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Current Techniques of Teaching and Learning in Bariatric Surgical Procedures

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Title: Current techniques of teaching and learning in bariatric surgical procedures: a systematic review

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Abstract

Objective: The gastric sleeve resection and gastric bypass are two of the most commonly performed bariatric procedures. This review provides an overview of current teaching and learning methods of those techniques in resident and fellow training.

Design: A database search was performed on Pubmed, Embase and the Education Resources Information Center (ERIC) to identify the methods used to provide training in bariatric surgery worldwide. After exclusion based on titles and abstracts, full texts of the selected articles were assessed. Included articles were reviewed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system.

Results: In total, 2442 titles were identified and 14 full text articles met inclusion criteria. Four publications described an ex vivo training course and six focused on at least one step of the gastric bypass procedure. Two randomized controlled trials (RCT) provided high-quality evidence on training aspects. Surgical coaching caused significant improvement of Bariatric Objective Structured Assessment of Technical Skills (BOSATS) scores (3.60 vs. 3.90, $p=0.017$) and reduction of technical errors (18 vs. 10, $p=0.003$). A pre-operative warm-up increased global rating scales (GRS) scores on depth perception ($p=0.02$), bimanual dexterity ($p=0.01$) and efficiency of movements ($p=0.03$).

Conclusion: Stepwise education, surgical coaching, warming up, Internet based knowledge modules and ex vivo training courses are effective in relation to bariatric surgical training of residents and fellows, possibly shortening their learning curves.

Introduction

Bariatric surgery is a still increasing part of the general and gastrointestinal surgeons' workload. Bariatric operations, and especially laparoscopic roux-en-y gastric bypass (LRYGB), are among the most frequently performed laparoscopic procedures.¹ As the master-apprentice system is still fostered in resident- and fellow training, a significant number of the bariatric procedures are performed with trainees, either as assistants or as first surgeons.

A national questionnaire in 251 surgical residency programs and 48 minimally invasive fellowship programs in the United States by Buchwald et al. showed that in 185 of the 251 programs bariatric surgery was performed, and in 100% of cases taught to residents.²

Numerous reports on the effects of fellow and resident participation in LRYGB are available in literature.³⁻⁷ Kim et al. reported benefits of fellowship programs for fellows, bariatric centers, and patient outcome.⁸ Negative effects, however, such as increased operating time, have also been reported.^{3,4} Steps have been made to incorporate bariatric surgery in the resident programs as in several countries including the United States, the bariatric curriculum of the Spanish Society of Bariatric Surgery and Metabolic Diseases (SECO) and the post-graduate Surgery for Obesity Registrar Training and Educational Development (SORTED) program in the United Kingdom.^{9,10} In the limited time span of surgical residency, as a result of current working hour regulations, advanced laparoscopic skills have to be mastered efficiently, without compromising patient safety.²

An email questionnaire amongst 132 residents and 59 faculty members performed by Gardner et al. shows that gaps exist in the technical competency of the residents, especially in advanced and laparoscopic cases.¹¹ Mattar et al., describing that 80% of residents are pursuing an additional fellowship to enhance their training level, observed the same problem.¹²

However, they also describe a gap between the level of the finishing resident and the required level of starting fellows, both on technical and non-technical aspects. These studies show that a critical appraisal of current teaching techniques could enhance future curriculum development.

Among advanced laparoscopic procedures, bariatric surgery takes a special place because past research has focused on the learning curve of surgeons accustomed with open bariatric procedures. Multiple combined pre-clinical and clinical training modules (i.e. weekend courses, mini fellowships) allowing bariatric surgeons to master the laparoscopic procedures are available.¹³ With the majority of bariatric cases performed laparoscopically, residents and fellows have to learn these procedures without experience in open gastric bypass and sleeve

operations. However, as these novice surgeons use laparoscopy from the start of their training, their laparoscopic learning curve may be shortened. Moreover, they can build on the pioneering work of previous surgeons, with a subsequent shorter learning curve.^{14,15} While the learning curve for gastric bypass procedures has previously been suggested to lie between 50-150 procedures to reach a standard procedure time and complication rate, the learning curve for bariatric naïve novices such as residents and fellows has not been defined.⁴

Solid clinical training of residents and fellows can improve results and reduce learning curve related complications. Training may include physical model and virtual reality simulators, animal and cadaver models, but also pre-, per- and post-operative guidance and instruction. A systematic review of Beyer-Berjot et al. on training in advanced abdominal laparoscopic surgery included 54 studies, but only five of those refer to bariatric surgery, of which three describe the laparoscopic adjustable gastric band and only two the LRYGB.¹⁶ Therefore evidence on the training of the gastric bypass and gastric sleeve is still lacking.

