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# Disordered eating and eating disorders among women seeking fertility treatment: A systematic review

Leah M. Hecht<sup>1</sup> · Ashley Hadwiger<sup>2</sup> · Shivali Patel<sup>2</sup> · Bryan R. Hecht<sup>3</sup> · Amy Loree<sup>1</sup> · Brian K. Ahmedani<sup>1,2</sup> · Lisa R. Miller-Matero<sup>1,2</sup>

Received: 21 March 2021 / Accepted: 14 June 2021

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## Abstract

The purpose of this systematic review is to evaluate the prevalence of disordered eating and eating disorders among women seeking fertility treatment.

Observational studies were searched in Ovid MEDLINE, Web of Science, Embase, and PsycInfo. Studies published prior to September 2020 when the search was conducted were considered. Inclusion criteria included (1) original and empirical research, (2) published in a peer-reviewed journal, and (3) reported on disordered eating among women seeking fertility treatment in the sample or reported on prevalence of eating disorders among women seeking fertility treatment in the sample. Independent screening of abstracts was conducted by two authors (LH and AH). Ten studies met the inclusion criteria. Sample size, study location, measures, and results for each study in this review were reported.

Among women pursuing fertility treatment, rates of current eating disorders ranged from 0.5 to 16.7%, while past eating disorder prevalence rates ranged from 1.4 to 27.5%. Current anorexia nervosa or bulimia nervosa was reported by up to 2% and 10.3% of women, respectively, while history of anorexia nervosa or bulimia nervosa was reported by up to 8.5% and 3.3% of women, respectively. Binge eating disorder or other eating disorders were reported by up to 18.5% and 9.1% of women, respectively. Disordered eating pathology was endorsed by 1.6 to 48% of women seeking fertility treatment. Endorsement of pathological eating attitudes was generally higher among women seeking fertility treatment with current or past eating disorders as compared to community samples, with the exception of dietary restraint. Rates of current and past eating disorders are higher among women seeking fertility treatment than in the general population. Providers treating women with infertility should be cognizant of these prevalence rates and consider screening for eating pathology in their patients as this may contribute to their likelihood of successful conception and/or subsequent pregnancy outcomes.

**Keywords** Disordered eating · Eating disorders · Eating pathology · Fertility treatment

## Introduction

Infertility, the inability to conceive after 12 months of unprotected sexual intercourse, affects up to 12% of couples globally (Vander Borgh and Wyns 2018). The etiology of infertility includes male factors (26–30%), ovulatory dysfunction (21–25%), tubal factors (14–20%), uterine, cervical, or peritoneal abnormalities (10–13%), a combination of the aforementioned factors (40%), or is unexplained (25–28%) (Lindsay and Vitrikas 2015). A woman's fertility is affected by biological factors, including age and body mass index (BMI); medical illnesses such as polycystic ovarian syndrome, endometriosis, and uterine fibroids; and behavioral factors, including tobacco use and alcohol consumption (Cunningham 2017; Lindsay and Vitrikas 2015; Vander Borgh and Wyns 2018).

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Many studies have examined the impact of eating disorder pathology on fertility and pregnancy. Importantly, disordered eating and eating disorders are implicated in hypothalamic-pituitary–gonadal (HPG) axis dysfunction, resulting in oligomenorrhea, amenorrhea, and ovulatory dysfunction (Boutari et al. 2020; Cousins et al. 2015; Warren 2011). Moreover, women with eating disorders have been reported to have lower parity and experience childbirth at an older age (Tabler et al. 2018). Of the women with an eating disorder who do become pregnant, there are increased risks for complications, including caesarean section, premature birth, miscarriage, intrauterine growth restriction, large for gestational age babies, maternal hypertension, prolonged duration of first and second stages of labor, and antepartum hemorrhage (Arnold et al. 2019). Additionally, disordered eating increases the risk of abnormal infant birth weight and results in lower APGAR scores at 1 min (Chan et al. 2019).

A recent systematic review highlighted that eating disorders in the general population are on the rise (Galmiche et al. 2019). The lifetime prevalence of eating disorders in women by age 40 is 19.7% (Ward et al. 2019). Moreover, up to 95% of eating disorders are reported to emerge by age 25 (Ward et al. 2019). The most recognized eating disorders include anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED), with prevalence rates of 1.4%, 1.9%, and 2.8%, respectively, among women (Galmiche et al. 2019). AN is characterized by restriction of energy intake leading to a significantly low body weight, intense fear of gaining weight or becoming fat, and a disturbance in one's own perception of their body shape or weight (Diagnostic and Statistical Manual of Mental Disorders 2013). Subtypes of AN include restricting type or binge eating/purging type; and severity is categorized by BMI, ranging from mild to extreme. BN is defined by recurrent episodes of binge eating, which are characterized by eating a substantially larger amount of food in a discrete period than what most individuals would eat and a sense of lack of control over eating during the episode, associated with recurrent inappropriate compensatory behaviors such as self-induced vomiting, laxative or diuretic abuse, fasting, or excessive exercise (Diagnostic and Statistical Manual of Mental Disorders 2013). Compensatory behaviors occur at least once weekly for 3 months; and the severity of BN is categorized by frequency of compensatory behavior episodes occurring per week. BED is characterized by recurrent episodes of binge eating occurring at least once weekly for 3 months without associated compensatory behaviors (Diagnostic and Statistical Manual of Mental Disorders 2013). Binge eating episodes lead to marked distress and are associated with physical, cognitive, and emotional sequelae. The severity of binge eating is based on the frequency of binge eating episodes per week.

