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The prevalence of rumination syndrome and rumination disorder: A systematic review and meta-analysis

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Abstract

Background: Rumination is characterized by the repeated regurgitation of food. Rumination syndrome is a disorder of gut-brain interaction diagnosed by Rome criteria, whereas rumination disorder is a feeding and eating disorder diagnosed by DSM-5 criteria. We aimed to determine the global prevalence of rumination according to these criteria across all age groups.

Methods: We performed a systematic review and meta-analysis of studies reporting the prevalence of rumination syndrome according to Rome III and Rome IV and rumination disorder according to the following validated DSM-5 assessments: PARDI, EDA-5, EDY-Q, STEP, and STEP-CHILD. We searched MEDLINE, EMBASE, and PsychINFO (from January 1, 2006, to June 1, 2023) to identify studies reporting the prevalence of rumination in community settings in participants of any age. We did a meta-analysis to estimate the pooled prevalence and odds ratio (OR) of rumination according to diagnostic criteria, country, and characteristics such as age and sex.

Key Results: The search strategy generated 1243 studies, of which 147 studies appeared to be relevant. Thirty studies were included, with a total of 114,228 participants, of whom 61,534 of these were adults and 52,694 were children. The pooled prevalence of rumination syndrome in children of all ages according to Rome III criteria was 1.0% (95% CI 0.3–1.6; I^2 91.1%), but no data were available for adults. According to Rome IV criteria, the pooled prevalence of rumination syndrome in children of all ages was 0.4% (95% CI 0.2–0.6; I^2 56.4%) and 3.7% in adults (95% CI 2.3–5.1; I^2 91.4%). The pooled prevalence of rumination disorder in children of all ages according to EDY-Q was 2.1% (95% CI 0.9–3.4; $I^2 = 78.1\%$), but only one study utilizing EDY-Q in adults was included (0.7% [95% CI 0.4–1.0]). No data were available for children or adults using any other validated DSM-5 assessments for rumination disorder. Irrespective of diagnostic criteria, the pooled prevalence of rumination was higher in adults compared to children and adolescents (3.0% [95% CI 1.4–4.7; $I^2 = 98.1\%$] vs. 0.8% [95% CI 0.4–1.3; $I^2 = 90.8\%$]), but higher in adolescents than in children (1.1% [95% CI 0.3–2.0; $I^2 = 92.8\%$] vs. 0.1% [95% CI 0.0–0.2; $I^2 = 24.5\%$]). In adults, factors independently associated with rumination were female gender (OR 1.4 [95% CI 1.0–2.0]), anxiety (OR

2.3 [95% CI 2.1–2.6]), and depression (OR 1.8 [95% CI 1.2–2.9]). No association between gender and rumination was seen in children.

Conclusions and Inferences: The prevalence of rumination is more common in adults than in children. In adults, rumination is associated with female gender, anxiety, and depression. Future population studies should aim to better understand why this behavior is more common in adults and also compare validated DSM-5 assessments for rumination disorder with Rome criteria for rumination syndrome as prevalence may differ.

KEYWORDS
feeding and eating disorders, functional gastrointestinal disorders, prevalence, rumination disorder, rumination syndrome, systematic review

1 | INTRODUCTION

Rumination comes from the Latin "ruminare" meaning to chew the cud. In humans, rumination is characterized by effortless regurgitation of food, which typically occurs soon after meals when food has not mixed sufficiently with gastric acid. Hence, patients often re-chew the regurgitated contents. Despite this distinct presentation, rumination is often misdiagnosed as gastroesophageal reflux or vomiting. Physiologically, rumination occurs due to abdominal wall contractions, which forces gastric contents into the esophagus and mouth. This can be diagnosed objectively on high-resolution impedance manometry.[1] However, this test is invasive and not practical for assessing prevalence in epidemiological studies.

