



Prevalence and related factors of eating disorders in pregnancy: a systematic review and meta-analysis

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Abstract

Purpose To reveal the prevalence of eating disorders (EDs) and related factors in pregnancy.

Methods The search was performed in PubMed, EBSCOhost, Web of Science, Scopus, Google Scholar, and Ovid databases search up to April 3, 2022, using the keywords combination of "(eating disorders OR anorexia nervosa OR bulimia nervosa OR binge eating disorder) AND (pregnancy OR pregnant)". Two researchers independently extracted data from the articles using a standard form. We evaluated the quality of the studies according to the Joanna Briggs Institute assessment tools.

Results The prevalence of EDs in pregnant women in the 11 studies involving 2,369,520 pregnant women was ranging between 0.5 and 10.6%. The prevalence of EDs in pregnant women was 4.3% (95% confidence interval 2%–9%; $I^2 = 99.5\%$). The prevalence of anorexia nervosa and binge eating disorder during pregnancy shows a statistically significant increase compared to pre-pregnancy, and the prevalence of bulimia nervosa during pregnancy decreases. The prevalence of EDs is higher in pregnant women under 30 years of age, secondary school graduates, married, and with normal BMI. Half of the pregnant women with EDs had anxiety and about one-third of pregnant women had depression. Excessive exercise is observed in 0.7% of pregnant women, fasting in 0.3%, laxative or diuretic use in 0.1%, and self-induced vomiting in 0.6%.

Conclusions This study is important as it is the first systematic review and meta-analysis to reveal the global prevalence of EDs in pregnant women and related factors. Continuing routine screening tests to detect EDs during pregnancy may contribute to taking special preventive measures for risk groups and protecting mother–child health.

Trial registration PROSPERO registration number (CRD42022324721), date of registration: 10/05/2022.

Keywords Eating disorders · Pregnancy · Related factors · Meta-analysis

What does this study add to the clinical work

Eating disorders are important health problems to be carefully considered in pregnant women. The prevalence of eating disorders among pregnant women was 4.3%. The results show that attention to eating disorder symptoms is very important, especially in pregnant women under the age of 30, secondary school graduates, married, and with a normal BMI.

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Introduction

Eating disorders (EDs) are physiological dysfunction associated with mental factors and disrupts physical health and psychosocial functioning [1]. The Diagnostic and

Statistical Manual (DSM-5) identifies three primary ED diagnoses: Anorexia Nervosa (AN; is distinct as a condition of self-starvation, where people are underweight and engaged in behaviors to prevent weight gain. It includes people who do and do not binge eat or purge (induce vomiting or laxative/diuretic misuse), Bulimia Nervosa (BN; is characterized by recurrent episodes of bingeing and purging. People with bulimia nervosa are not underweight and are in a regular cycle of compensatory behaviors such as binge eating and purging and/or abuse of laxatives, diuretics, and other drugs/ fasting/compulsive exercise. The specific clinical features of both Anorexia nervosa and bulimia nervosa represent an irrational overestimation of the importance of controlling food, weight, and body shape), and Binge Eating Disorder (BED; consists of a large amount of food intake, greater than most people would carry out during that time and circumstances; is characterized by repeated episodes binge eating with feelings of loss of control and, is similar to BN, but this must occur in the absence of any regular compensatory behaviors). Two further categories (Other Specified Feeding or Eating Disorder (OSFED), and Unspecified Feeding or Eating Disorder (UFED), also exist to classify EDs that do not more accurately fit into AN, BN, or BED, such as atypical presentations of the above or other feeding and eating disorders [2].

While the prevalence of EDs is in women at 3.8%, it is reported that this prevalence increased to 5.1–7.5% in pregnancy [3, 4]. Although EDs are common in the female population, there is insufficient literature on pregnancy or assessment and treatment guidelines for obstetric patients [5]. EDs lead to some problems in pregnancy such as miscarriage, a significant increase in morbidity and mortality, preeclampsia, and low birth weight [6]. While a study has indicated that there may be an improvement or even remission in EDs symptomatology during pregnancy [7], other has defined pregnancy as a high-risk period for the relapse of EDs [8].

Pregnant women with ED may feel ambivalent feelings between maintaining their ED behavior and doing what they think is best for their baby [9]. It is hypothesized that pregnant women with ED may have a higher diet quality, as they are often overly preoccupied with eating and weight control. On the other hand, physical changes and weight gain can become the main focus of pregnant women. Pregnant women may feel stressed out due to the changing body image and emotional stress and ED behaviors can be used as a way to manage this stress. While some studies have indicated that there may be an improvement or even remission in ED symptomatology during pregnancy [7], others have defined pregnancy as a high-risk period for the relapse of ED [8].

The neglect of ED behaviors in pregnancy by health professionals and the focus of clinical guidelines on preventing obesity is the most important obstacles in defining ED in pregnancy [4]. Moreover, the high prevalence of ED in women of reproductive age necessitates the investigation of the prevalence of ED during pregnancy [10]. Understanding ED during pregnancy is important in terms of preventing maternal and fetal morbidity and mortality, and improving the quality of life of women and future generations [11]. Nurses are in an ideal position to include important questions about eating attitudes as a component of the antepartum care of pregnant women [12]. To our knowledge, although there are some recent studies reviewing ED in pregnant women [13, 14], there is no study that analyzes the global prevalence of ED in pregnancy and associated factors through meta-analysis. Thus, this systematic review and meta-analysis study aims to systematically review, evaluate, and summarize the available evidence from studies worldwide focusing on ED in pregnant women. The primary research question of this study was "what is the global prevalence of ED in pregnant women and related factors?"

Methods

Search strategy

This study was prepared based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, 2020) (Appendix Table 2) and was registered with PROSPERO (CRD42022324721). The search was conducted by two authors using PubMed, EBSCOhost, Web of Science, Scopus, Google Scholar, and Ovid databases. The combination of "(eating disorders OR anorexia nervosa OR bulimia nervosa OR binge eating disorder) AND (pregnancy OR pregnant)" was used as keywords to focus on the study topic. The search was carried out on April 3, 2022.