It has been proposed that disordered eating exists on a continuum, ranging from a healthy body image and energy balance to the aforementioned eating disorders (Baechle et al. 2014;

Sundgot-Borgen and Torstveit 2010). Disordered eating behaviors include similar symptoms as eating disorders (i.e., purging behaviors, binge eating episodes, and food restriction); however, they do not meet full criteria for an eating disorder diagnosis (Pereira and Alvarenga 2007). For example, an individual who engages in binge eating behavior less than weekly would not be diagnosed with binge eating disorder but would be exhibiting disordered eating pathology. While a subset of women meets diagnostic criteria for an eating disorder, there is a larger number of women who exhibit disordered eating pathology but who may not meet the threshold for the diagnosis (Reba-Harrelson et al. 2009; Smink et al. 2012). Furthermore, the prevalence rates of diagnosed eating disorders are much lower than the prevalence rates of disordered eating in Western countries (0.4–13% versus 8.3–26%, respectively) (Makino et al. 2004).

Thus, with the growing prevalence of eating disorders, and the potential impact on pregnancy outcomes, it is essential that we understand the frequency with which eating pathology presents in women undergoing fertility treatments. For those women with eating disorder pathologies who are unable to conceive, ovulation induction and/or assisted reproductive technologies (ART) may be employed. As undergoing infertility treatments can be stressful, there is increased risk for eating disorder relapse (Grilo et al. 2012). Side effects of ART treatment, including bloating and abdominal discomfort in the case of in vitro fertilization (IVF), also have the potential to exacerbate eating pathology (Suthersan et al. 2011). Additionally, given the link between obesity and spontaneous abortion, women may be advised to lose weight prior to conception (whether or not they are undergoing IVF), which may promote disordered eating (Cavalcante et al. 2019; Fedorcsák et al. 2000).

## Objective

The purpose of the systematic review is to examine the prevalence rates of disordered eating and eating disorders among women seeking infertility treatment. Conducting this review will provide a more generalizable understanding of the prevalence rates among this specialized subpopulation.

## Methods

### Eligibility criteria, information sources, search strategy

Guidelines of the Preferred Reported Items for Systematic Reviews and Meta-Analyses (PRISMA) were followed for this systematic review (Moher et al. 2009). Electronic searches of literature in MEDLINE, Embase, Web of Science, and PsycInfo were conducted in September 2020. The search was restricted to studies published in English and

excluded animal studies. There were no date restrictions imposed. Searches were modified according to database-specific requirements, including the use of customized keywords, Boolean operators, controlled vocabulary, and truncation, as described in the Cochrane Handbook (Higgins et al. 2019). Appendix 1 includes the search terms for each of the databases and the number of retrieving results.

## Study selection, data extraction, and data synthesis

Differentiation was made as to whether the study focused on eating disorders (e.g., diagnosed according to the International Classification of Diseases or the Diagnostic and Statistical Manual of Mental Disorders (Diagnostic and Statistical Manual of Mental Disorders 2013) criteria) or disordered eating (e.g., eating pathology not diagnosed according to clinical criteria). After obtaining the articles, the references were reviewed to see if any additional articles should be included. Independent screening of abstracts was conducted by two authors (LH and AH). In order to be included, the study must have been (1) original and empirical research, (2) published in a peer-reviewed journal, and (3) reported on disordered eating among women seeking fertility treatment in the sample or reported on prevalence of eating disorders among women seeking fertility treatment in the sample. Conference presentations were excluded, although when a conference presentation was identified, attempts were made to inquire with the first author of the work to see whether it was subsequently published. Unpublished dissertations were also excluded. Manuscripts which focused on hospitalizations due to eating disorders were not included as this represents a skewed sample of individuals with very high levels of pathology and the goal of this manuscript was to obtain a representative estimate of eating pathology among those undergoing fertility treatment. In cases where conflicts regarding whether to include or exclude articles arose, the authors discussed until consensus was reached or had a third rater as the tie-breaker (LMM). When publications from the same author were reviewed, the corresponding author was contacted to ascertain whether participants were included in multiple samples. In one case in which the same participants were included in more than one study, the article that most closely aligned with our variables of interest (e.g., article focus was on eating pathology) was retained for inclusion while the other article was excluded.

## Results

### Study selection

A total of 194 articles were derived from the initial search, of which 54 were duplicates. Two additional articles were found

from reviewing the reference sections of existing articles. Initial screening excluded 116 records, primarily because the articles were not focused on the outcomes of interest (e.g., focused on polycystic ovarian syndrome), were not original research (e.g., a review), or were treatment studies. While we excluded articles that only included patients with polycystic ovarian syndrome, we would direct those interested in this topic to a recent systematic review and meta-analysis published on the association between polycystic ovarian syndrome and eating disorders (Thannickal et al. 2020). The full texts of 26 articles were assessed for eligibility. Following exclusion, primarily because articles did not examine the outcome(s) of interest, there were a total of 10 studies included in this review. Figure 1 shows the results of the search using PRISMA guidelines (Moher et al. 2009).

### Study characteristics

All of the studies examined eating pathology among women undergoing fertility treatment. Sample sizes for the studies ranged from 30 to 385 (Allison et al. 1988; Rodino et al. 2016). Of the articles that met inclusion criteria, three articles reported exclusively on eating disorder diagnoses (Barbosa-Magalhaes et al. 2021; Bruneau et al. 2017; Sbaragli et al. 2008), one article focused exclusively on disordered eating (Allison et al. 1988), and six articles focused on both eating disorder diagnoses and disordered eating (Cousins et al. 2015; Freizinger et al. 2010; Resch et al. 2004; Rodino et al. 2016; Stewart et al. 1990; Sylvester et al. 2020). The majority of the studies were conducted in the USA (Cousins et al. 2015; Freizinger et al. 2010; Sylvester et al. 2020), two studies were conducted in France (Barbosa-Magalhaes et al. 2021; Bruneau et al. 2017), two studies were conducted in Australia (Allison et al. 1988; Rodino et al. 2016), one study was conducted in Italy (Sbaragli et al. 2008), one study was conducted in Canada (Stewart et al. 1990), and one study was conducted in Budapest (Resch et al. 2004). All studies were cross-sectional.