Rumination syndrome was first classified by the Rome criteria. These criteria were established to aid the diagnosis and treatment of disorders of gut-brain interaction (DGBI). Over the years, these criteria have evolved with Rome III released in 2006,[2] and then subsequently revised to Rome IV in 2016, which included the renaming of functional gastrointestinal disorders (FGID) to DGBI.[3] In 2013, rumination disorder was added to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) as a feeding and eating disorder.[4] Following this, several questionnaires and interview techniques were developed to diagnose rumination disorder and rumination behaviors including the Pica, ARFID, and Rumination Disorder Interview (PARDI), Eating Disorder Assessment 5 (EDA-5), Eating Disorders in Youth Questionnaire (EDY-Q), and Screening Tool of Eating Problems (STEP).[5]

To date, there has been no systematic review published on the pooled prevalence of rumination syndrome or rumination disorder according to Rome or DSM-5 criteria, respectively. The aim of this systematic review and meta-analysis was to determine the prevalence of rumination according to these criteria among all age groups.

Key points

- Rumination is an underrecognized behaviour related to the repeated and effortless regurgitation food.
- In this meta-analysis, rumination was found to be more common in adults than in children yet the reason for this is unclear.
- In adults, rumination is more likely to occur in females and those with depression and/or anxiety.
- There are no studies to date directly comparing the prevalence of rumination when diagnosed by DSM-5 assessments versus Rome criteria as rates may be higher with the former.

2 | MATERIALS AND METHODS

The study was registered with the international prospective register of systematic reviews database, PROSPERO, in May 2023 (CRD42023422510). The study was undertaken as part of a postgraduate project with the sponsor, Newcastle University.

We searched EMBASE (from January 01, 2006 to Jun 01, 2023), MEDLINE (from Jan 01, 2006 to Jun 01, 2023), and PsycINFO (from Jan 01, 2006 to Jun 01, 2023) to identify studies that reported the prevalence of rumination syndrome in adults and children according to Rome III or IV criteria, as well as rumination disorder in adults and children according to DSM-5 criteria that used validated interviews or questionnaires including PARDI, EDA-5, EDY-Q, STEP, and STEP-CHILD.

Since Rome III was the earliest diagnostic criteria released in 2006,[2] we limited the search strategy from this year to present. Only studies performed in a general population or community setting were included. Studies that reported the prevalence of rumination in clinical settings, such as primary care or hospitals, and convenience samples, such as individuals at health screening check-ups or university students, were ineligible for inclusion. However, studies from schools were included since school attendance is compulsory in most countries for children and may therefore be reflective of a community sample. We also excluded any study that was performed in specific conditions or disease populations.

A full search strategy can be found in the supplementary appendix (Figure S1). Briefly, we searched the medical literature using the terms "rumination syndrome" (both as medical subject headings and free text), "rumination disorder" (as free text), and "rumination behavio$r" (as free text). We combined these as a set operator. We searched "Rome 3 or Rome III" (as free text) or "Rome 4 or Rome IV" (as free text) as a combined set operator. We searched for the free text terms "functional gastro*" or "gastro* disorder" or "GI disorder" or "FGID" or "gut-brain" or "brain-gut" as a set operator. We combined this with the text terms "prevalence" or "epidemiolog*." We searched the terms "Feeding and Eating Disorders" (both as medical subject headings and free text) and "feeding problem" or "feeding disorder" or "eating disorder" (as free text). We combined these as a set operator.

No language restrictions were applied. Abstracts were exported as an EndNote library and imported into Rayyan software. Duplicates were removed within Rayyan. We did a recursive search using previously published systematic reviews on the prevalence of FGID, DGBI, or DSM-5 eating disorders. Two investigators (JH and ST) screened articles independently within Rayyan. After unblinding, disagreements were resolved by discussion with a third investigator (AH). Full articles were then further screened for inclusion.

Data were extracted independently by two investigators (JH and ST) into a Microsoft Excel Spreadsheet (Version 2307). Discrepancies were resolved with a third investigator (AH). Data collected from each study included setting, method of data collection, criteria used to diagnose rumination, country, sample size, number of participants with rumination, number of participants with rumination by age and gender, and any other risk factors reported.