Inclusion and exclusion criteria

The PICOS format was used to define the inclusion criteria of the studies and to identify the data to be extracted [16]: Population (P): Pregnant women. Intervention (I): EDs. Control (C): None. Outcomes (O): To determine the prevalence of EDs in pregnant women and the related factors. Study Design (S): Descriptive, cross-sectional, case-control, case studies, and cohort studies focusing on EDs in pregnancy, published in Turkish and English between 2013 and 2022, were included.

In the studies included in the study, the diagnosis of EDs was selected according to the most recent DSM-5 classification, the best-characterized EDs are anorexia

nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED). Studies were conducted with pregnant women with health problems other than EDs (hyperemesis gravidarum, etc.), qualitative studies, experimental studies, and study types other than the original articles were excluded.

Study selection and data extraction

Study selection and data extraction were conducted independently by two authors. 6571 studies were found in the first search. Studies reached from databases were transferred to EndNote X9.2 (Clarivate Analytics, Australia) and 1145 duplications were excluded here. The keywords of our study were scanned again in the titles, abstracts, and keywords of the studies. 1327 studies were assessed for eligibility. After the deletion of exclusions, 11 studies met the inclusion criteria (Fig. 1). Data such as ED prevalence (general, pre-pregnancy, and during pregnancy), age, and educational status were extracted by the authors from the studies.

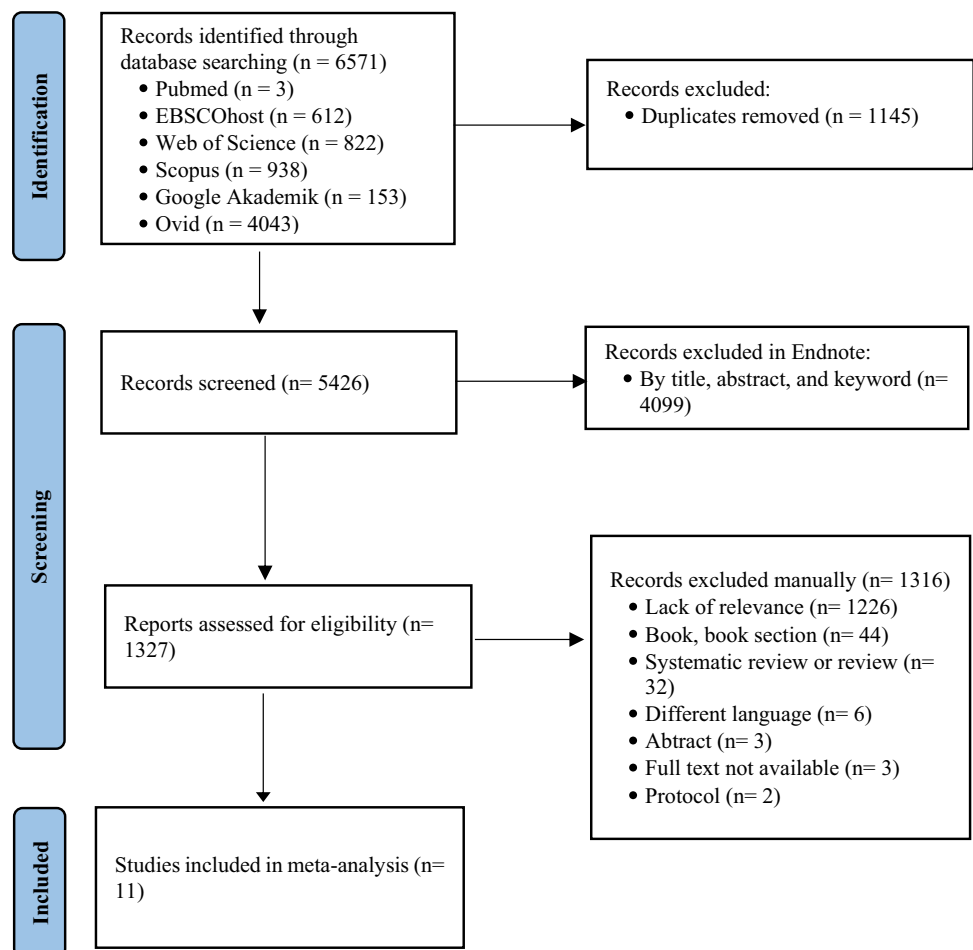
Quality of studies

Joanna Briggs Institute (JBI) assessment tools were used to evaluate the methodological quality of the studies. There are nine questions for descriptive studies, eleven questions for cohort studies, and eight questions for cross-sectional studies in the assessment tools. Each question in the assessment tools was answered with “Yes, No, Uncertain, and Not Applicable” options. The quality was graded into three categories: high quality, moderate quality, and low quality. The quality level is accepted as “high” if the rate of items answered as “yes” is over 80%, “moderate” if it is between 51 and 80%, and “low” if it is less than 50% [17]. Study selection, data extraction, and quality evaluation were conducted independently by each author, their results were compared and disagreements were resolved.

Statistical analysis

The data were analyzed using the Comprehensive Meta-Analysis V2 program (CMA; Biostat, Englewood, NJ, USA)

Fig. 1 PRISMA flow chart



for Statistical analysis. The effect size was determined by the event rate. The heterogeneity of the studies was examined with Q -value and I-squared (I^2) values. The random-effects model was used to test heterogeneity ($I^2 > 50\%$) [18]. To reveal the reason for the heterogeneity in the publications, subgroup analyses were performed according to EDs type (pre-pregnancy and during pregnancy), age, education, marital status, pre-pregnancy Body Mass Index (BMI), psychiatric comorbidity, and the ED-related behaviors of pregnant women. Publication bias was evaluated with the Funnel plot, Trim and Fill, Kendall's tau, and Egger method.

Results

Characteristics of the studies

The prevalence of EDs in pregnant women in the 11 studies involving 2,369,520 pregnant women was ranging between 0.5 and 10.6%. The characteristics of the studies are presented in Appendix Table 3.

Primer outcome: Pooled EDs prevalence

The results of the pooled EDs prevalence in pregnant women are given in Table 1. The prevalence of EDs was analyzed by 10 studies [19–28] (Fig. 2). The prevalence of EDs in pregnant women was 4.3% (95% CI, 2%–9%; $p < 0.001$). The heterogeneity was high for pooled EDs prevalence ($Q = 1994.171$, $I^2 = 99.5\%$).

Subgroup analyses

The reasons for the high heterogeneity in the results of the pooled EDs prevalence were investigated with subgroup analyses. The results of subgroup analyses were shown in Table 1.