### Synthesis of results

#### Eating disorder studies

**Assessment measures** Table 1 shows the results of the studies examining eating disorder diagnoses among women. The majority of studies used clinical interviews to ascertain eating disorder diagnosis. The Structured Clinical Interview for DSM-IV (First and Gibbon 2004) was used by two studies (Freizinger et al. 2010; Sbaragli et al. 2008), while other studies (Barbosa-Magalhaes et al. 2021) used the Composite International Diagnostic Interview (World Health,

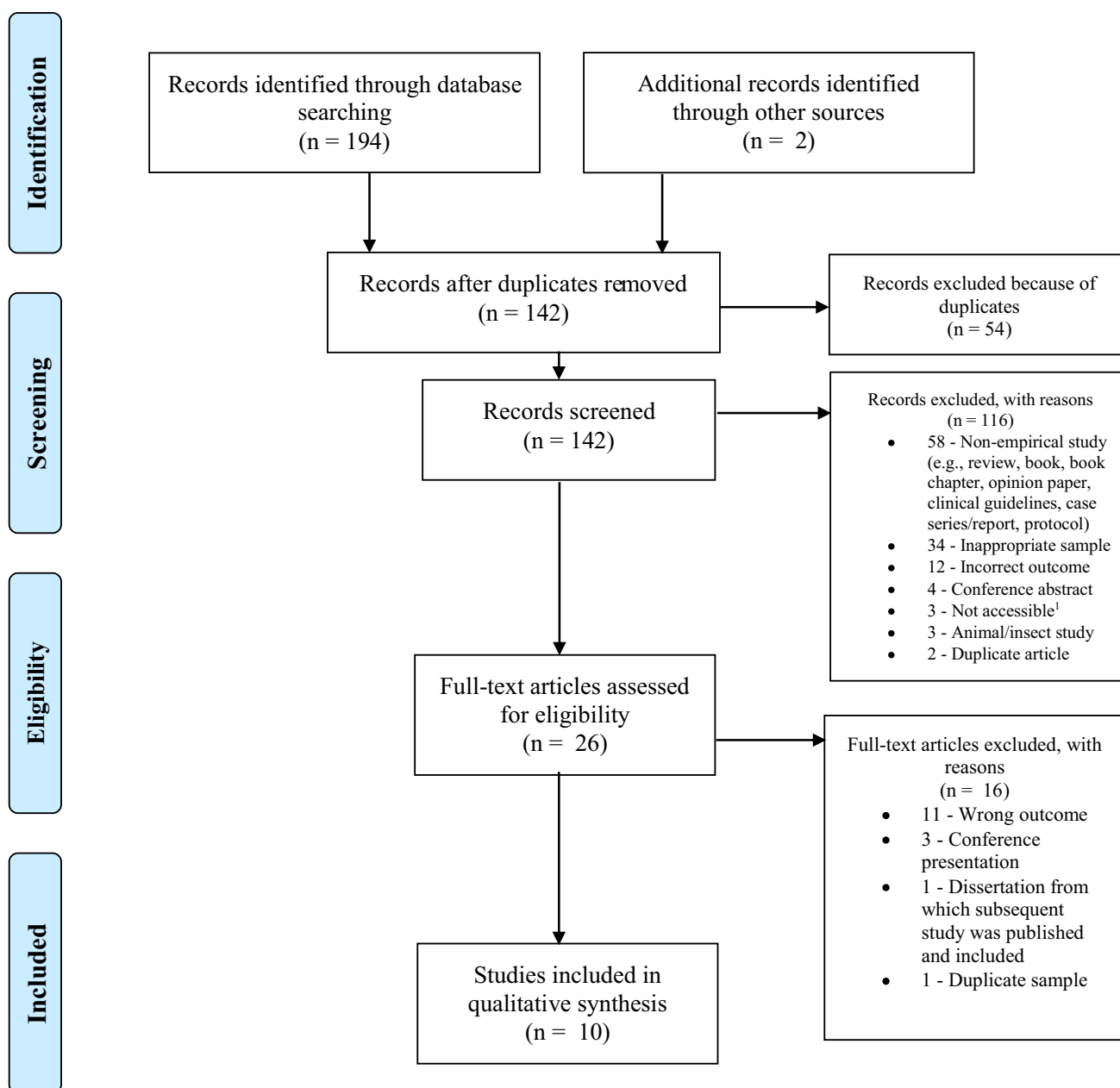


Fig. 1 PRISMA 2009 flow diagram

or an unspecified clinical interview (Stewart et al. 1990). Two studies used both a clinical interview and a self-report measure to ascertain diagnosis (Bruneau et al. 2017; Resch et al. 2004). The Eating Disorder Inventory-3 (Garner 2004) (Cousins et al. 2015), the Bulimic Investigatory Test, Edinburgh (Henderson and Freeman 1987; Resch et al. 2004), and a demographic questionnaire (Rodino et al. 2016) were used in other studies to evaluate eating disorder diagnosis. Only one study used medical records to determine eating disorder diagnoses (Sylvester et al. 2020). Data shows moderate concordance between interview and self-report measures of

eating disorders, specifically the Eating Disorder Examination and Eating Disorder Examination-Questionnaire (Berg et al. 2012), demonstrating that self-report measures may be preferred for their ease of administration.