We calculated the pooled prevalence of rumination using a random-effects model according to diagnostic criteria, age group, and gender. We assessed heterogeneity between studies using the I^2 statistic with a cutoff of 50% and the χ^2 test with a p value less than 0.10 to define a significant degree of heterogeneity. We compared the proportion of male and female individuals with rumination and adults and children with rumination using odds ratios (OR) with 95% CIs. Where 10 or more studies were available, we performed Egger's test to funnel plots publication bias. These were performed in RStudio (version 2023.03). All included studies were assessed independently for bias by two reviewers (JH and ST) using the Joanna Briggs Institute checklist for prevalence studies.[6]

3 | RESULTS

The search strategy generated 1243 citations. The PRISMA flow chart can be seen in Figure 1. After screening titles and abstracts, we identified 147 studies that appeared relevant. All retrieved articles

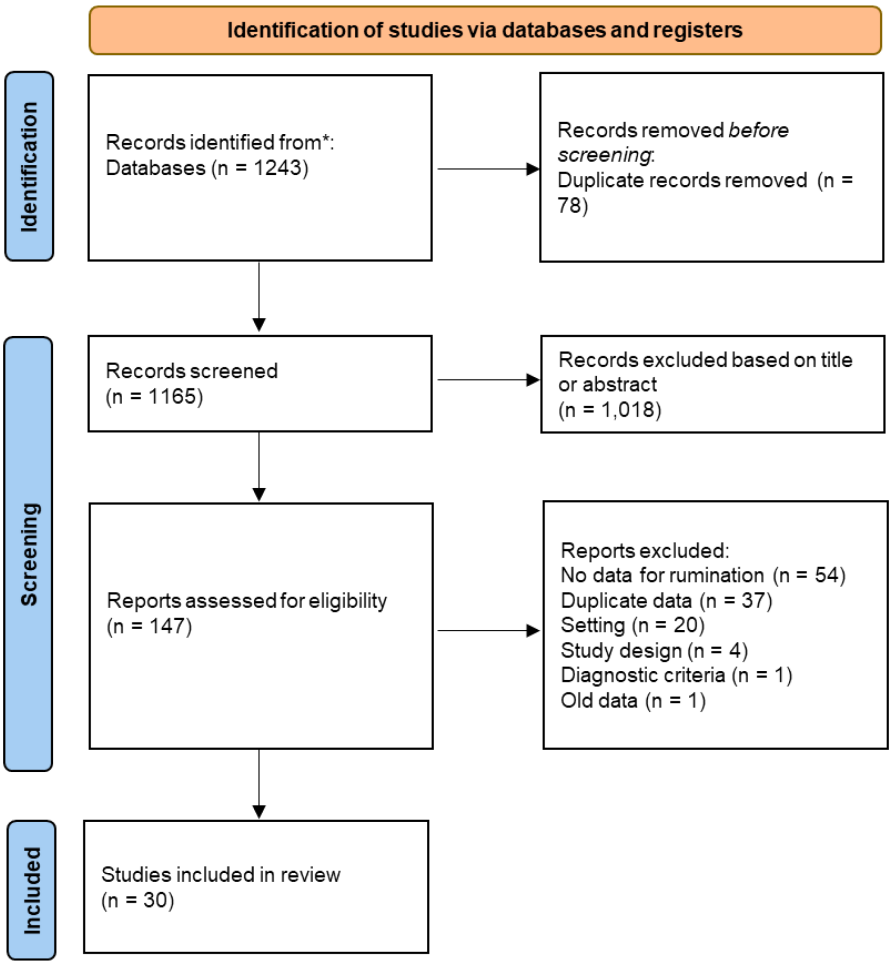

FIGURE 1 PRISMA flow diagram of study selection process.

were in English, bar one in Spanish. After screening full articles, 30 studies were included with a total of 114,228 participants.[7-36] 61,534 of these were adults from five studies, and 52,694 were children from 25 studies (Table 1). Agreement between investigators for assessment of study eligibility was very good (κ statistic 0.9).

