hypoglycemia stated that the risk of developing hypoglycemia-related neurological symptoms, including seizures, is higher compared to the general population. However, all the studies reported that it is considered low and insignificant despite the increased risk.

Furthermore, the remaining two cohort studies suggested that the potential mechanism underlying hypoglycemia following RYGB is a persistent increase in GLP-1 levels after meal stimulation, leading to increased insulin secretion

(5,6,7). These suggestions confirm that insulin secretion improves after bariatric surgery [39].

This systematic review also incorporated 15 case reports documenting cases of seizure episodes occurring after bariatric surgery, predominantly Roux-en-Y gastric bypass (RYGB). Among these 15 cases, nine were attributed to recurrent episodes of hypoglycemia. These studies highlight the importance of promptly identifying and treating conditions characterized by hyperinsulinemic hypoglycemia (Nesidioblastosis) to prevent irreversible neurological damage.

A systematic review was conducted to summarize the reasons for reversing RYGB. The findings revealed that among 100 participants, 8.5% underwent reversal due to postprandial hypoglycemia. This result aligns with the findings of our systematic review [36].

Three cases were linked to elevated ammonia levels. One contributing factor to hyperammonemia was post-sleeve steatohepatitis. At the same time, the other two cases were associated with rare urea cycle disorders that were revealed by the altered absorption resulting from bariatric surgery. The primary drawback of the studies was the extensive variation in the post-bariatric surgery time frame during which patients experienced seizures. This limitation raises questions about additional factors that may contribute to seizures. Additionally, most included studies focused on RYGB, leaving limited information on other surgical procedures. Furthermore, some studies needed more detailed information on the specific types and frequencies of seizures observed after bariatric surgery. Also, certain studies mentioned the occurrence of epilepsy after bariatric surgery, but failed to provide clear criteria used for diagnosing epilepsy. This absence of standardized diagnostic criteria raises concerns about the accuracy of epilepsy diagnoses in the reported cases.

Interpretation of our findings is limited by the small number of primary studies, variable timing of seizure onset, incomplete reporting of seizure characteristics, and inconsistent diagnostic criteria for epilepsy. Clinically, the findings support postoperative monitoring, patient education, and structured follow-up to enable early detection and management of reversible causes of seizures after bariatric surgery. This highlights the need for additional research to provide sufficient information.

5. Conclusion

In conclusion, seizures after bariatric surgery appear uncommon but clinically significant and are most often linked to reversible metabolic disturbances, particularly postprandial hypoglycemia after Roux-en-Y gastric bypass. Although cohort studies suggest an increased relative risk of seizures and epilepsy, the available evidence is limited and heterogeneous. Further prospective studies are needed to define absolute risks, clarify mechanisms, and guide standardized prevention and management strategies.

Declarations

6.1 Ethics approval and consent to participate

Not applicable. This study is a systematic review and does not involve primary data collection from human or animal participants.

6.2 Consent for publication

Not applicable.

6.3 Competing interests

The authors declare that they have no competing interests.

6.4 Funding

This review did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

6.6 Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files.

6.7 Systematic review registration

This systematic review is registered in PROSPERO.

6.8 Clinical trial registration number

Not applicable.

Author Contribution

M.A.D, R.A.S, L.M.B and M.A.Y; conceptualized the review, registered the protocol, and conducted the initial literature search. M.A.D, R.A.S, L.M.B and M.A.Y; contributed to screening, data extraction, and quality assessment. A.D, M.A, H.R and M.F; supervision and conceptualization. All authors contributed to the writing and critical revision of the manuscript and approved the final version.

Data Availability

All data generated or analyzed during this study are included in this published article and its supplementary information files.