**Types of eating disorders and their prevalence** All of the studies examined current or past eating disorders, with the exception of one which examined only lifetime rates of eating disorders (e.g., diagnosis of an eating disorder during their life) and did not differentiate whether the eating disorders were present currently or in the past (Barbosa-Magalhaes

**Table 1** Review of results examining eating disorders among women undergoing fertility treatment

AUTHOR	Sample	Country	outcome measure	Results
BRUNEAU ET AL. 2017	60	France	Mini-international neuropsychiatric interview SCOFF	<ul style="list-style-type: none"> <li>• Current or past eating disorder 16.7% (<math>n = 10</math>); 8.3% past AN (<math>n = 5</math>), 3.3% past BN (<math>n = 2</math>), 1.7% current AN (<math>n = 1</math>), 1.7% current BN (<math>n = 1</math>), 1.7% past BED (<math>n = 1</math>)</li> <li>• Screened positive for eating disorder 11.7% (<math>n = 7</math>)</li> </ul>
SBARAGLI ET AL. 2008	81 infertile couples and 70 fertile couples with functional, organic, or male factor infertility (study included males and females; results only reported for females)	Italy	Structured Clinical Interview for DSM-IV	<ul style="list-style-type: none"> <li>• Current BED 18.5% (<math>n = 15</math>); past BED 11.1% (<math>n = 9</math>)</li> <li>• Higher rates of past BED in women with infertility as compared to controls</li> <li>• Women with PCOS or unexplained infertility had higher rates of past BED than women with anatomic infertility or fertile women</li> </ul>
COUSINS ET AL. 2015	51 women with infertility (ovulation disorder or unexplained); 34 women without infertility	United States	Eating Disorder Inventory-3	<ul style="list-style-type: none"> <li>• Current eating disorder 13.7% (<math>n = 7</math>) in infertility group compared to 17.6% (<math>n = 6</math>) in fertile group</li> <li>• Past eating disorder 27.5% (<math>n = 14</math>) in infertility group compared to 35.3% (<math>n = 12</math>) in fertile group</li> <li>• Current or past eating disorder 20.7% (<math>n = 17</math>); 6.1% current EDNOS (<math>n = 5</math>) with 4 meeting BED criteria, 3.7% past EDNOS (BED) (<math>n = 3</math>); 8.5% past AN (<math>n = 7</math>), 2.4% past BN (<math>n = 2</math>)</li> <li>• Lifetime eating disorder: 95.2% (<math>n = 20</math>) in pulsatile GnRH group (17 AN-restricting, 3 AN-purging, 1-BN) vs. 23.8% (<math>n = 5</math>) in control group (5 AN-restricting)</li> </ul>
FREIZINGER ET AL. 2010	82 (unexplained, male factor, other, or PCOS)	United States	Structured Clinical Interview-Module H	<ul style="list-style-type: none"> <li>• Current eating disorder 0.5% (<math>n = 2</math>)</li> <li>• Past eating disorder 6.8% (<math>n = 26</math>)</li> </ul>
BARBOSA-MAGALHAES ET AL. 2021	42 women with hypothalamic amenorrhea, ovarian dysfunction, PCOS, tubal obstruction, endometriosis, or unexplained infertility (21 receiving pulsatile GnRH treatment & 21 women receiving non-pulsatile GnRH treatment)	France	Composite International Diagnostic Interview	<ul style="list-style-type: none"> <li>• Current eating disorder 16.7% (<math>n = 11</math>), 6.1% BN (<math>n = 4</math>), 1.5% AN (<math>n = 1</math>), 9.1% EDNOS (<math>n = 6</math>)</li> <li>• Current BN 10.3% (<math>n = 6</math>); current subclinical BN 13.8% (<math>n = 8</math>)</li> </ul>
RODINO ET AL. 2016	385 women with male factor, unexplained, PCOS, other ovulatory disorders, or heterogeneous infertility	Australia	Self-report via demographic questionnaire	<ul style="list-style-type: none"> <li>• Current eating disorder 1.4% (<math>n = 1</math>)</li> <li>• Past eating disorder 1.4% (<math>n = 1</math>)</li> </ul>
STEWART ET AL. 1990	66	Canada	Clinical interview based on DSM-III-R criteria	<ul style="list-style-type: none"> <li>• Current eating disorder 16.7% (<math>n = 11</math>), 6.1% BN (<math>n = 4</math>), 1.5% AN (<math>n = 1</math>), 9.1% EDNOS (<math>n = 6</math>)</li> <li>• Current BN 10.3% (<math>n = 6</math>); current subclinical BN 13.8% (<math>n = 8</math>)</li> </ul>
RESCH ET AL. 2004	58 women with male factor infertility, tubal disease, or endometriosis	Budapest	Bulimia Investigation Test, Edinburgh; supported by clinical interviews	<ul style="list-style-type: none"> <li>• Current eating disorder 1.4% (<math>n = 1</math>)</li> <li>• Past eating disorder 1.4% (<math>n = 1</math>)</li> </ul>
SYLVESTER ET AL. 2020	72	USA	ED diagnosis by medical record	<ul style="list-style-type: none"> <li>• Current eating disorder 1.4% (<math>n = 1</math>)</li> <li>• Past eating disorder 1.4% (<math>n = 1</math>)</li> </ul>