Most studies were performed in single countries, bar one global epidemiology study across 26 countries in adults,[18] one study of adults across Great Britain,[30] one study performed in schools across different Latin American countries,[33] and two performed in schools across different Mediterranean countries.[29,31]

The pooled prevalence of rumination syndrome in all children (0–18 years) according to Rome III criteria was 1.0% (95% CI 0.3–1.6; $I^2=91.1\%$) from 18 studies.[7,8,10,11,13,14,17,19,20,22–24,26,27,29,32,33,35] There was significant heterogeneity with evidence of funnel plot asymmetry (Egger's test, $p=0.001$). The pooled prevalence of rumination syndrome in all children (0–18 years) according to Rome IV criteria was 0.4% (95% CI 0.2–0.6; $I^2=56.4\%$) from five studies.[12,25,28,31,34] There was moderate heterogeneity. The pooled prevalence of rumination syndrome in adults according to Rome IV criteria was 3.7% (95% CI 2.3–5.1; $I^2=91.4\%$) from four studies.[9,18,30,36] There was significant heterogeneity. No studies were included in adults using Rome III criteria. All pooled data for Rome III and IV by age subgroups can be found in Table 2.

The pooled prevalence of rumination disorder in children according to the EDY-Q was 2.1% (95% CI 0.9–3.4; $I^2=78.1\%$) from two studies.[15,21] There was significant heterogeneity. Only one study was performed in adults using the EDY-Q (0.7% [95% CI 0.4–1.0]).[16] No studies were included in children or adults from community settings using any other validated screening or diagnostic technique for rumination disorder (PARDI, EDA-5, STEP, or STEP-CHILD).

From the five studies in adults,[9,16,18,30,36] and 24 studies in children and adolescents (4–18 years).[7,8,10–15,17,19–29,31,33–35] the pooled prevalence of rumination was higher in adults (3.0% [95% CI 1.4–4.7; $I^2=98.1\%$] vs. 0.8% [95% CI 0.4–1.3; $I^2=90.8\%$]; Figure S2). Confidence intervals did not overlap, which indicates significance. Where data was available for children (4–10 years) from three studies[8,29,31] and adolescents (10–18 years) from 13 studies,[8,10,12–15,22,24,26,29,31,33,36] the pooled prevalence of rumination was higher in adolescents (1.1% [95% CI 0.3–2.0; $I^2=92.8\%$] vs. 0.1% [95% CI 0.0–0.2; $I^2=24.5\%$]; Figure S3). There was significant heterogeneity in studies reporting data in adolescents but not children, with plot asymmetry (Egger's test, $p=0.005$). The pooled prevalence of rumination in infants and toddlers (0–3 years) was 2.9% (95% CI 0.8–5.0; $I^2=52.3\%$) from two studies.[25,32] There was moderate heterogeneity.

Seven studies reported the prevalence of rumination according to gender in children and adolescents.[13,15,21,23,24,26,34] The pooled prevalence of rumination was no different between females and males (1.8% [95% CI 0.4–3.2; $I^2=93.3\%$] vs. 2.1% [95% CI 0.4–3.7; $I^2=93.3\%$]; OR 0.9 [95% CI 0.4–1.7]; Figure S4) with significant heterogeneity between studies (I^2 59.9%; $\chi^2=0.03$). Of the two studies that reported the proportion of individuals with rumination according to gender in adults,[18,36] the pooled prevalence of rumination was higher in females (5.1% [95% CI 1.7–8.4; $I^2=96.7\%$] vs. 3.2% [95% CI 2.2–4.3; $I^2=74.2\%$]; OR 1.4 [95% CI 1.0–2.0]; Figure S5) with significant heterogeneity between studies (I^2 76.1%; $\chi^2=0.04$). These two studies also reported independent risk factors in adults.[18,36] The pooled odds ratio for anxiety was 2.3 (95% CI 2.1–2.6; $I^2=0.0\%$; $\chi^2=0.41$; Figure S6) and depression was 1.8 (95% CI 1.2–2.9; $I^2=82.0\%$; $\chi^2=0.41$; Figure S7).

