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Eating behaviors in relation to gestational weight gain and postpartum weight retention: a systematic review

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Abbreviations

IOM: Institute of Medicine
GWG: Gestational weight gain
PPWR: Postpartum weight retention
BMI: Body Mass Index
TFEQ: Three Factor Eating Questionnaire
DEBQ: Dutch Eating Behavior Questionnaire
RRS: Revised Restraint Scale
PPWL: Postpartum weight loss

Abstract

Preventing obesity is of utmost public health importance. This paper systematically reviews associations between eating behaviors and peripartum weight change. This knowledge is crucial in the development of interventions that reduce long-term obesity, often triggered and boosted in the peripartum. Through MEDLINE, EMBASE, and Web of Science, we identified 20 studies that fulfilled inclusion criteria: studies on food cravings, disinhibition, restrained, external, emotional, uncontrolled, intuitive or mindful eating in relation to gestational or postpartum weight among adult women. Higher gestational weight gain was associated with lower intuitive eating (in 3/3 studies) and higher restrained eating (in 4/11 studies), external eating (in 2/2 studies), emotional eating (in 3/4 studies), food cravings (in 3/3 studies), and disinhibition (in 1/3 studies). No association with uncontrolled eating was found (in 1 study). No studies on mindful eating and gestational weight were identified. Higher postpartum weight loss was associated with higher restrained (in 2/4 studies) and intuitive eating (in 1/1 study). No associations between postpartum weight and food cravings, disinhibition and mindful eating were found. No studies on external, emotional and uncontrolled eating and postpartum weight were identified. Concluding, certain eating behaviors might be related with peripartum weight change.

Introduction

Obesity is a major public health threat as it is a risk factor for chronic diseases such as type 2 diabetes, cardiovascular disease and certain types of cancer.[1] Women of reproductive age are especially at risk of developing or worsening obesity, as pregnancy is usually accompanied by weight gain.[2] The Institute of Medicine (IOM) revised the guidelines for gestational weight gain (GWG) in 2009.[3] Globally, 47% of pregnant women exceed the recommended GWG,[4] which increases the risk of pregnancy- and birth related complications such as pregnancy-induced hypertension, cesarean section, large for gestational age infants and postpartum weight retention (PPWR).[3,4] PPWR is a serious public health concern because it contributes to the obesity epidemic.[2] Additionally, PPWR incurs an increased risk for complications in subsequent pregnancies.[5,6] Moreover, it contributes to an increased risk of obesity in the offspring, causing an intergenerational cycle of obesity.[7]

Generally, interventions to reduce GWG and PPWR target changes in food intake, alongside physical activity.[8,9] However, Skouteris et al. emphasize in their systematic review that psychological factors should have a more prominent role in intervention strategies to effectively reduce excessive GWG.[8] It is thus essential to gain insight into underlying psychological mechanisms, such as eating behaviors. Whereas the concept of food intake reflects which foods are eaten and how much (for example collected via food frequency questionnaires or 24-hour dietary recall methods), the concept of eating behavior rather depicts the mechanisms driving behavior of how and under which circumstances one tends to eat. To illustrate, individuals high in restrained eating strongly attempt to limit their food intake,[10] individuals high in emotional eating tend to overeat during negative mood,[11] and individuals high in external eating tend to eat when they see, smell or taste food that they find appealing.[12] It has to be noted that eating behaviors are normal characteristics that are (to a varying extent) present in every individual, which is distinct from eating disorders (e.g. anorexia nervosa) that are serious mental illnesses.[13]