This systematic review provides an overview of current teaching methods of the most common bariatric procedures, the laparoscopic roux-en-y gastric bypass (LRYGB) and gastric sleeve resection (LGS), to residents and fellows.

Methods

A systematic review was performed using medical databases PubMed-Medline, Embase and the Education Resources Information Center (ERIC). Searches were dated November 1st 2015. A broad search was performed in PubMed and Embase using the Mesh terms Bariatric Surgery, Medical Education and Learning and related text words. For ERIC, the keywords 'bariatric surgery', 'gastric bypass' and 'gastric sleeve' were used. Duplicates were removed by matching titles and authors.

Exclusion criteria

By means of a predefined list titles referring to robotic surgery, laparo-endoscopic single-site surgery (LESS) or single incision laparoscopic surgery (SILS), biliopancreatic diversion and laparoscopic adjustable gastric banding were excluded. Studies focusing on obesity related co-morbidity like obstructive sleep apnoe, hernia and pancreatitis, and other subjects not related to primary bariatric surgery such as dermatology, cosmetic and plastic surgery were also eliminated. As the search criteria included 'training' and 'exercise' studies focusing on patient training and patient exercise and, moreover, diet and nutrition were removed.

Inclusion criteria

Two independent reviewers (M.A.K. and G.H.v.R.) independently selected titles. Only abstracts describing resident or fellow learning were selected, excluding studies solely describing learning curves or education of fully trained surgeons. Next, full text peer reviewed articles were included if selected by one or both reviewers. Both reviewers fully and independently assessed the selected full texts. In case of disagreement, articles were discussed until consensus was reached.

Data extraction

The final selection was analyzed for type of procedure, laparoscopic experience, education level and types of tests. Outcomes included operation times and complications. Study quality was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) system.¹⁷

Results

Article selection

In total, 2442 titles were identified in the search. A number of 388 duplicates were removed. Based on previously described exclusion criteria 486 titles were excluded, and another 1292 were considered irrelevant. Sixty-two of 276 remaining titles were selected based on abstract. Eighteen of those were not published as a full text peer reviewed article. Fourteen out of these 44 articles were included in this systematic review after full text assessment. The selection process is displayed in Figure 1.

Level of evidence

Two randomized controlled studies, one systematic review, nine cohort or retrospective series and two surveys were included [Table A]. Study populations varied between 5-272 subjects. Eight of fourteen studies focused on residents only, others also included fellows or surgeons. Most studies concentrated on LRYGB procedures, three studies included the LGS. One study of Azer et al. solely focused on knowledge acquisition of surgical residents on the topic of bariatric surgery through an online platform.¹⁸ Four publications (28%) described an ex vivo training course for residents and surgeons.¹⁹⁻²²

Three authors (21%) divided the gastric bypass procedure into three steps (creating the pouch, gastro-enterostomy, entero-enterostomy) and taught residents one step at a time.^{6,23,24} Three other studies described the education of a single step only (entero-enterostomy) or aimed their study at training of a single step.^{20,25,26}

Quality grading of reports

The quality grading of reports is displayed in Table A. For a full overview a risk of bias assessment is included in appendix A. Most included studies were small and retrospective. Using the GRADE system, two randomized controlled trials (RCT) were graded as 'high', with arguments to upgrade the grade for one RCT. Two studies provided moderate evidence. The remaining twelve publications provide low (n=6) or very low (n=4) graded evidence. Due to the heterogeneity between the studies, reflected for instance in operating times and types of interventions, statistic comparison or pooling of data was not possible.

Training level and assessment

Most studies applied to senior surgical residents (postgraduate year 3-5). Trainees' experience in minimal invasive surgery (MIS) was described in detail by Bonrath et al. and Iordens et al..^{23,26} The Global Ratings Scales, Objective Structured Assessment of Technical Skills (OSATS), Bariatric OSATS (BOSATS) and error counts were used for evaluation of the effects of various interventions.^{20,26,27} The resident and fellow education remarks are summarized in Table B.