Three studies [22, 23, 27] revealed a relationship between the prevalence of ED types in pre-pregnancy, and eight studies [19–23, 25, 27, 29] revealed a relationship between the prevalence of ED types during pregnancy. Pre-pregnancy AN prevalence was 0.2%, and AN prevalence during pregnancy was 0.4%. The prevalence of pre-pregnancy BED was 3.3%, and the prevalence of BED during pregnancy was 3.8%. Pre-pregnancy BN prevalence was 0.9%, and BN prevalence during pregnancy was 0.8%. The prevalence of AN and BED during pregnancy shows a statistically significant increase compared to pre-pregnancy, and the prevalence of BN during pregnancy decreases ($p < 0.001$).

Two studies [20, 29] revealed a relationship between the prevalence of EDs in pregnant women and age. 61.6% of the pregnant women with EDs were under 30 years old. EDs

prevalence was found to be higher in young pregnant women ($p < 0.001$).

Three studies [20, 24, 25] investigated the relationship between EDs prevalence in pregnant women and education level. Of the pregnant women with EDs, 48.2% were in secondary school ($p < 0.05$).

Three studies [20, 24, 25] investigated the relationship between EDs prevalence in pregnant women and marital status. Of the pregnant women with EDs, 85% (95% CI, 51.5%–96.8%) were married ($p < 0.05$).

Three studies [20, 24, 25] investigated the relationship between EDs prevalence in pregnant women and pre-pregnancy BMI. 57.2% (95% CI, 36.8%–75.4%) of the pregnant women with EDs had a normal BMI ($p < 0.01$).

Two studies [20, 25] investigated the relationship between the prevalence of EDs in pregnant women and psychiatric problems. Half of the pregnant women with EDs (49.4%) had anxiety and about one-third of pregnant women (30.7%) had depression ($p < 0.05$).

ED-related behaviors were examined in two studies [22, 23]. Excessive exercise is observed in 0.7% of pregnant women, fasting in 0.3%, laxative or diuretic use in 0.1%, and self-induced vomiting behavior in 0.6% ($p < 0.05$).

Publication Bias

When the publication bias was examined, the Trim and Fill method shows that the effect size will decrease if two studies are added to the left of the funnel plot. The corrected and uncorrected values of the mean effect size are reported in the funnel plot (Fig. 3). However, Kendall's tau ($\tau = -0.44444$, $p = 0.073$) and Egger's method (constant term -0.17481 , $p = 0.980$) values showed that there was no publication bias in the meta-analysis.

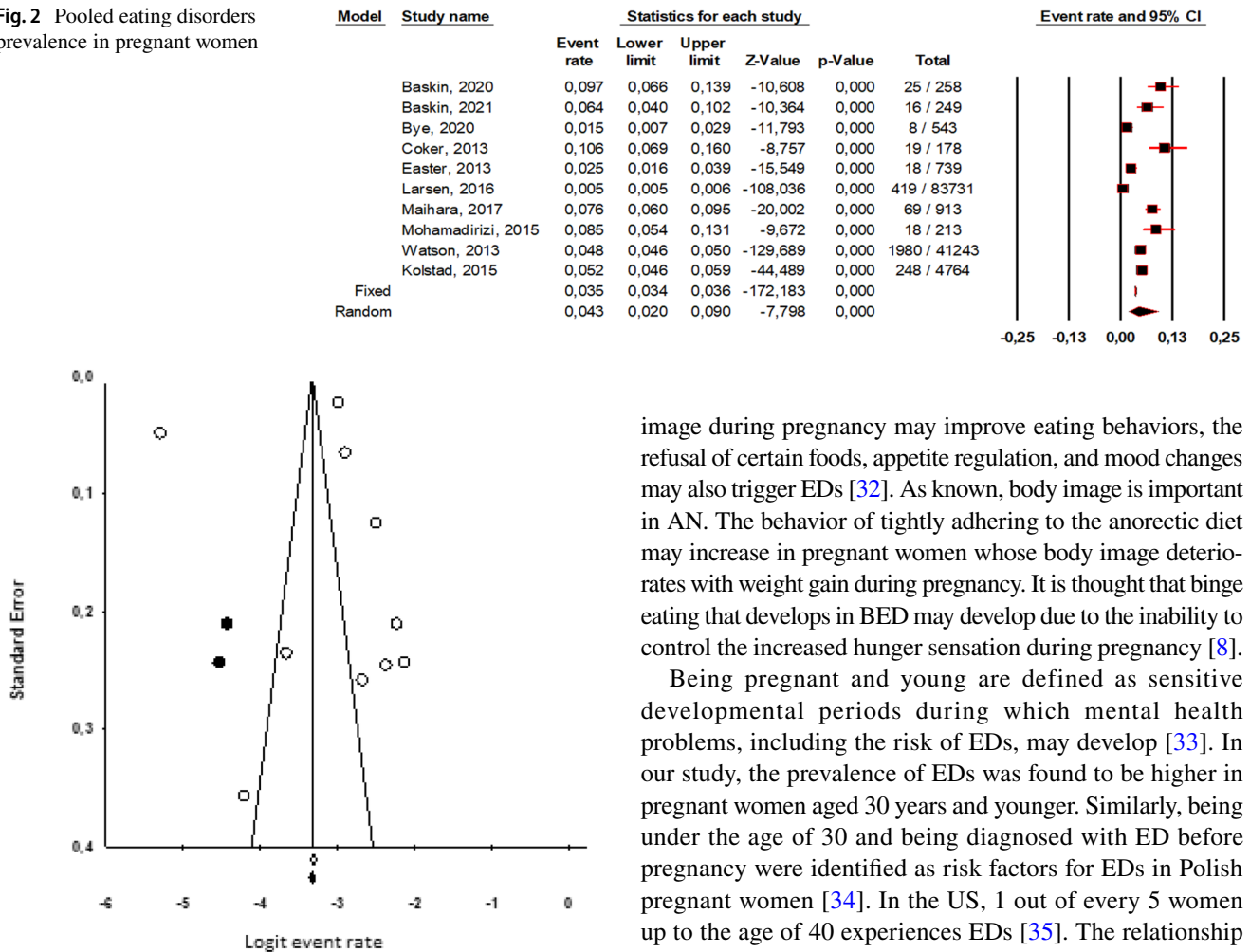
Discussion

Understanding EDs during pregnancy is important in terms of preventing maternal and fetal morbidity and mortality [11]. In our study, the prevalence of pooled EDs in pregnant women was found to be 4.3%. The reasons for the high heterogeneity in outcomes of pooled ED prevalence in pregnancy were explored by subgroup analyses. The difference between the prevalence of ED types before and during pregnancy was thought to lead to heterogeneity. It was determined that the most common type of ED before and during pregnancy was BED (3.3%, and 3.8%, respectively), and the rarest was AN (0.2%, and 0.4%, respectively). The prevalence of ED during pregnancy has been reported to be approximately 5% [3]. In the systematic review of Martínez-Olcina et al. (2020) [13], similar to our findings, it was reported that BED