There was significant heterogeneity between studies. We used an I^2 cutoff of 50% for significant heterogeneity, but most studies in our analyses were greater than 75%, even when the same diagnostic criteria in the same age groups were applied (Table 2). Critical appraisal revealed that most studies were subject to bias (Table 3). It was unclear whether studies provided "sufficient coverage of the identified sample" because they did not report response rates from different subgroups for age and gender, which may be due to studies reporting the prevalence of different FGID or DGBI where subgroup data was only available for the overall number of FGID or DGBI rather than rumination independently. 86% of studies did not provide appropriate statistical analysis, which in all cases was due to an absence of frequencies and/or confidence intervals for prevalence data on rumination. These data are recommended for clear transparency in prevalence studies. However, proportional data was available from all included studies and translated into frequencies for the meta-analysis.

4 | DISCUSSION

This is the first systematic review and meta-analysis exclusively on the prevalence of rumination syndrome and rumination disorder. We included prevalence data for rumination syndrome according to Rome III and Rome IV criteria and rumination disorder according to EDY-Q. Interestingly, we found that, regardless of diagnostic criteria, the pooled prevalence of rumination was greater in adults at 3.0% than in children and adolescents at 0.8%. In addition, the 95% CIs around these estimates did not overlap, even when diagnosed exclusively by Rome IV criteria. It appears that the prevalence of rumination increases from childhood through adolescence and into adulthood. The reason for this is unclear, which highlights the research need to better understand these differences. Indeed, there are differences in the adult and pediatric Rome criteria for diagnosing rumination syndrome. For example, the Rome IV pediatric, but not adult, criteria includes an exclusion criterion in the presence of other medical diagnoses, such as eating disorders, which may have excluded some participants. On the other hand, Rome pediatric criteria include the repeated regurgitation of food not proceeded by retching for at least 2 months before diagnosis, which is less strict than the adult criteria of 3 months with a symptom onset of 6 months. Potentially, parentally completed questionnaires could lead to the under-reported prevalence of rumination in older children since rumination is often a private behavior.

In children and adolescents collectively, there was no difference in the pooled prevalence of rumination between genders. We were

TABLE 1 Characteristics from included studies.