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Figures

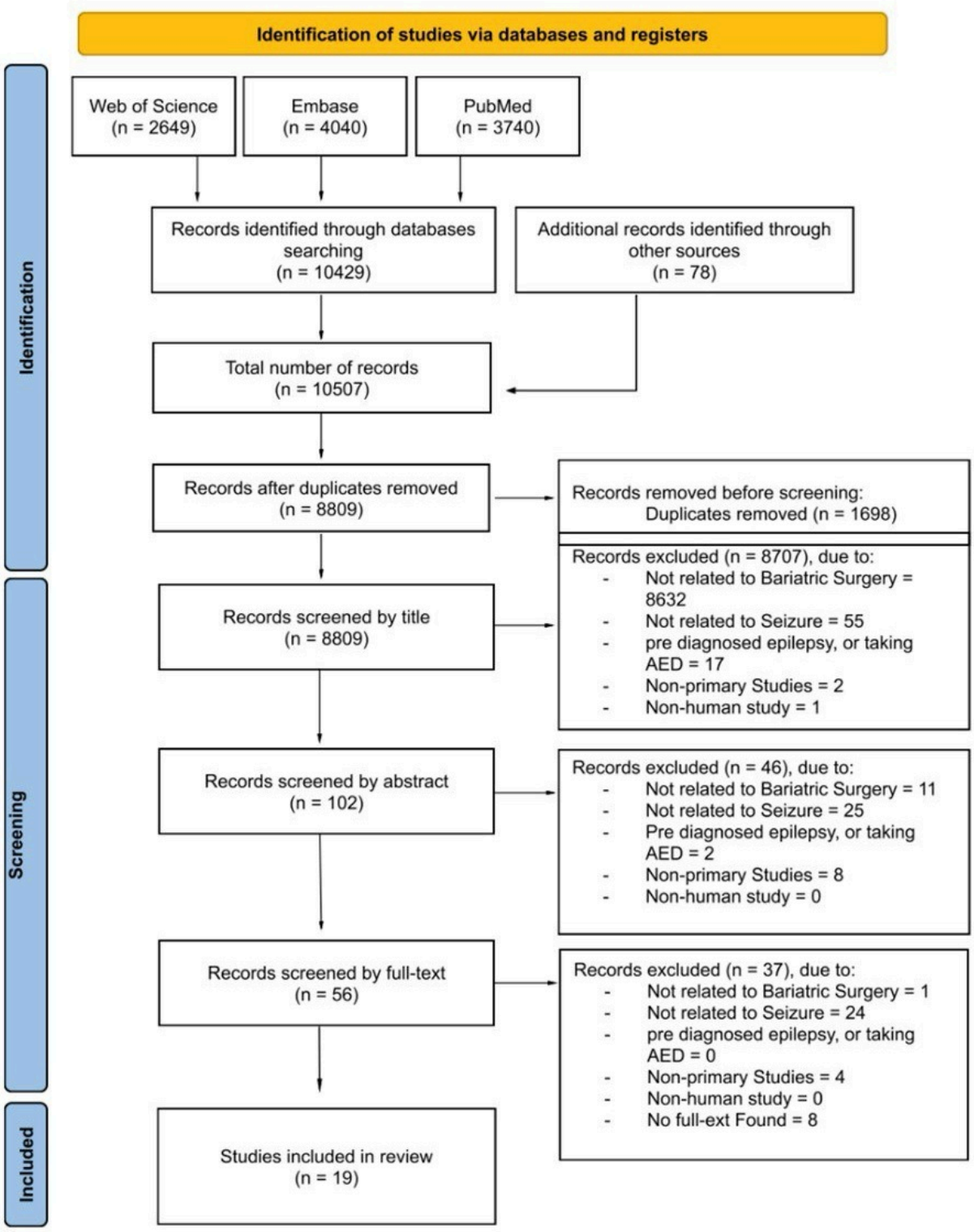


Figure 1

PRISMA flow diagram of study selection