Table 1 Effect sizes and heterogeneity results of studies

Subgroups	Model	Number Studies	Effect size (95% interval)	Heterogeneity		
				Q	<i>p</i>	<i>I</i> ²
				1994.171	<0.001	99.549
Pre-pregnancy ED-type prevalence						
AN	Mixed	2	0.002 (0.000–0.007)	5.304	0.021	81.145
BED	Mixed	3	0.033 (0.030–0.037)	13.322	<0.010	84.988
BN	Mixed	3	0.009 (0.004–0.020)	204.334	<0.001	99.021
Total between	Mixed			28.332	<0.001	
Pregnancy ED type prevalence						
AN	Mixed	6	0.004 (0.001–0.026)	203.922	<0.001	97.548
BED	Mixed	6	0.038 (0.032–0.044)	53.008	<0.001	90.567
BN	Mixed	6	0.008 (0.004–0.016)	124.480	<0.001	95.983
Total between	Mixed			23.006	<0.001	
Difference between pre-pregnancy and pregnancy ED type prevalence						
AN				138,710	<0.001	99,279
BED				95,928	<0.001	98,958
BN				17,417	<0.001	94,259
Age						
< 30	Fixed	2	0.616 (0.594–0.637)	0.209	0.647	0.000
> 29	Fixed	2	0.384 (0.363–0.406)	0.209	0.647	0.000
Total between	Fixed			201.863	<0.001	
Education						
Primary	Fixed	3	0.245 (0.206–0.289)	2.569	0.277	22.135
Secondary	Mixed	3	0.482 (0.373–0.593)	4.922	0.085	59.363
High	Mixed	3	0.299 (0.137–0.535)	15.192	0.001	86.835
Total between	Mixed			13.847	0.001	
Marital status						
Married	Mixed	3	0.850 (0.515–0.968)	32.343	<0.001	93.816
Single	Mixed	3	0.150 (0.032–0.485)	32.343	<0.001	93.816
Total between	Mixed			8.250	0.004	
Pre-pregnancy BMI						
Underweight	Mixed	3	0.136 (0.058–0.287)	7.281	0.026	72.533
Normal	Mixed	3	0.572 (0.368–0.754)	16.536	<0.001	87.905
Overweight	Mixed	3	0.194 (0.048–0.532)	37.940	<0.001	94.729
Obese	Mixed	2	0.046 (0.005–0.312)	15.852	<0.001	93.692
Total between	Mixed			15.673	0.001	
Psychiatric comorbidity						
Anxiety	Fixed	2	0.494 (0.390–0.599)	0.003	0.960	0.000
Depression	Fixed	2	0.307 (0.218–0.413)	0.289	0.591	0.000
Total between	Fixed			6.116	0.013	
ED-related behaviors						
Excessive exercise	Fixed	1	0.007 (0.003–0.016)	0.000	1.000	0.000
Fasting	Mixed	2	0.003 (0.000–0.025)	30.184	<0.001	96.687
Laxative or diu- retic	Mixed	2	0.001 (0.001–0.004)	2.623	0.105	61.876
Vomiting	Mixed	2	0.006 (0.002–0.017)	8.187	0.004	87.786
Total between	Mixed			6.612	0.085	

AN Anorexia Nervosa, BN Bulimia Nervosa, BED Binge Eating Disorder, BMI Body Mass Index, ED Eating Disorder

Fig. 2 Pooled eating disorders prevalence in pregnant women

○ Observed studies ● Imputed studies

Fig. 3 Funnel plot of pooled prevalence studies

is more common in pregnant women than AN and BN. The weighted means of lifetime EDs were 8.4%; for AN, the weighted means (ranges) of lifetime prevalence were 1.4% (0.1–3.6%); for BN, the weighted means (ranges) of lifetime prevalence were 1.9% (0.3–4.6%); for BED, the weighted means (ranges) of lifetime prevalence were 2.8% (0.6–5.8%) [30].

Although the risk of ED increases during pregnancy [8], it has also been reported that during pregnancy the prevalence of AN and BN decreases, and the prevalence of BED increases compared to the pre-pregnancy period [31]. Our study revealed that the prevalence of BN during pregnancy decreases during pregnancy compared to the pre-pregnancy period, and the prevalence of AN and BED increased. In a systematic review, it has been reported that an increased sense of responsibility for the health of the fetus and positive changes in body

image during pregnancy may improve eating behaviors, the refusal of certain foods, appetite regulation, and mood changes may also trigger EDs [32]. As known, body image is important in AN. The behavior of tightly adhering to the anorectic diet may increase in pregnant women whose body image deteriorates with weight gain during pregnancy. It is thought that binge eating that develops in BED may develop due to the inability to control the increased hunger sensation during pregnancy [8].

Being pregnant and young are defined as sensitive developmental periods during which mental health problems, including the risk of EDs, may develop [33]. In our study, the prevalence of EDs was found to be higher in pregnant women aged 30 years and younger. Similarly, being under the age of 30 and being diagnosed with ED before pregnancy were identified as risk factors for EDs in Polish pregnant women [34]. In the US, 1 out of every 5 women up to the age of 40 experiences EDs [35]. The relationship between age and ED may be explained by the fact that young women use social media more [36].

Data on how education level affects EDs are very limited. No relationship was found between education level and the prevalence of EDs in the USA [37]. In our study, it was found that EDs were more common in pregnant women who graduated from secondary school. A study conducted with high school students in Poland reported that the frequency of EDs was 21 times higher in 1st and 2nd-year female students than in other students, and this difference was attributed to the younger age of 1st and 2nd-year students [38]. On the other hand, success was found to be associated with an increased risk of AN and BN in Swiss youth. This relationship was explained by the pursuit of perfectionism, which affects different behaviors [39].