Effects on surgical outcome

Seven publications that included information on the effects of resident participation on surgical outcome are summarized in Table C. The average difference in operation time is a decrease of 9.6 minutes (range -93 to +40 minutes). After exclusion of studies that showed decreased operating room (OR) times due to simplification of the operative procedure²⁸, or severe inclusion bias²⁴, OR time was increased by 29.3 minutes (range +13 to +40 minutes). Two studies described no difference in complication rates. Davis et al. described increased morbidity and return to operating room rates.⁵ Martin et al. found an overall decrease of early complications from 15 to 5% and a significant decrease in anastomotic strictures using a simplified technique.²⁸ Fanous et al. reported increased rates of acute renal failure from 0% to 0.82% (p=0.047).⁶ This study found a non-significant effect on excess weight loss (64% vs. 66%). Harrington et al., who reported on the effects of in vivo training of the entero-enterostomy, found increased costs of \$1457 per anastomosis (mean duration 93.5 minutes).²⁵

In vivo training interventions

Four studies described in vivo training interventions: a coaching program²⁶; a pre-operative warm-up²⁷; and stepwise-education.^{23,24}

Bonrath et al. performed a RCT on the effect of surgical coaching.²⁶ Their study focuses on the creation of the jejuno-jenunostomy as part of a laparoscopic RYGB. The study group of 18 participants was randomized between standard intra-operative coaching and standard coaching combined with 'comprehensive surgical coaching', i.e. extra-operative video playback with self-reflection and feedback from a trained surgeon. This led to significant improvements in post training Bariatric Objective Structured Assessment of Technical Skills (BOSATS) scores (3.60 in control group versus 3.90 in the intervention group, p=0.017) and reduction of technical errors (18 in control group versus 10 in the intervention group, p=0.003). The intervention group also showed significant improvement of the standard

Objective Structured Assessment of Technical Skills (OSATS), BOSATS and technical errors from their baseline to post training measurements (all $p=0.008$). The coaching sessions (33 of 40 sessions recorded) took a median time of 25 (23-28) minutes, and 53 minutes of assessment of the procedures, video editing and defining learning curves. All the participants in the intervention group found the coaching very useful.

Moran-Atkin et al. also performed a RCT studying the effect of a pre-operative warm-up on performance of residents and fellows on laparoscopic procedures including LGS and LRYGB expressed in global rating scales (GRS) scores. Significant enhanced performance was noted on depth perception ($p=0.02$), bimanual dexterity ($p=0.01$) and efficiency of movements ($p=0.03$).²⁷

In a Dutch study Iordens et al. described their technique to teach residents a LRYGB.²³ Over a 4-year period, a resident performed the last operation of a day dedicated to bypass surgery; in the other procedures the resident was first assistant. Noted is that all five were postgraduate year (PGY) 5-6 residents with specific interest in advanced laparoscopic procedures. The residents learned the procedure step-by-step. In this way, resident operated on total number of 83 patients. This resulted in a slight but significant increase in operating times from 116 min to 129 minutes ($p<0.001$). Complication rates of 18% in the control group vs. 22% in the group operated by residents did not differ significantly ($p=0.455$). The study of Rovito et al. showed a similar design.²⁴ The five PGY 5 students in this group performed at least 12 procedures each. The attending surgeons' surgical time was 213 minutes, the residents' mean 170 minutes. In both groups two leaks occurred.

Pre-operative interventions

Five studies focused on intervention in the training before the operative theater, one group changed the operative procedure to facilitate training and shorten the learning curve.

Azer et al. implemented an internet-based knowledge module on bariatric surgery to their general surgery curriculum.¹⁸ The largest effect was found in a subgroup analysis of residents who completed a bariatric rotation before the study period. Zevin et al. identified the available simulation-based training programs in addition to re-examining the learning curve of roux-y gastric bypass.²¹ They also proposed a five-step mostly ex-vivo bariatric surgery training curriculum, consisting of knowledge-based learning, a procedural task analysis, training in a laboratory environment before the last two steps, transfer skills to the operating room and granting privileges.

The studies of Leandros et al., Varas et al. and Zimmerman et al. described advanced laparoscopic training courses focused on bariatric procedures.^{19,20,22} These wet lab and box trainer studies concluded the LRYGB and LGS, or steps of the procedures, can be trained ex vivo before transferring skills to the operating theater even to PGY1 residents.