Author, year	Country	Sample size	Rumination, *n* (%)	Age range, years	Criteria	Method	Setting
Agakidis 2019[7]	Greece	835	1 (0.1)	6–18	ROME III	Self-administered QPGS-RIII	Public schools
Altamimi 2020[8]	Jordan	1547	5 (0.3)	4–18	ROME III	Self-administered and Parental QPGS-RIII	Public schools
Bashashati 2023[9]	USA	197	5 (2.5)	18+	ROME IV	Self-administered RIVDQ	Community
Bhatia 2016[10]	India	1115	3 (0.3)	10–17	ROME III	Self-administered QPGS-RIII	Public school
Bouzios 2017[11]	Greece	1658	8 (0.5)	6–17	ROME III	Self-administered and Parental QPGS-RIII	Public schools
Cinquetti 2021[12]	Italy	1594	13 (0.8)	11–14	ROME IV	Self-administered and Parental QPGS-RIV	Public and private schools
Devanarayana 2011[13]	India	427	17 (4.0)	12–16	ROME III	Self-administered QPGS-RIII	Public school
Farello 2021[14]	Italy	407	11 (2.7)	10–17	ROME III	Self-administered QPGS-RIII	Public school
Hartmann 2018[15]	Germany	804	12 (1.5)	14–17	DSM-5	Self-administered and Parental EDY-Q	Community
Hartmann 2022[16]	Germany	2403	17 (0.2)	18+	DSM-5	Self-administered EDY-Q	Community
Játiva 2017[17]	Ecuador	417	3 (0.7)	8–15	ROME III	Self-administered QPGS-RIII	Public and private schools
Josefsson 2022[18]	Global[a]	54,127	1678 (3.1)	18+	ROME IV	Self-administered RIVDQ	Community
Lewis 2016[19]	USA	949	0 (0.0)	4–18	ROME III	Parental QPGS-RIII	Community
Lu 2016[20]	Panama	321	0 (0.0)	8–14	ROME III	Self-administered QPGS-RIII	Public schools
Murray 2018[21]	Switzerland	1430	40 (2.8)	7–13	DSM-5	Self-administered EDY-Q	Public schools
Nelisen 2018[22]	Argentina	483	3 (0.6)	12–18	ROME III	Self-administered QPGS-RIII	Public and private schools
Peralta 2017[23]	Colombia	864	10 (1.2)	8–17	ROME III	Self-administered QPGS-RIII	Public and private schools
Rajindrajith 2012[24]	Sri Lanka	2163	110 (5.1)	10–16	ROME III	Self-administered QPGS-RIII	Public schools
Robin 2018[25]	USA	1255	6 (0.5)	0–18	ROME IV	Parental QPGS-RIV	Community
Sagawa 2013[26]	Japan	3976	4 (0.1)	10–17	ROME III	Self-administered QPGS-RIII	Public schools
Saps 2017[27]	Colombia	4394	17 (0.4)	8–18	ROME III	Self-administered QPGS-RIII	Public and private schools
Saps 2018[28]	Colombia	3567	16 (0.4)	8–18	ROME IV	Self-administered QPGS-RIV	Public and private schools
Scarpato 2018[29]	Croatia, Greece, Israel, Italy, Jordan, Lebanon, Macedonia, Serbia, Spain	13,134	10 (0.1)	4–18	ROME III	Self-administered and Parental QPGS-RIII	Public schools
Simons 2022[30]	England, Scotland, Wales	1906	60 (3.1)	18+	ROME IV	Self-administered RIVDQ	Community
Strisguilio 2022[31]	Croatia, Greece, Israel, Italy, Macedonia, Spain	4180	11 (0.3)	4–18	ROME IV	Self-administered and Parental QPGS-RIV	Public schools
van Tillburg 2015[32]	USA	264	11 (4.2)	0–3	ROME III	Parental QPGS-RIII	Community
Velasco 2018[33]	Colombia, Ecuador, El Salvador, Mexico, Panama, Nicaragua	6193	21 (0.3)	11–18	ROME III	Self-administered and Guided QPGS-RIII	Public and private schools
Vital 2022[34]	Cuba	318	0 (0.0)	10–15	ROME IV	Self-administered QPGS-RIV	Public schools
Zablah 2015[35]	El Salvador	399	1 (0.3)	8–15	ROME III	Self-administered QPGS-RIII	Public and private schools
Zand Irani 2017[36]	USA	2901	164 (5.7)	18+	ROME IV	Self-administered QPGS-RIV	Community

[a]Argentina, Australia, Belgium, Brazil, Canada, China, Colombia, Egypt, France, Germany, Great Britain, Israel, Italy, Japan, Mexico, Netherlands, Poland, Romania, Russia, Singapore, South Africa, South Korea, Spain, Sweden, Turkey, USA.

TABLE 2 Pooled prevalence of rumination according to Rome III, Rome IV, and EDY-Q.

Rome III	Number of studies	Participants	Pooled prevalence (95% CI)	I^2	p Value for χ^2
All children (0–18 years)	18	39,546	1.0% (0.3–1.6)	91.1%	<0.0001
Infants & Toddlers (0–3 years)	1	264	4.2% (1.8–6.6)	n/a	n/a
Children (4–10 years)	2	6992	0.10% (0.0–0.5)	60.7%	0.1107
Adolescents (10–18 years)	9	22,245	1.40% (0.2–2.6)	94.5%	<0.0001
Children & Adolescents (4–18 years)	17	39,282	0.90% (0.2–1.5)	91.1%	<0.0001
Adults (≥18 years)	0	n/a	n/a	n/a	n/a
Rome IV					
All children (0–18 years)	5	10,914	0.40% (0.2–0.6)	56.4%	0.0568
Infants & Toddlers (0–3 years)	1	296	2.0% (0.4–3.6)	n/a	n/a
Children (4–10 years)	1	1840	0.5% (0.0–1.6)	n/a	n/a
Adolescents (10–18 years)	3	4252	0.4% (0.0–0.9)	70.1%	0.0354
Children & Adolescents (4–18 years)	5	10,618	0.3% (0.0–0.6)	81.2%	0.0003
Adults (≥18 years)	4	59,131	3.7% (2.3–5.1)	91.4%	<0.0001
EDY-Q					
Children & Adolescents (4–18 years)	2	2234	2.1% (0.9–3.4)	78.1%	0.0327
Adults (≥18 years)	1	2403	0.7% (0.4–1.0)	n/a	n/a