EDs were reported to be more common in young, single women with multiple sexual partners in the US [40]. In the US, being married was found to reduce the risk of hospitalization for individuals with a history of EDs [41]. The higher prevalence of EDs in married pregnant women in our study may be because most of the pregnant women included in the meta-analysis were married. Because societal norms

regarding fertility mostly cause women to become pregnant after marriage [42].

In most cultures, pregnancy is a period when weight gain is more socially acceptable [43]. In the literature, ED symptoms have been associated with gestational BMI [11]. In our study, pre-pregnancy EDs prevalence was found to be higher in pregnant women with normal BMI. Some studies reported low BMI in pregnant women with AN [44] and high BMI in pregnant women with BED [45].

Psychiatric comorbidity is common in eating disorders and may increase the burden of the disease [46]. Our findings revealed that approximately one out of every two pregnant women with EDs have anxiety and one out of every three pregnant women with EDs have depression. Depressive symptoms are 5.9 times more common in individuals with ED compared to their peers of the same age [46].

Some individuals with ED exhibit compensatory behaviors such as self-induced vomiting after binge eating, misuse of drugs such as diuretics or enemas, prolonged fasting, and excessive exercise [4]. Our findings showed that 0.7% of pregnant women did excessive exercise, 0.6% vomited after binge eating, 0.3% fasted, and 0.1% used laxatives or diuretics. In Brazil, 12.2% of the women with normal BMI in the general population used vomiting as a compensatory behavior, and 15% used diuretics and laxatives [47].

During pregnancy, the woman needs to have adequate and balanced nutrition to meet her own physiological needs, to keep the energy, vitamin, and mineral stored in her body in balance, to ensure the healthy growth of the fetus, and to prepare for breastfeeding. There is a significant relationship between the nutrition of the pregnant woman and the health status of the fetus during pregnancy. Optimal nutrition is essential in pregnancy to optimize the outcome. Insufficient and unbalanced nutrition of the pregnant woman; causes problems such as premature birth, low birth weight baby, fetal growth restriction, and stillbirth [48, 49]. The main causes of malnutrition in pregnancy encompass insufficient micro and macronutrient intake [48], eating disorders [14], alcohol uses [50], wrong food selection, and hyperemesis gravidarum [51].

The risks of excessive weight gain, gestational diabetes mellitus (GDM), gestational hypertension, preeclampsia, cesarean delivery, obesity, and cardiovascular diseases increase due to the effect of unbalanced nutrition during pregnancy [14]. All these adversely affect the health of both

the mother and the fetus. For instance, patients undergoing bariatric surgery present increased rates of the abnormal obstetric outcome as a consequence of malabsorption [52].

Limitations

Our study has some limitations. First, the studies in the meta-analysis used different scales to assess ED symptoms; however, none of them are pregnancy-specific. Although it is agreed that these assessment methods are appropriate for assessing EDs in pregnancy, tools for assessing ED symptoms in pregnancy need to be appropriate to the unique nature of pregnancy. Second, data drawn from prospective cohort studies with a follow-up period other than pregnancy do not include the postpartum period. Another limitation of the study is the high heterogeneity of the studies included in the meta-analysis. It aimed to reveal the reason for this heterogeneity through subgroup analyses.

Conclusions

This is the first meta-analysis to present cumulative knowledge on the global prevalence of EDs in pregnancy and the related factors. All these related factors (age, educational level, BMI, etc.) should be considered when designing interventions to change the pathological feeding behaviors of pregnant women.

EDs during pregnancy cause negative clinical and psychological consequences on maternal and infant health. Therefore, screening, symptom management, and regular follow-up strategies should be developed with a multidisciplinary team to screen for EDs in pregnancy. Furthermore, it is necessary to develop measuring instruments specific to the unique nature of pregnancy to detect signs of EDs. Continuing routine screening tests to detect EDs during pregnancy may contribute to taking special preventive measures for risk groups and protecting mother-child health.

Appendix

See Tables 2 and 3.

Table 2 PRISMA 2020 checklist

Section and Topic	Item #	Checklist item	Location where item is reported
Title			
Title	1	Identify the report as a systematic review	1
Abstract			
Abstract	2	See the PRISMA 2020 for Abstracts checklist	Title Page
Introduction			
Rationale	3	Describe the rationale for the review in the context of existing knowledge	1, 2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses	2
Methods			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses	2
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted	2
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used	2
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process	2, 3
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process	3
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect	3 Table 1
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information	3 Table 1
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process	3
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results	3 Table 2
Synthesis methods			
	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5))	3
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions	3
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses	3
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used	3
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression)	3
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results	3
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases)	5 Table 1
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome	3

Table 2 (continued)

Section and Topic	Item #	Checklist item	Location where item is reported
Results			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram	Figure 1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded	3
Study characteristics	17	Cite each included study and present its characteristics	3 Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study	Table 1
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots	Table 1 Table 2 Figure 2
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies	Table 1 Figure 3
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect	Table 2 Figure 2
	20c	Present results of all investigations of possible causes of heterogeneity among study results	Table 2
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results	Figure 2
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed	Table 2
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed	Figure 2
Discussion			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence	5
	23b	Discuss any limitations of the evidence included in the review	7
	23c	Discuss any limitations of the review processes used	7
	23d	Discuss implications of the results for practice, policy, and future research	7
Other information			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered	2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared	2
	24c	Describe and explain any amendments to information provided at registration or in the protocol	2
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review	7
Competing interests	26	Declare any competing interests of review authors	7
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review	Table 1

From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. <https://doi.org/10.1136/bmj.n71>