In 2007, Harrington et al. performed a time-cost analysis on the LRYGB procedural step of the laparoscopic entero-enterostomy.²⁵ Their results showed that it would cost around \$45,000 to give fifteen senior residents the opportunity to perform two anastomoses. Part of their calculation was the educational time, and the extra 43 minutes operation time residents needed compared to surgeons.

Martin et al. reduced the learning curve by simplification and standardization of the operative technique, introducing a linear stapled anastomosis. In this study, PGY 2-5 residents performed 140 LRYGB surgeries. The average operating time was 116 minutes. A survey between the surgeons and residents showed the new technique to be faster and simpler, and easier to teach.²⁸

Discussion

This systematic review is the first to focus on education of bariatric surgical procedures. Fourteen studies describing training aspects of the LRYGB and LGS were included. With the use of the educational database ERIC, it was attempted to include studies from an educational point of view; however, none of the search hits were suitable for inclusion. We will next assess the systematic review process, summarize the data on training and effect on patient outcomes and propose how to implement these outcomes.

A variety of methods to perform a systematic review are available. In this study the GRADE technique was used because this system is suitable for both studies with a high and low level of evidence and both RCT's and local initiatives were expected.¹⁷ This system not only assigns grades to the type of evidence but also offers clear guidelines for altering this grade with a down- or upgrade for the quality of this study. For healthcare education literature STORIES (Structured approach to the Reporting In healthcare education of EvidenceSynthesis) is available, but this system is less suitable when also reporting on patient outcome data.²⁹ The results of this review should however be interpreted with care as only two studies provided a high level of evidence.

Bonrath et al. studied the effect of surgical coaching on the performance of residents.²⁶ This well designed but small RCT showed that additional extra-operative coaching based on video fragments significantly improved BOSATS scores and reduced technical errors. Their intervention added structured and guided self-assessments. The positive effects of this self-assessment technique continued to show after 2-months follow up. Although the coaching was a time-investment for both coach and residents, all participants concluded coaching should be a part of resident training. Whether a surgeon or educationalist should do the coaching remains unclear.

Moran-Atkin et al. studied the effect of a pre-operative ex-vivo warm-up by residents before entering the operating theater to perform laparoscopic surgery.²⁷ Significant improvements in depth perception and dexterity were found in residents who performed laparoscopic cases, including laparoscopic sleeve resection and LRYGB. Due to the small RCT the results cannot be specified for the bariatric procedures, but the overall effect is noted. These two high-quality studies showed that training programs should not only focus on the operating room, but also on what happens before and after surgery. Warming up could be a way to make training more efficient. Adequate debriefing and the specification of goals before training could shorten the learning curve.

Several attempts have been described to ease the mastering of bariatric surgery and reduce the learning curve. Two retrospective series of Iordens et al. and Rovito et al. studied the concept of dividing the procedure up into different steps.^{23,24} The residents performed the first of three fundamental steps of the procedure (entero-enterostomy, pouch creation and gastro-enterostomy). After mastery of the first step, the next step was trained. Both groups did not report effects of their methods on test scores or other performance indicators.

The relatively short operation times in the group of Iordens et al. may be influenced by the different six-year Dutch surgical curriculum. The Dutch residents all had over 100 cases of minimal invasive surgery experience as primary surgeon and had attended basic laparoscopic and suturing courses. The generalizability of this single center study is hampered by its retrospective design. The results of the Rovito series have to be interpreted with care as the mean operative time of 213 minutes by the attending surgeon, and 170 minutes by the trainees, suggest a severe selection bias. The results of the surgeon were collected earlier in the learning curve and may be a reflection of more difficult operations by the attending, as they reported on a significant number of patients with a BMI > 50 in this group.

Currently, no published expertise exists on the actual training method of these steps for bariatric procedures, like the Intraoperative Video ENhanced Surgical Training (INVEST) as proposed by van Det et al. for laparoscopic cholecystectomies.³⁰ Our results suggest that dividing the operations into smaller steps however, may be one of many ways to enhance resident teaching.

One of the fundamental steps in surgical training is knowledge gathering. Azer et al. successfully implemented an internet-based knowledge module.¹⁸ As the largest effect was found in a subgroup analysis of residents who completed a bariatric rotation before their study, it can be hypothesized that participating in surgeries and acquiring knowledge could best be combined. Next to knowledge gaining, preoperative ex vivo training was studied in several studies. The use of a wet lab and box trainer at some point in the training appears to be a useful instrument.^{19–22} The presented systematic review did not show any specific animal model training.