AN anorexia nervosa; BN bulimia nervosa; BED binge eating disorder; EDNOS eating disorder not otherwise specified

et al. 2021). Only one study focused exclusively on BN (Resch et al. 2004), while all other studies examined multiple eating disorder diagnoses. Of the studies that reported rates of any type of eating disorders, rates of past eating disorders ranged from 1.4 (Sylvester et al. 2020) to 27.5% (Cousins et al. 2015), while rates of current eating disorders ranged from 0.5 (Rodino et al. 2016) to 16.7% (Stewart et al. 1990). Of the studies that reported specifically on AN, the prevalence of current AN ranged from 1.5 (Stewart et al. 1990) to 1.7% (Bruneau et al. 2017). Rates of history of AN were much higher, ranging from 8.3 (Bruneau et al. 2017) to 8.5% (Freizinger et al. 2010). Lifetime history of an eating disorder was 95.2% among women receiving pulsatile gonadotropin releasing hormone (GnRH) treatment, with AN occurring most commonly, as compared to women not receiving pulsatile GnRH treatment, in which the prevalence of lifetime AN was 23.8% (Barbosa-Magalhaes et al. 2021). Prevalence of current bulimia nervosa ranged from 1.7 (Bruneau et al. 2017) to 10.3% (Resch et al. 2004), while history of bulimia nervosa ranged from 2.4 (Freizinger et al. 2010) to 3.3% (Bruneau et al. 2017). Because BED was not formally recognized until the Diagnostic and Statistical Manual of Mental Disorders 5 (DSM-5) was published in 2013 (Diagnostic and Statistical Manual of Mental Disorders 2013), eating disorder not otherwise specified (EDNOS) was commonly used to diagnose binge eating prior to the DSM-5 (Keel et al. 2011). As such, rates of current EDNOS ranged from 6.1 (Freizinger et al. 2010), with the majority of those individuals endorsing binge eating, to 9.1% (Stewart et al. 1990). A history of EDNOS, specifically binge eating, was reported by 3.7% of individuals (Freizinger et al. 2010). A history of binge eating disorder was reported by 1.7 (Bruneau et al. 2017) to 11.1% (Sbaragli et al. 2008), while current BED was reported by 18.5% (Sbaragli et al. 2008).

**Eating disorders between women with and without fertility treatment** Of note, two studies compared rates of eating disorders among women with infertility seeking fertility treatment to women without infertility in their respective samples. In Cousins et al. (2015), rates of both current and past eating disorders were higher among fertile women. To the contrary, Sbaragli et al. (2008) noted that rates of history of BED were higher among women with infertility than among fertile women; there was an effect of infertility diagnosis such that women with polycystic ovarian syndrome or whose infertility was unexplained more frequently endorsed a history of BED than women whose infertility was due to identified causes (Sbaragli et al. 2008).

### Disordered eating studies

**Assessment measures** Table 2 shows the results of the studies examining disordered eating attitudes and behaviors among women. All studies used self-report measures

to examine disordered eating. The majority of studies used the Eating Disorder Examination-Questionnaire (Fairburn and Beglin 2008) (EDE-Q) (Freizinger et al. 2010; Rodino et al. 2016; Sylvester et al. 2020), while other studies used a version of the Eating Disorder Inventory (Allison et al. 1988; Cousins et al. 2015), Eating Attitudes Test (Stewart et al. 1990), Herman and Polivy Restraint Scale (Cousins et al. 2015), or the Bulimic Inventory Test, Edinburgh (Resch et al. 2004).

**Eating pathology between women with and without fertility treatment** Two studies compared rates of eating pathology between women with infertility and those without. Cousins et al. (2015) used the Eating Disorder Inventory-3 (Garner 2004) and Herman and Polivy Revised Restraint Scale (Herman and Polivy 1980). Results showed those with infertility reported significantly higher drive for thinness and bulimic tendencies than those without infertility; scores on subscales of body dissatisfaction and dietary restraint were significantly lower among those with infertility, which the authors noted was consistent with the lower body mass index of those with infertility (Cousins et al. 2015). Freizinger et al. (2010) compared scores on the EDE-Q (Fairburn and Beglin 2008) between those with a present or past eating disorder and those without, as well as to a community sample of norms. The results showed that those with a past or present eating disorder had significantly higher EDE-Q global score, as well as scores on the eating concerns, weight concerns, and shape concerns subscales as compared to those without a current or past eating disorder; scores on the eating concerns and weight Concerns scores were also significantly higher among those with a current or past eating disorder as compared to those in the community sample. Among women with infertility, scores were higher on global eating pathology and shape concerns as compared to the community sample, although no differences among groups were found on the dietary restraint subscale.

**Risk related to type of infertility diagnosis** Two studies included in this review examined associations between infertility diagnosis and disordered eating pathology or pathological exercise. Those with polycystic ovarian syndrome or other types of ovulatory dysfunction were approximately 6.98 times ( $CI = 1.39, 34.90, P = 0.018$ ) more likely to engage in compulsive exercise than those without ovulatory infertility (Rodino et al. 2016). Women who were anovulatory had higher levels of eating pathology than ovulatory women specifically in terms of their drive for thinness (Allison et al. 1988).

**Other prevalence rates** The remaining studies evaluated prevalence of disordered eating within their sample using various measures. Specifically, two studies using the EDE-Q (Fairburn and Beglin 2008) showed 1.6–9.7% of women had a score