For more information, visit: <http://www.prisma-statement.org/>

Table 3 Characteristics of the studies

No	Author and country	Aims	Design	Sample	Age n (%)	Education n (%)	Marital status n (%)	Instrument	Eating Disorders (ED) prevalence n (%)	Prevalence of ED type in pre-pregnancy n (%)	Prevalence of ED type in pregnancy n (%)	Pre-pregnancy Body Mass Index n (%)	Psychiatric comorbidity n (%)	ED-related behaviors n (%)	Quality Assessment*
1	(Ante et al., 2020) [29] Canada	To evaluate the relationship between anorexia nervosa (AN) and adverse birth outcomes	Retro-spective cohort	2,134,945	<30: 1178 (61.6) ≥30: 732 (38.4)			Diagnostic and Statistical Manual (DSM)		AN: 1910 (0.1)					●●●
2	(Baskin et al., 2020) [19] Australia	To examine the relationships between psychosocial factors, relationship satisfaction, attitudes towards pregnancy, motherhood, and ED during pregnancy	Prospective cohort	258				Eating Disorder Examination Questionnaire (EDE-Q)	25 (9.7)	AN: 13 (5.0) Bulimia Nervosa (BN): 8 (3.1) Binge Eating Disorders (BED): 6 (2.3)					●●●
3	(Baskin et al., 2021) [28] Australia	To compare the change in symptoms of ED during pregnancy with healthy pregnant women	Prospective cohort	249				EDE-Q	16 (6.4)						●●○
4	(Bye et al., 2020) [20] United Kingdom	To describe the prevalence and clinical features of ED in pregnancy	Cross-sectional	543	<30: 9 (56) ≥30: 7 (44)	Primary: 2 (13) Secondary: 4 (25) High: 10 (63)	Married: 8 (50) Single: 8 (50)	DSM	16 (1.5)	AN: 3 (0.1) BED: 6 (0.5)	AN: 3 (0.1) BED: 6 (0.5) Normal: 4 (33%) Overweight: 5 (42%)	Underweight: 3 (25%) Normal: 4 (33%) Overweight: 5 (42%)	Depression: 4 (25) Anxiety: 8 (50)		●●○

Table 3 (continued)

No	Author and country	Aims	Design	Sample	Age n (%)	Education n (%)	Marital status n (%)	Instrument	Eating Disorders (ED) prevalence n (%)	Prevalence of ED type in pre-pregnancy n (%)	Prevalence of ED type in pregnancy n (%)	Pre-pregnancy Body Mass Index n (%)	Psychiatric comorbidity n (%)	ED-related behaviors n (%)	Quality Assessment*
5	(Coker et al., 2013) [21] Australia	To examine the relationship between ED and BMI and quality of life in pregnant women with and without ED	Prospective	178				The Eating and Exercise Examination (EEE)	19 (10.6)	AN: 1 (0.6) BN: 7 (3.9)					●●●
6	(Easter et al., 2013) [22] United Kingdom	To diagnose ED in pregnancy and investigate related symptoms	Descriptive	739				The Eating Disorder Diagnostic Scale (EDDS)	19 (2.5)	AN: 3 (0.4) BN: 1 (0.1) BED: 9 (1.2) PD: 1 (0.1)	AN: 4 (0.5) BN: 1 (0.1) BED: 13 (1.8)			Laxatives or diuretics: 2 (0.3) Fasting 7 (0.9) Vomiting: 8 (1.1) Excessive exercise: 5 (0.7)	●●●
7	(Kolsiad et al., 2015) [23] Norway	To investigate the prevalence of ED and complications of pregnancy and childbirth in pregnant women with and without epilepsy	Cohort	106,508				DSM	4764 (5.2)	BN: 1747 (1.7) BED: 3165 (3.3)	BN: 466 (0.5) BED: 4298 (4.7)			Laxatives or diuretics: 79 (0.1) Fasting: 60 (0.1) Vomiting: 392 (0.4)	●●●

Table 3 (continued)

No	Author and country	Aims	Design	Sample	Age n (%)	Education n (%)	Marital status n (%)	Instrument	Eating Disorders (ED) prevalence n (%)	Prevalence of ED type in pre- pregnancy n (%)	Prevalence of ED type in pregnancy (%)	Pre- pregnancy Body Mass Index n (%)	Psychiatric comorbid- ity n (%)	ED-related behaviors n (%)	Quality Assessment*
8	(Larsen et al., 2016) [24] Denmark	To examine self-reported and hospital-diagnosed pregnant women with ED	Cohort	83,731		Primary: 79 (23.4) Secondary: 164 (48.4) High: 94 (27.8)	Married: 322 (96) Single: 15 (4)	International Classification of Disease 10th version (ICD-10)	337 (0.5)			Underweight: 61 (17.5%) Normal: 250 (73%) Overweight: 20 (5.3%) Obese: 6 (1.5%)			●●●
9	(Maihara et al., 2017) [25] Brazil	To determine the presence of ED and its relationship with anxiety and depression in high-risk pregnancies	Cross-sectional and prospective	913		Primary: 21 (30.4) Secondary: 39 (56.5) High: 9 (13)	Married: 60 (87) Single: 9 (13)	Structured Clinical Interview for DSM Disorders (SCID)	69 (7.6)		AN: 1 (0.1) BN: 6 (0.7) BED: 10 (1.1)	Underweight: 3 (4.3%) Normal: 38 (55.1%) Overweight: 19 (27.6%) Obese: 9 (13%)	Depression: 22 (31.9) Anxiety: 34 (49.3)		●●●
10	(Mohamadirizi et al., 2015) [26] Iran	To determine the relationship between ED symptoms and Obsessive-Compulsive Disorder in primigravida women	Cross-sectional	213				EDE-Q	18 (8.5)						●●●

Table 3 (continued)

No	Author and country	Aims	Design	Sample	Age n (%)	Education n (%)	Marital status n (%)	Instrument	Eating Disorders (ED) prevalence n (%)	Prevalence of ED type in pre-pregnancy n (%)	Prevalence of ED type in pregnancy (%)	Pre-pregnancy Body Mass Index n (%)	Psychiatric comorbidity n (%)	ED-related behaviors n (%)	Quality Assessment*
11	(Watson et al., 2013) [27] Norway	To compare the prevalence of ED before and during pregnancy in two different groups	Cohort	41,243				DSM	2068 (4.8)	AN: 40 (0.1) BN: 310 (0.7) BED: 1480 (3.5)	BN: 102 (0.2) BED: 1954 (4.8)				●●●

NA not available

●○○ Low

●●○ Moderate

●●● High

Author contributions All authors contributed to the study's conception and design. Material preparation, data collection, and analysis were performed by PÇÖ and ATO. The first draft of the manuscript was written by ATO and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Declarations