The importance of training of residents and fellows must be considered in respect to the possible side effects on patient outcomes such as surgical site infections (SSI) and venous thromboembolic events (VTE).³¹ Single studies as performed by Davis et al. did not show these effects.⁵ Due to the heterogeneity of the reviewed studies, our data could not be pooled to provide additional evidence on this subject.

A small study of Harrington et al. reported on the costs of intra-operative resident training.²⁵ The reported operation times may not reflect current standard techniques, however, the calculation of the additional costs of training may still be valid and these should also be considered.

Further research could lead to development of training programs leading to sufficient expertise in laparoscopic bariatric surgery after completion of surgical rotations or a specific fellowship, which may result in granting of bariatric privileges.

The ideal curriculum focusing on technical skill training in bariatric surgery should include the components studied in this review. Assuming basic laparoscopic skills are mastered, training starts with some sort of procedural specific ex vivo training. This could either be virtual reality training, box trainers or cadaveric models or a combination of those. In vivo training procedures should be done after a warming up and may benefit from a stepwise approach. Surgical coaching will enhance the learning experience, for instance by recording

the procedures and obtain feedback not only from the attending surgeon but also from an independent coach who supervises the whole training process.

After such a specified training program for residents, the gap in expertise before entering a fellowship should be filled and the next step could be a minimal invasive surgery (MIS) or bariatric fellowship as proposed by Schirmer.³²

Conclusion

This systematic review of the literature concludes the evidence on the training methods used to teach surgical residents and fellows bariatric surgeries is limited. However, there is some high quality evidence that should enhance further training initiatives.

In our opinion, an ideal surgical residency or fellowship includes knowledge acquisition and efficient technical training. A structured fellowship program or resident program, including warming up and surgical coaching is likely to be more effective than separate ex vivo courses only.

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Table A – GRADE assessment of included studies

Study	Year of publication	Type of trial	Region	N. of participants	N. of procedures	GRADE	Up- or down grading	Reason for adjustment
Azer et al ¹⁸	2013	Cohort	USA	12	-	Very low	Downgrade	High risk of bias *
Bonrath et al ²⁶	2015	RCT	Canada	18	-	High	Upgrade	Large effects
Buchwald et al ²	2006	Survey	USA	251	-	Low	No downgrade	100% response
Davis et al ⁵	2013	Retro-spective	USA	N/A	6133	Low	No upgrade	Extent of resident involvement not reported
Fanous et al ⁶	2012	Cohort	USA	18	711	Very low	Downgrade	Selection bias. * Extent of role of senior residents unclear
Harrington et al ²⁵	2007	Cohort	USA	12	23	Low	No upgrade	Small sample size, short observation period, no long term follow-up. Yet prospective work
Iordens et al ²³	2012	Retro-spective	Europe	5	83	Low	No upgrade	Retrospective study, small sample size
Leandros et al ¹⁹	2009	Survey	Europe	73	-	Low	No upgrade	Effects not that large
Martin et al ²⁸	2010	Cohort	USA	Unclear	140	Very low	No upgrade	Small sample size, prospective database
Moran-Atkin et al ²⁷	2014	RCT	USA	20	40	High	No upgrade	Risk of attrition bias
Rovito et al ²⁴	2005	Retro-spective	USA	5	200	Very low	Downgrade	Unclear resident learning curve, small sample size
Varas et al ²⁰	2012	Cohort	Chili	25	-	Moderate	Upgrade	Large effect
Zevin et al ²¹	2012	Syst. Review	Global	N/A	-	Moderate	No upgrade	Good review, but no grading of mostly retrospective articles
Zimmerman et al ²²	2010	Cohort	USA	36	-	Low	No upgrade	Effects not that large

RCT randomized controlled trial, *RYGB* roux-and-y gastric bypass. *N/A* not applicable

* risk of bias assessed in table 3

Table B – Study populations and teaching methods [#Reviewers: Altered]