unable subgroup children and adolescents independently by gender due to a lack of available data. In adults, rumination was more prevalent in females although with the considerable limitation that only two studies were included in the subgroup meta-analysis for gender in adults. Nevertheless, previous meta-analyses in other DGBI, such as irritable bowel syndrome and functional constipation, have also identified an increased prevalence in adult females compared to males.[37,38] Rumination was also more common in adults with anxiety and depression according to meta-analysis. Therefore, patients with rumination should be screened for mood disorders, and vice versa. In infants and toddlers, the pooled prevalence of rumination was 2.9%, but a limitation was the lack of infant and toddler studies eligible for inclusion due to performance in clinical settings. Also, infant regurgitation was reported by 1 in 4 by Mother's,[32] which may be difficult to distinguish from true rumination in parentally completed questionnaires.

Our search identified no studies for inclusion that utilized the PARDI, EDA-5, STEP, or STEP-CHILD in a general population or community setting. Three studies utilized the EDY-Q to diagnose rumination disorder behavior.[15,16,21] Rumination disorder behavior is reported on a Likert scale of 0 (never true) to 6 (always true). Recurrent rumination disorder behavior was defined in all three studies by a clinical cut-off of ≥4.[15,16,21] However, a limitation of the EDY-Q is that it only includes a single item assessment of rumination ('I regurgitate food that I have already swallowed').[39] It does not consider potential exclusion criteria. The Rome criteria includes an item on the presence of retching to exclude potential vomiting disorders as well as rechewing or expelling food, which can help to distinguish rumination from gastroesophageal reflux.[2,3] These criteria assist in the exclusion of alternative diagnoses which may explain why the prevalence of rumination was higher according to the EDY-Q at 2.1% than with Rome III at 1.0% or Rome IV at 0.4% in children and adolescents. Meta-analysis by geographical area were not included due to a lack of data from regions and substantial heterogeneity.

Another limitation was the potential overlap in data from separate studies that included children aged up to 10 years with those that included adolescents from 10 years, as well as adolescents aged up to 18 years with those in adults aged 18 years. Interestingly, in the Rome IV global epidemiology study, Josefsson and colleagues reported no significant difference in the prevalence of rumination based on 10-year intervals in adults, including those aged 18–29 years compared to older adults.[18] Lastly, methods for diagnostic criteria were heterogenous including Rome III, Rome IV, and EDY-Q. However, this could also be considered a strength of the study as we were able to compare the prevalence of rumination between these criteria, including Rome III versus Rome IV and rumination syndrome versus rumination disorder. Our findings have revealed the need for further studies to directly compare validated DSM-5 assessments for rumination disorder against the Rome questionnaire for rumination syndrome in general populations. Moreover, there are several different tools for diagnosing rumination disorder, which may suggest there is no clear consensus.

5 | CONCLUSION

The prevalence of rumination appears to increase from childhood through to adulthood, but the reasoning for this is unclear, which warrants the need for future study to better understand this overall uncommon behavior. In adults, rumination is associated with female gender, but not in children. Adults with anxiety and depression are also more likely to have rumination, but there is a lack of data on the prevalence of mood disorders and rumination in children. In addition, there is a lack of prevalence data for rumination disorder

TABLE 3 Risk of bias assessment.