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References

- Treasure J, Duarte TA, Schmidt U (2020) Eating disorders. *Lancet* (London, England) 395:899–911. [https://doi.org/10.1016/S0140-6736\(20\)30059-3](https://doi.org/10.1016/S0140-6736(20)30059-3)
- American Psychiatric Association (2013) *American Psychiatric Association Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, 5th edn. DC, USA, Washington
- Bye A, Martini MG, Micali N (2021) Eating disorders, pregnancy and the postnatal period: a review of the recent literature. *Curr Opin Psychiatry* 34:563–568. <https://doi.org/10.1097/YCO.0000000000000748>
- Bye A, Mackintosh N, Sandall J et al (2018) Supporting women with eating disorders during pregnancy and the postnatal period. *J Heal Visit*. <https://doi.org/10.12968/JOHV.2018.6.5.224>
- Zauderer C (2012) Eating disorders and pregnancy: supporting the anorexic or bulimic expectant mother. *J Obstet Gynecol Neonatal Nurs* 41:S177–S178. https://doi.org/10.1111/J.1552-6909.2012.01363_25.X
- Currin L, Schmidt U, Treasure J, Jick H (2005) Time trends in eating disorder incidence. *Br J Psychiatry* 186:132–135. <https://doi.org/10.1192/bjp.186.2.132>
- Dörsam AF, Preißl H, Micali N et al (2019) The impact of maternal eating disorders on dietary intake and eating patterns during pregnancy: a systematic review. *Nutrients* 11:1–17. <https://doi.org/10.3390/nu11040840>
- Sollid C, Clausen L, Maimburg RD (2021) The first 20 weeks of pregnancy is a high-risk period for eating disorder relapse. *Int J Eat Disord* 54:2132–2142. <https://doi.org/10.1002/EAT.23620>
- Tierney S, Fox JRE, Butterfield C et al (2011) Treading the tightrope between motherhood and an eating disorder: a qualitative study. *Int J Nurs Stud* 48:1223–1233. <https://doi.org/10.1016/j.ijnurstu.2010.11.007>
- Mantel Ä, Hirschberg AL, Stephansson O (2020) Association of maternal eating disorders with pregnancy and neonatal outcomes. *JAMA Psychiat* 77:285–293. <https://doi.org/10.1001/JAMAPSYCHIATRY.2019.3664>
- Zanardo V, Volpe F, Giliberti L et al (2018) Prepregnancy Body Mass Index shift across gestation: primary evidence of an association with eating disorders. *J Matern Fetal Neonatal Med* 33:415–420. <https://doi.org/10.1080/14767058.2018.1494709>
- Mancini K (2017) Body image, eating attitudes and breastfeeding intention: implications for mental health and maternal child nurses. *Issues Ment Health Nurs* 38:750–755. <https://doi.org/10.1080/01612840.2017.1324928>