Study	Procedures	Target	Teaching method	MIS experience	Tests
Azer et al ¹⁸	None	Resident	Online information platform	PGY 1-2 vs 3-5	Knowledge tests
Bonrath et al ²⁶	LRYGB	Combination	Coaching during entero-enterostomy vs no coaching	PGY 3-5 MIS experience 0-50 *	BOSATS OSATS error count
Buchwald et al ²	LRYGB	Combination	N/A	N/A	N/A
Davis et al ⁵	LRYGB	Combination	N/A	PGY 1-2 vs 3-5 and fellows	-
Fanous et al ⁶	LRYGB	Resident	Whole procedure in vivo	SSR	-
Harrington et al ²⁵	LRYGB	Resident	Stepwise education in vivo of entero-enterostomy	PGY 3-5	-
Iordens et al ²³	LRYGB	Resident	Stepwise education in vivo of gastric bypass in three steps	PGY 5-6 ** MIS experience>100	-
Leandros et al ¹⁹	LGS	Combination	Ex vivo training course	Noted for surgeons	-
Martin et al ²⁸	LRYGB	Resident	Whole procedure simplified RYGB	PGY 2-5	-
Moran-Atkin et al ²⁷	LRYGB and LGS	Combination	Warm-up vs. no warm-up	PGY 1-3 vs 4-5	GRS
Rovito et al ²⁴	LRYGB	Resident	Stepwise education in vivo of gastric bypass in three steps	PGY 5	-
Varas et al ²⁰	LRYGB	Resident	Stepwise education ex vivo of the entero-enterostomy	PGY 1	GRS
Zevin et al ²¹	LRYGB	Combination	Ex vivo training course	N/A	-
Zimmerman et al ²²	LGS	Resident	Ex vivo training course	PGY 1-5	-

* As primary surgeon

** The Dutch curriculum spans 6 years

LRYGB laparoscopic Roux-en-Y gastric bypass, *MIS* minimal invasive surgery, *PGY* post-graduate year, *(B)OSATS* (Bariatric) Objective Structured Assessment of Technical Skills, *GRS* Global Rating Scale

Table C – Effects on patient outcomes and costs

Study	OR time	Early complications	Late complications	Surgical outcome	Costs
Davis et al ⁵	Increased 107 to 142 min	Increased morbidity 4 to 5.2 %. Increased return to OR 2.6 to 2.7%	No differences	-	-
Fanous et al ⁶	Increased 128 to 168 min	No difference	Increased acute renal failure 0 to 0.82%	Non significant 66 vs 64 % EWL	-
Harrington et al ²⁵	Increased 50 tot 93.5 min *	-	-	-	\$1457 per anastomosis
Iordens et al ²³	Increased 116 to 129 min	No difference	-	-	-
Martin et al ²⁸	Decreased 209 to 116 min	Decreased 15 to 5%	Decreased strictures 10% to 3.6 %	-	-
Rovito et al ²⁴	Decreased 213 to 170 min	No differences	No differences	-	-
Varas et al ²⁰	Increased 12 to 18.5-43.5 min*	N/A	N/A	N/A	-

* study aimed to single step
OR operating room

Appendix A – Risk of bias assessment

Study	Selection Clear inclusion criteria	Selection Random sequence allocation done	Selection Analyzed in defined group	Performance Rule out concurrent intervention	Attrition Small loss to follow up	Detection Definition of outcomes stated	Detection Blinding of assessor	Reporting Reporting of all specified outcomes
Azer et al ¹⁸	Yes	N/A	Yes	No	No	Yes	Yes	Yes
Bonrath et al ²⁶	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Buchwald et al ²	Yes	N/A	Yes	N/A	Yes	N/A	N/A	Yes
Davis et al ⁵	Yes	N/A	Yes	No	Unclear	Yes	Yes	Yes
Fanous et al ⁶	No	No	Yes	Yes	Yes	Yes	Yes	Unclear
Harrington et al ²⁵	No	No	Yes	N/A	Yes	Yes	No	Yes
Iordens et al ²³	Yes	No	Yes	Yes	Yes	yes	No	Yes
Leandros et al ¹⁹	Yes	N/A	Yes	Yes	Unclear	Yes	Yes	Yes
Martin et al ²⁸	Yes	Yes	Yes	No	Yes	No	No	Yes
Moran-Atkin et al ²⁷	Yes	Yes	Yes	No	No	Yes	Yes	Unclear
Rovito et al ²⁴	No	No	Yes	No	Unclear	Unclear	No	Unclear
Varas et al ²⁰	Yes	No	Yes	No	Yes	yes	No	Yes
Zevin et al ²¹	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Zimmerman et al ²²	Yes	N/A	Yes	Yes	Unclear	yes	Yes	Yes

N/A Not applicable