**Table 2** Review of results examining disordered eating among women undergoing fertility treatment

Author	Sample	Country	Outcome measure	Results
Cousins et al. 2015	51 women with infertility (ovulation disorder or unexplained); 34 women without infertility	United States	Eating Disorder Inventory-3 Herman and Polivy Revised Restraint Scale	<ul style="list-style-type: none"> <li>• Infertility group: significantly higher scores on drive for thinness (<math>M=0.18</math>, <math>SE=0.01</math>) and bulimia subscales (<math>M=0.35</math>, <math>SE=0.01</math>), significantly lower on body dissatisfaction (<math>M=1.10</math>, <math>SE=0.22</math>)</li> <li>• Infertility group: significantly lower rates of dietary restraint (<math>M=12.4</math>, <math>SE=1.5</math>)</li> </ul>
Freizinger et al. 2010	82 (unexplained, male factor, other, or PCOS); Sample subdivided by past or present ED	United States	Eating Disorder Examination-Questionnaire	<ul style="list-style-type: none"> <li>• ED group scored significantly higher on global score, eating concerns, weight concerns, and shape concerns as compared to no ED group, with no differences in dietary restraint; also higher on eating concerns (<math>M=1.12</math>, <math>SD=1.21</math>) and weight concerns (<math>M=2.29</math>, <math>SD=1.43</math> relative to community sample)</li> <li>• Infertility group: significantly higher on global score (<math>M=1.90</math>, <math>SD=1.23</math>) and shape concerns (<math>M=2.67</math>, <math>SD=1.57</math>) than norms from a community sample</li> <li>• 1.6% (<math>n=6</math>) had score &gt; 4 indicative of ED</li> <li>• Women with ovulatory infertility had higher scores across the EDE-Q subscales than those with male factor, unexplained, or heterogeneous infertility</li> <li>• Women in ovulatory-PCOS group had higher risk of engaging in compulsive exercise compared to nonovulatory infertility group (OR = 6.98, CI = 1.39, 34.90, <math>p=0.018</math>)</li> <li>• 18.1% (<math>n=12</math>) had score of 20 or more</li> <li>• Women with abnormal menses had higher scores than women with normal menses</li> </ul>
Rodino et al. 2016	385 women with male factor, unexplained, PCOS, other ovulatory disorders, or heterogeneous infertility	Australia	Eating Disorder Examination-Questionnaire	<ul style="list-style-type: none"> <li>• 9.7% (<math>n=7</math>) had score (<math>\geq 2.3</math>) indicative of disordered eating</li> <li>• Anovulatory women scored significantly higher (<math>M=7.6</math>, <math>SE=2.21</math>) than ovulatory women (<math>M=2.5</math>, <math>SE=0.73</math>) on the drive for thinness subscale</li> <li>• There were no differences in total EDI score, bulimia, or body dissatisfaction across the groups</li> <li>• Current disordered eating behavior 24.1% (<math>n=14</math>), with an additional 10.3% (<math>n=6</math>) and 13.8% (<math>n=8</math>) exhibiting clinical or subclinical bulimia for a total of 48% endorsing some type of eating pathology</li> </ul>
Stewart et al. 1990	66	Canada	Eating Attitudes Test	<ul style="list-style-type: none"> <li>• 18.1% (<math>n=12</math>) had score of 20 or more</li> <li>• Women with abnormal menses had higher scores than women with normal menses</li> </ul>
Sylvester et al. 2020	72	United States	Eating Disorder Examination-Questionnaire	<ul style="list-style-type: none"> <li>• 9.7% (<math>n=7</math>) had score (<math>\geq 2.3</math>) indicative of disordered eating</li> <li>• Anovulatory women scored significantly higher (<math>M=7.6</math>, <math>SE=2.21</math>) than ovulatory women (<math>M=2.5</math>, <math>SE=0.73</math>) on the drive for thinness subscale</li> <li>• There were no differences in total EDI score, bulimia, or body dissatisfaction across the groups</li> <li>• Current disordered eating behavior 24.1% (<math>n=14</math>), with an additional 10.3% (<math>n=6</math>) and 13.8% (<math>n=8</math>) exhibiting clinical or subclinical bulimia for a total of 48% endorsing some type of eating pathology</li> </ul>
Allison et al. 1988	30 women with explained, male factor, or unknown infertility; Sample subdivided by ovulatory ( $n=18$ ) and anovulatory ( $n=12$ )	Australia	Eating Disorder Inventory	<ul style="list-style-type: none"> <li>• Anovulatory women scored significantly higher (<math>M=7.6</math>, <math>SE=2.21</math>) than ovulatory women (<math>M=2.5</math>, <math>SE=0.73</math>) on the drive for thinness subscale</li> <li>• There were no differences in total EDI score, bulimia, or body dissatisfaction across the groups</li> <li>• Current disordered eating behavior 24.1% (<math>n=14</math>), with an additional 10.3% (<math>n=6</math>) and 13.8% (<math>n=8</math>) exhibiting clinical or subclinical bulimia for a total of 48% endorsing some type of eating pathology</li> </ul>
Resch et al. 2004	58 women with male factor infertility, tubal disease, or endometriosis	Budapest	Bulimia Investigation Test, Edinburgh; supported by clinical interviews	<ul style="list-style-type: none"> <li>• Current disordered eating behavior 24.1% (<math>n=14</math>), with an additional 10.3% (<math>n=6</math>) and 13.8% (<math>n=8</math>) exhibiting clinical or subclinical bulimia for a total of 48% endorsing some type of eating pathology</li> </ul>

*M* mean; *SD* standard deviation; *SE* standard error

indicative of eating pathology or an eating disorder (Rodino et al. 2016; Sylvester et al. 2020). Studies using other measures of eating pathology reported higher estimates of current eating pathology ranging from 18.1 (Stewart et al. 1990) to 48% of women pursuing fertility treatment (Resch et al. 2004).

## Discussion

Eating disorders are associated with menstrual disturbances which may impact fertility. Because studies of disordered eating and infertility have been conducted for several decades around the world with women presenting for different types of fertility treatment, there was a need for a systematic review of this literature in order to examine the prevalence of self-reported disordered eating behavior and eating disorder diagnoses among women seeking fertility treatment. This systematic review included studies from 8 countries with publications spanning 32 years (1988 to 2020).