13. Martínez-Olcina M, Rubio-Arias JA, Reche-García C et al (2020) Eating disorders in pregnant and breastfeeding women: a systematic review. *Medicina (B Aires)* 56:1–19. <https://doi.org/10.3390/MEDICINA56070352>
14. Janas-Kozik M, Żmijowska A, Zasada I et al (2021) Systematic review of literature on eating disorders during pregnancy-risk and consequences for mother and child. *Front psychiatry*. <https://doi.org/10.3389/FPSYT.2021.777529>
15. PRISMA (2020) PRISMA
16. Methley AM, Campbell S, Chew-Graham C et al (2014) PICO, PICOS and SPIDER: a comparison study of specificity and sensitivity in three search tools for qualitative systematic reviews. *BMC Health Serv Res* 14:1–10. <https://doi.org/10.1186/S12913-014-0579-0/TABLES/7>
17. JBI (2022) Critical Appraisal Tools
18. Higgins J, Green S (2011) Cochrane Handbook for Systematic Reviews of Interventions. In: Cochrane Collab.
19. Baskin R, Meyer D, Galligan R (2020) Psychosocial factors, mental health symptoms, and disordered eating during pregnancy. *Int J Eat Disord* 53:873–882. <https://doi.org/10.1002/EAT.23264>
20. Bye A, Nath S, Ryan EG et al (2020) Prevalence and clinical characterisation of pregnant women with eating disorders. *Eur Eat Disord Rev* 28:141–155. <https://doi.org/10.1002/erv.2719>
21. Coker EL, Mitchell-Wong LA, Abraham SF (2013) Is pregnancy a trigger for recovery from an eating disorder? *Acta Obstet Gynecol Scand* 92:1407–1413. <https://doi.org/10.1111/aogs.12256>
22. Easter A, Bye A, Taborelli E et al (2013) Recognising the symptoms: how common are eating disorders in pregnancy? *Eur Eat Disord Rev* 21:340–344. <https://doi.org/10.1002/erv.2229>
23. Kolstad E, Gilhus NE, Veiby G et al (2015) Epilepsy and eating disorders during pregnancy: prevalence, complications and birth outcome. *Seizure* 28:81–84. <https://doi.org/10.1016/j.seizure.2015.02.014>
24. Larsen PS, Nybo Andersen AM, Olsen EM et al (2016) What's in a self-report? A comparison of pregnant women with self-reported and hospital diagnosed eating disorder. *Eur Eat Disord Rev* 24:460–465. <https://doi.org/10.1002/erv.2464>
25. Maihara A, Rosana G, Benute GRG et al (2017) Presence of eating disorders and its relationship to anxiety and depression in pregnant women. *Midwifery* 51:12–15. <https://doi.org/10.1016/j.midw.2017.05.005>
26. Mohamadirizi S, Kordi M, Shakeri M, Modares-Gharavi M (2015) The relationship between eating disorder symptoms and obsessive compulsive disorder in primigravida women. *Iran J Nurs Midwifery Res* 20:642–646. <https://doi.org/10.4103/1735-9066.170015>
27. Watson HJ, Von Holle A, Hamer RM et al (2013) Remission, continuation and incidence of eating disorders during early pregnancy: a validation study in a population-based birth cohort. *Psychol Med* 43:1723–1734. <https://doi.org/10.1017/S0033291712002516>
28. Baskin R, Meyer D, Galligan R (2021) Predicting the change in perinatal disordered eating symptoms: an examination of psychosocial factors. *Body Image* 37:162–171. <https://doi.org/10.1016/j.bodyim.2021.02.002>
29. Ante Z, Luu TM, Healy-Profitós J et al (2020) Pregnancy outcomes in women with anorexia nervosa. *Int J Eat Disord* 53:403–412. <https://doi.org/10.1002/eat.23251>
30. Galmiche M, Déchelotte P, Lambert G, Pierre Tavalacci M (2019) Prevalence of eating disorders over the 2000–2018 period: a systematic literature review. *Am J Clin Nutr* 109:1402–1413
31. Knoph C, Von Holle A, Zerwas S et al (2013) Course and predictors of maternal eating disorders in the postpartum period. *Int J Eat Disord* 46:355–368. <https://doi.org/10.1002/EAT.22088>
32. Sebastiani G, Andreu-Fernández V, Herranz Barbero A et al (2020) Eating disorders during gestation: implications for mother's health, fetal outcomes, and epigenetic changes. *Front Pediatr*. <https://doi.org/10.3389/FPED.2020.00587>
33. Larsen JT, Bulik CM, Thornton LM et al (2021) Prenatal and perinatal factors and risk of eating disorders. *Psychol Med* 51:870–880. <https://doi.org/10.1017/S0033291719003945>
34. Czech-Szczapa B, Szczapa T, Merritt TA et al (2015) Disordered eating attitudes during pregnancy in mothers of newborns requiring Neonatal intensive care unit admission: a case control study. *J Matern neonatal Med* 28:1711–1715. <https://doi.org/10.3109/14767058.2014.966675>
35. Ward ZJ, Rodriguez P, Wright DR et al (2019) Estimation of eating disorders prevalence by age and associations with mortality in a simulated nationally representative US cohort. *JAMA Netw Open* 2:e1912925–e1912925. <https://doi.org/10.1001/JAMANETWORKOPEN.2019.12925>
36. Zeeni N, Doumit R, Abi Kharmia J, Sanchez-Ruiz MJ (2018) Media, technology use, and attitudes: associations with physical and mental well-being in youth with implications for evidence-based practice. *Worldviews Evid-Based Nurs* 15:304–312. <https://doi.org/10.1111/WVN.12298>
37. Udo T, Grilo CM (2018) Prevalence and correlates of DSM-5–Defined eating disorders in a nationally representative sample of U.S. Adults *Biol Psychiatry* 84:345–354. <https://doi.org/10.1016/J.BIOPSYCH.2018.03.014>
38. Kotwas A, Karakiewicz-Krawczyk K, Zabielska P et al (2020) The incidence of eating disorders among upper secondary school female students. *Psychiatr Pol* 54:253–263. <https://doi.org/10.12740/PP/OnlineFirst/99164>
39. Sundquist J, Ohlsson H, Winkleby MA et al (2016) School achievement and risk of eating disorders in a swedish national cohort. *J Am Acad Child Adolesc Psychiatry* 55:41. <https://doi.org/10.1016/J.JAAC.2015.09.021>
40. Fergus KB, Copp HL, Tabler JL, Nagata JM (2019) Eating disorders and disordered eating behaviors among women: associations with sexual risk. *Int J Eat Disord* 52:1310–1315. <https://doi.org/10.1002/EAT.23132>
41. Tabler J, Utz RL (2020) Hospitalization following eating disorder diagnosis: the buffering effect of marriage and childbearing events. *SSM - Popul Heal*. <https://doi.org/10.1016/J.SSMPH.2020.100672>
42. Spagnoletti BRM, Bennett LR, Kermod M, Wilopo SA (2018) “I wanted to enjoy our marriage first... but I got pregnant right away”: a qualitative study of family planning understandings and decisions of women in urban Yogyakarta, Indonesia *BMC Pregnancy Childbirth* 18:1–14. <https://doi.org/10.1186/S12884-018-1991-Y/TABLES/2>
43. Vartanian LR, Porter AM (2016) Weight stigma and eating behavior: a review of the literature. *Appetite* 102:3–14. <https://doi.org/10.1016/J.APPET.2016.01.034>
44. Koubaa S, Hällström T, Brismar K et al (2015) Biomarkers of nutrition and stress in pregnant women with a history of eating disorders in relation to head circumference and neurocognitive function of the offspring. *BMC Pregnancy Childbirth*. <https://doi.org/10.1186/S12884-015-0741-7>
45. Silvani J, Schmidt MI, Zajdenverg L et al (2020) Impact of binge eating during pregnancy on gestational weight gain and postpartum weight retention among women with gestational diabetes mellitus: LINDA-Brasil. *Int J Eat Disord* 53:1818–1825. <https://doi.org/10.1002/EAT.23361>
46. Demmler JC, Brophy ST, Marchant A et al (2020) Shining the light on eating disorders, incidence, prognosis and profiling of patients in primary and secondary care: national data linkage study. *Br J Psychiatry* 216:105–112. <https://doi.org/10.1192/BJP.2019.153>

47. Chapuis-de-Andrade S, de Araujo RM, Lara DR (2017) Association of weight control behaviors with body mass index and weight-based self-evaluation. *Brazilian J Psychiatry* 39:237–243. <https://doi.org/10.1590/1516-4446-2016-2038>
48. Marshall NE, Abrams B, Barbour LA et al (2022) The importance of nutrition in pregnancy and lactation: lifelong consequences. *Am J Obs Gynecol*. 226:607–632. <https://doi.org/10.1016/j.ajog.2021.12.035>
49. das Neves MC, Teixeira AA, Garcia FM, et al (2022) Eating disorders are associated with adverse obstetric and perinatal outcomes: a systematic review. *Braz J Psychiatry*. 44:201–2014. <https://doi.org/10.1590/1516-4446-2020-1449>
50. Ward N, Correia H, McBride N (2021) Maternal psycho-social risk factors associated with maternal alcohol consumption and fetal alcohol spectrum disorder: a systematic review. *Arch Gynecol Obs* 304(6):1399
51. Nurmi M, Rautava P, Gissler M et al (2022) Readmissions due to hyperemesis gravidarum: a nation-wide Finnish register study. *Arch Gynecol Obs* 306:1519–1529
52. Yu Y, Groth SW (2023) Risk factors of lower birth weight, small-for-gestational-age infants, and preterm birth in pregnancies following bariatric surgery: a scoping review. *Arch Gynecol Obs* 307:343–378

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