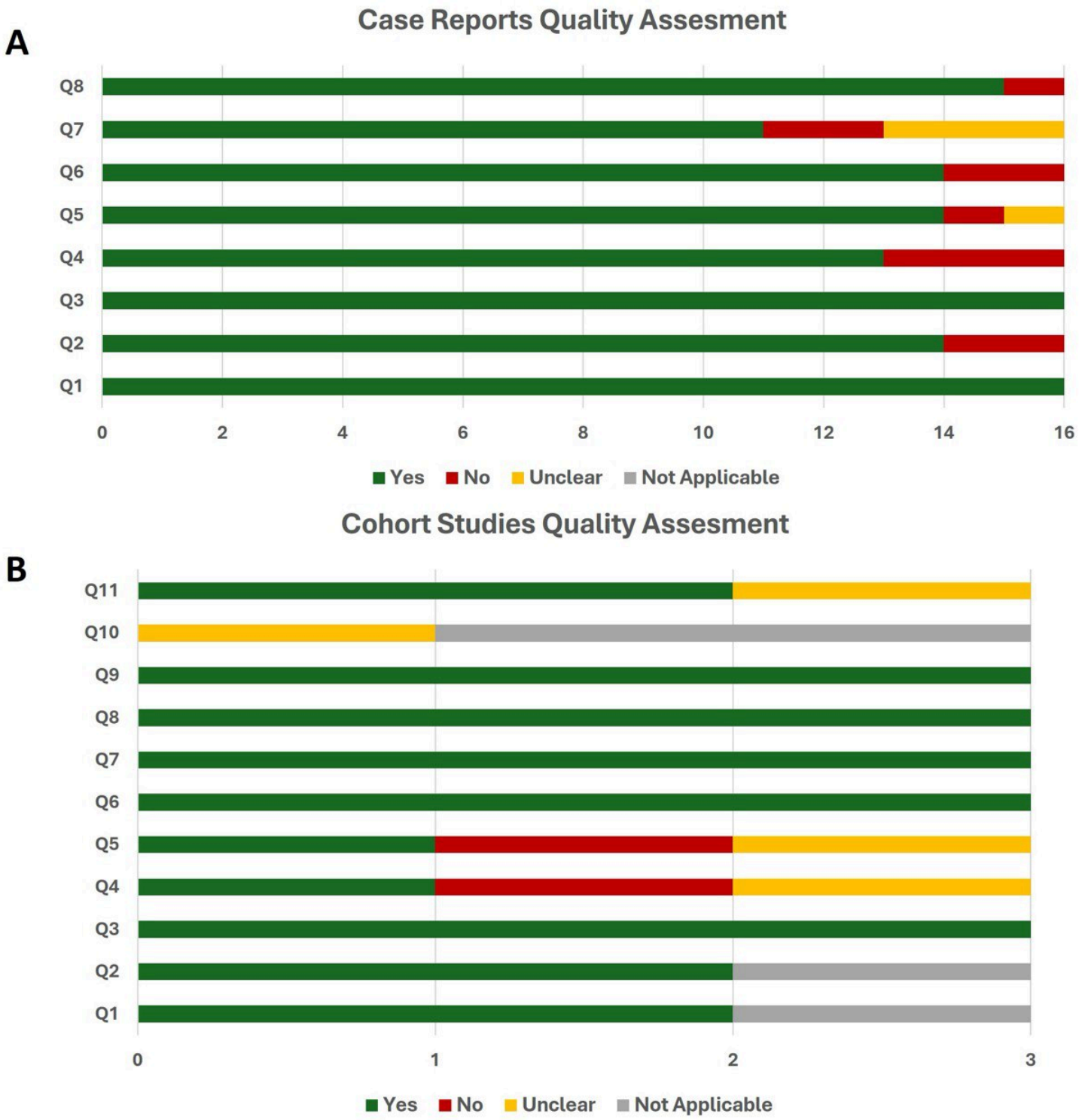


Figure 2

Risk of bias assessment for each domain for (A) Case reports, (B) Cohort studies.

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