Results generally suggested that levels of current and past eating disorder diagnoses are higher among women seeking fertility treatment as compared to currently published rates of eating disorder prevalence. A recent systematic review highlighted the lifetime prevalence of AN, BN, and EDNOS among women in the general population was 1.4%, 1.9%, and 4.3%, respectively (Galmiche et al. 2019). The present systematic review found as many as 8.5% (Freizinger et al. 2010), 6.1% (Stewart et al. 1990), 11.1% (Sbaragli et al. 2008), and 27.5% (Cousins et al. 2015) of women seeking fertility treatment had a history of AN, BN, BED, or any eating disorder, respectively. In this systematic review, up to 1.7% (Bruneau et al. 2017), 10.3% (Resch et al. 2004), 9.1% (Stewart et al. 1990), and 18.5% (Sbaragli et al. 2008) of women seeking fertility treatment met criteria for AN, BN, ENDOS, or BED, respectively. A study of women undergoing ovulation induction with pulsatile GnRH treatment found that as many as 95.2% had a history of an eating disorder compared to women receiving other types of fertility treatment (Barbosa-Magalhaes et al. 2021). This type of treatment can be used to address the slowed GnRH pulse frequency among women with hypothalamic amenorrhea (Martin et al. 1990), which can result from eating disorders. Results obtained through self-report vs. clinical interview have been shown to be generally comparable in assessing AN and BN (Carter et al. 2001; Wolk et al. 2005); however, self-report measures often show greater endorsement of binge eating compared to clinical interviews (Fairburn and Beglin 1994; Wilfley et al. 1997). In this review, the majority of the studies utilized an independent diagnostic interview or a combination of both diagnostic interview and self-report to ascertain diagnoses of AN, BN, BED, and EDNOS.

Current disordered eating pathology was reported by up to 48% of women pursuing fertility treatment (Resch et al. 2004).

Comparatively, the prevalence of eating pathology among women in the community is reported to be 5.9% (Hilbert et al. 2012). Results of this systematic review also showed that, when compared to women without infertility, those with infertility had higher levels of eating pathology and concerns about body shape (Freizinger et al. 2010), as well as higher rates of drive for thinness and bulimic behaviors (Cousins et al. 2015). In both studies, levels of dietary restraint among women with infertility were similar or lower than women without infertility. Differences in levels of dietary restraint may be attributed to the numerous dietary recommendations proposed to increase fertility, including polyunsaturated fatty acids found in fish, oils, and proteins from animal- and plant-based products (Gaskins and Chavarro 2018).

Findings suggest that the type or prevalence of disordered eating may be related to infertility diagnosis. In addition to disordered eating and broader infertility concerns, some studies examined eating pathology associated with infertility diagnosis, menstrual regularity, and type of fertility treatment. According to Sbaragli et al. (2008), a history of binge eating disorder is more commonly reported among women with “functional” (e.g., unexplained) or endocrine abnormalities, than among women with anatomic abnormalities. Findings from Stewart et al. (1990) indicated that women with irregular menses report higher rates of eating pathology compared to women with normal menses, which is consistent with the multitude of hormonal changes observed in women with eating disorders (Warren 2011).

Some clinical implications can be drawn from these findings. Medical providers should be aware that rates of past eating disorders are high among women seeking fertility treatment, and that a subset of their patients may currently struggle with an eating disorder or some degree of eating pathology. It is especially pertinent for fertility treatment providers to be aware of past or current eating disorders in light of any suggestions that patients lose weight to improve treatment success, as this may be especially detrimental for women with eating pathology. It has been suggested that eating disorders should be treated prior to engaging in fertility treatment (Paslakis and de Zwaan 2019). However, women may be unwilling to disclose their history of disordered eating due to potential shame, guilt, or ignorance, even while seeking fertility treatment. Indeed, studies have revealed very high rates of nondisclosure of eating pathology among patients to their provider, such that none of the patients in either study disclosed this information to their healthcare provider (Freizinger et al. 2010; Rodino et al. 2016).

Given that self-report measures for eating pathology yield similar data as clinical interviews (Carter et al. 2001; Wolk et al. 2005), self-report measures may be perceived as a less threatening and more feasible screening approach in assessing eating disorders and disordered eating. Therefore, appropriate self-report screening tools may be helpful in obtaining

information that patients may not otherwise disclose and can serve as a good alternative if formal diagnostic interviews are not accessible. There are several disordered eating measures which are valid and reliable for use with community samples, including the 28-item EDE-Q (Fairburn and Beglin 2008) and the 5-item SCOFF (i.e., “sick, control, one, fat, food”) (Morgan et al. 2000). These measures have demonstrated comparable validity to the diagnostic interviews from which they are based (Berg et al. 2012; Luck et al. 2002). As such, these screening measures should be considered for the evaluation of eating pathology in fertility treatment patient populations. While the majority of fertility specialists recognize the importance of screening for eating pathology as a part of the fertility evaluation, only about one third of fertility clinics engaged in routine screening and less than one tenth had guidelines for treatment of eating disorders (Rodino et al. 2017). Recommendations for the screening of eating pathology by obstetric and gynecologic providers have been echoed by Paslakis and de Zwaan (2019) who offer a clinical algorithm for fertility treatment providers. Specifically, the algorithm recommends screening using a validated measure of eating pathology; if the screen is positive or the patient’s BMI is  $\leq 18.5$ , further evaluation by a mental health specialist should be conducted. Embedding psychology services into infertility practices may be helpful in better assessing for eating pathology, providing brief consultation, and streamlining the referral process for higher levels of care. It is our hope that this systematic review sheds light on the value of routine screening and the need for fertility practices to have clinical practice guidelines for eating disorder management.

This is the first systematic review examining both disordered eating and eating disorders among women seeking fertility treatment. One particularly important finding is that only a subset of women endorsing disordered eating would meet the criteria for an eating disorder. As such, examining disordered eating prevalence in addition to diagnosed eating disorders allows providers to reach a larger group of individuals who may exhibit eating pathology; this also offers an opportunity for early identification and prevention of a full-fledged eating disorder, as there is strong evidence that subsyndromal eating pathology can progress to an eating disorder (Le Grange and Loeb 2007). Furthermore, many eating disorders are undiagnosed, including atypical anorexia nervosa, avoidant/restrictive food intake disorder, and orthorexia nervosa (Dunn and Bratman 2016; Fitzgerald and Frankum 2017; Moskowitz and Weiselberg 2017). Because screening may not always be able to detect atypical eating disorders, we recommend fertility treatment providers have at least a cursory understanding of these disorders. As such, many women with normal or higher BMIs, with significant food aversion, or with excessive “clean eating” may be underdiagnosed unless properly assessed by fertility treatment

providers who are aware of these types of disordered eating pathologies.