Author, year	1. Was the sample frame appropriate to address the target population?	2. Were study participants recruited in an appropriate way?	3. Was the sample size adequate?	4. Were the study subjects and setting described in detail?	5. Was data analysis conducted with sufficient coverage of the identified sample?	6. Were valid methods used for the identification of the condition?	7. Was the condition measured in a standard, reliable way for all participants?	8. Was there appropriate statistical analysis?	9. Was the response rate adequate, and if not, was the low response rate managed appropriately?	Total "Yes"
Agakidis 2019[7]	No	Unclear	Yes	No	Unclear	Yes	Yes	No	Yes	4
Altamimi 2020[8]	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	No	Yes	7
Bashashati 2023[9]	Yes	No	Yes	No	Unclear	Yes	Yes	No	Yes	5
Bhatia 2016[10]	No	Unclear	Yes	No	Unclear	Yes	Yes	No	Unclear	3
Bouzios 2017[11]	Yes	No	Yes	No	Unclear	Yes	Yes	Yes	Yes	6
Cinquetti 2021[12]	No	No	Yes	No	Unclear	Yes	Yes	No	Yes	4
Devanarayana 2011[13]	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	6
Farello 2021[14]	No	No	Yes	No	Yes	Yes	Yes	No	Yes	5
Hartmann 2018[15]	No	No	Yes	Yes	Unclear	Yes	Unclear	No	Unclear	3
Hartmann 2022[16]	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	No	Yes	7
Jativa 2017[17]	No	No	Yes	No	Yes	Yes	Yes	No	Yes	5
Josefsson 2022[18]	Yes	Yes	Yes	Yes	Unclear	Yes	Yes	No	Yes	7
Lewis 2016[19]	Yes	No	Yes	No	Unclear	Yes	Yes	No	Yes	5
Lu 2016[20]	Unclear	No	Yes	No	Unclear	Yes	Yes	Yes	Yes	5
Murray 2018[21]	No	Unclear	Yes	Yes	Unclear	Yes	Unclear	No	Yes	4
Nelisen 2018[22]	No	Yes	Yes	No	Unclear	Yes	Yes	No	Yes	5
Peralta 2017[23]	No	No	Yes	Yes	Unclear	Yes	Unclear	No	Yes	4
Rajindrajith 2012[24]	Yes	Yes	Yes	No	Unclear	Yes	Yes	No	Yes	6
Robin 2018[25]	Yes	No	Yes	No	Unclear	Yes	Yes	No	Yes	5
Sagawa 2013[26]	No	Yes	Yes	Yes	Unclear	Yes	Yes	No	Unclear	5
Saps 2017[27]	Yes	No	Yes	No	Unclear	Yes	Yes	No	Yes	5
Saps 2018[28]	Unclear	No	Yes	No	Unclear	Yes	Yes	No	Yes	4
Scarpato 2018[29]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	9
Simons 2022[30]	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	7
Strisguilio 2022[31]	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	8
van Tillburg 2015[32]	Yes	No	Yes	No	Unclear	Yes	Yes	No	Yes	5
Velasco 2018[33]	Yes	No	Yes	No	Yes	Yes	Yes	No	Unclear	5
Vital 2022[34]	No	No	Yes	Yes	Unclear	Yes	Yes	No	Unclear	4
Zablah 2015[35]	No	No	Yes	No	Unclear	Yes	Yes	No	Yes	4
Zand Irani 2017[36]	No	Yes	Yes	Yes	Unclear	Yes	Yes	No	Yes	6

according to DSM-5 criteria compared to Rome criteria for rumination syndrome. Future population studies should also consider the diagnostic accuracy of validated DSM-5 assessments against Rome criteria, especially where single-item assessments of rumination are used, as this may affect prevalence values.

AUTHOR CONTRIBUTIONS

JJH designed the protocol. ST and ARH revised protocol. JJH and ST reviewed studies and analysed data. JJH wrote first draft of manuscript. ST and ARH revised manuscript. All authors approved final version of the manuscript including authorship list.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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