One important point of consideration is that all studies included in this review were cross-sectional. As such, we are unable to determine causation and the temporal associations between initiation of fertility treatment and eating pathology. This is particularly important given the mean age in which AN and BN develop is 18 years old (Volpe et al. 2016). Additionally, because cross-sectional studies do not measure incidence, the degree to which eating pathology may fluctuate throughout the course of fertility treatment is unknown. Many women experience distress while undergoing fertility treatment (Greil et al. 2011), and this could potentially contribute to the onset or exacerbation of eating pathology. This review highlights the need for studies to examine the potential onset and course of eating pathology over the course of fertility treatment, including whether this is associated with successful pregnancy outcomes.

Our review is not without limitations. The studies included used differing measures of eating pathology and clinical interviewing tools which limited our opportunities for direct comparison across samples. Furthermore, older studies used clinical interviews based on earlier versions of the Diagnostic and Statistical Manual (Bruneau et al. 2017; Freizinger et al. 2010; Sbaragli et al. 2008; Stewart et al. 1990), so results may change according to changes in diagnostic criteria, notably, the removal of amenorrhea criteria for AN and the addition of BED in the DSM-V (American Psychiatric Association 2013). Additionally, although studies in which the sample was focused on PCOS were excluded, other studies included in the review included some patients with a diagnosis of PCOS, which has the potential to bias results. Moreover, there is the concern for publication bias as only published manuscripts were included; however, this was done to ensure that the research included was peer-reviewed.

## Conclusions and implications

This study summarizes findings from over three decades of research and contributes to the body of literature on infertility and eating pathology. Rates of current and past eating disorders among women seeking fertility treatment are higher than rates in community samples (Smink et al. 2012). Disordered eating is also endorsed by women seeking fertility treatment. Results speak to the need for regular screening of eating pathology in fertility treatment practices. Identifying eating pathology among women seeking fertility treatment may be helpful for promoting diagnosis and treatment. However, there is a gap in the literature pertaining to whether eating pathology worsens during the course of fertility treatment or whether fertility treatments contribute to eating pathology, which are several important areas for future research. Future

studies should also examine the length of fertility treatment or rates of successful conception among women with eating disorders or disordered eating. A meta-analysis of the prevalence of eating disorders among women undergoing fertility treatment would also be beneficial.

## Appendix 1

### Ovid MEDLINE Results: 47.

(exp fertility/ or exp Infertility/) and (treatment or therapy or IVF).ti,ab. OR ((fertil\* or infertil\* or Fecundability or Fecundity or Sterility or Subfertility) adj4 (treatment or therapy or IVF)).mp.

AND

((Eating adj2 pathology) or (eating adj2 problem\*) or (eating adj2 concern\*) or disordered eat\* or eating disorder\* or eating behav\* or Feeding Disorder\* or (eating adj2 attitude\*) or (food adj2 behavior) or (avoid\* adj2 food) or over-eating or (restrict\* adj2 food\*)).mp. OR exp "Feeding and Eating Disorders"/

Limit to English language.

Exclude (animals not (humans and animals)).sh.

### Embase Results: 95.

'eating disorder'/exp/mj OR 'feeding behavior'/exp/mj OR ((eating NEAR/2 pathology):ti,ab) OR ((eating NEAR/2 problem\*):ti,ab) OR ((eating NEAR/2 concern\*):ti,ab) OR 'disordered eat\*':ti,ab OR 'eating disorder\*':ti,ab OR 'eating behav\*':ti,ab OR 'eating attitude\*':ti,ab.

AND

((fertil\* OR infertil\* OR fecundability OR fecundity OR sterility OR subfertility OR 'assisted reproduction') NEAR/4 (treatment OR therapy OR ivf):ti,ab OR 'infertility therapy'/exp OR (('infertility'/exp/mj OR 'fertility'/exp/mj) AND (treatment:ti,ab OR therapy:ti,ab OR ivf:ti,ab)).

Limit to English language, exclude animals.

### Web of Science: 32.

TS = ((fertil\* or infertil\* or Fecundability or Fecundity or Sterility or Subfertility) NEAR (treatment or therapy or IVF)) AND TS = ((Eating NEAR pathology) or (eating NEAR problem\*) or (eating NEAR concern\*) or disordered eat\* or eating disorder\* or eating behav\*) *Indexes = SCI-EXPANDED Timespan = 2002-present.*

### APA PsycInfo: 20.

(exp fertility/ or exp infertility/ or exp Reproductive Technology/ or exp Fertility Enhancement/) and (treatment or therapy or IVF).ti,ab. OR ((fertil\* or infertil\* or Fecundability or Fecundity or Sterility or Subfertility or ovulation

or conception or reproduction) adj4 (treatment or therapy or IVF)).mp.

AND

exp eating attitudes/ or exp eating behavior/ or exp eating disorders/ OR ((Eating adj2 pathology) or (eating adj2 problem\*) or (eating adj2 concern\*) or disordered eat\* or eating disorder\* or eating behav\* or weight control).mp.

**Acknowledgements** We wish to acknowledge the work of Brianna Andre, MLIS, AHIP, Henry Ford Health System, and Steven J. Moore, MLIS, Henry Ford Health System, who assisted with identifying citations for the systematic literature review.

## Declarations

**Conflict of interest** The authors declare no competing interests.

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