It is essential to create an overview of which eating behaviors are related to GWG and PPWR and which are not, in order to gain knowledge of which eating behaviors are important to target in future public health efforts. Based on previous research it is likely that eating behaviors are associated with GWG and PPWR. A systematic review by Kapadia and colleagues showed that restrained eating is a risk factor for excessive GWG, but this review did not address GWG in its totality.[14] Furthermore, the relationships between other types of eating behaviors and GWG were not reviewed. We expect that not only restrained eating but also other types of eating behaviors play an important role in GWG and potentially also in PPWR. Studies among general populations clearly show that higher levels of eating behaviors such as emotional, external, and disinhibited eating are associated with higher body mass index (BMI) and weight gain.[12,15] This, together with the well-known pregnancy-related phenomena of intense emotions, stronger perception of external stimuli and food cravings,[16] supports the hypothesis that the related eating behaviors also play an important role in GWG. Since GWG and PPWR are strongly related to each other, it is important to include not only GWG but also PPWR to gain insight in the role of eating behaviors in weight change in the peripartum as a continuous timeframe. Weight changes throughout the peripartum are essential determinants of health of both women and offspring.[7,17] Given the fact that eating behaviors are modifiable,[18-20] a better understanding of the relations between eating behaviors and peripartum weight changes could demonstrate which eating behaviors to target in lifestyle interventions to achieve an adequate GWG and prevent PPWR. This is of great public health importance, since it could prevent or reduce obesity in the longer term. The aim of this review was therefore to provide insight into the associations between eating behaviors and GWG and PPWR.

Methods

This systematic review was performed in accordance with the PRISMA guidelines.[21]

Definitions

Several types of eating behaviors have been distinguished in literature. Restrained eating is defined as “conscious restriction of food intake in order to control body weight or to promote weight loss”.[10] External eating is defined as “eating in response to food stimuli such as sight, smell and taste of attractive food regardless of internal feelings of hunger and satiety”.[12] Emotional eating is defined as “eating in response to negative emotions such as depressive feelings”.[12] Food cravings are defined as “intense desires for particular types of food that are difficult to resist”.[22] Disinhibition is defined as “the loss of control over eating behaviors in response to either internal or external cues”.[23] Uncontrolled eating is defined as “tendency to overeat while experiencing feelings of being out of control”.[24] Intuitive eating is the unconditional permission to eat, which relies on internal hunger and satiety cues and eating for physical rather than emotional reasons.[25] Mindful eating is defined as “a nonjudgmental awareness of physical and emotional sensations while eating or in a food-related environment”.[26]

Gestational weight gain (GWG) is the amount of weight a woman gains during pregnancy. It is usually calculated by subtracting either the pre-pregnancy weight or the weight at the antenatal booking appointment from the last known weight in pregnancy. The IOM has formulated the following guidelines on recommended GWG: 12.5-18 kg for women with a pre-pregnancy BMI <18.5 kg/m^2; 11.5-16 kg for women with a pre-pregnancy BMI of 18.5-24.9 kg/m^2; 7-11.5 kg for women with a pre-pregnancy BMI of 25-29.9 kg/m^2; 5-9 kg for women with a pre-pregnancy BMI ≥30 kg/m^2.[17]

Postpartum weight retention (PPWR) is the amount of weight a woman retains after delivery. It is calculated by subtracting the pre-pregnancy weight from the weight at a certain time in the postpartum. As is regularly done in literature,[27,28] we allow a scope of one year after delivery, representing the long-term postpartum.

Eligibility criteria

Studies were eligible for this review if they assessed associations between eating behavior (i.e. restrained eating, external eating, emotional eating, food cravings, disinhibition, uncontrolled eating, intuitive eating or mindful eating as defined above) and weight among adult pregnant or postpartum (until one year after delivery) women. Exclusion criteria were as follows: studies describing food intake (i.e. quantities of foods eaten, or the nutrients derived from that) rather than eating behavior; studies among adolescent women, men, children, or animals; studies performed after bariatric surgery; qualitative studies; review articles; conference abstracts; studies not available in English. Studies assessing eating disorders (e.g. anorexia nervosa, bulimia nervosa, pica, binge eating) were excluded, as these are serious mental illnesses that are outside the scope of this review. Intervention studies were not excluded provided that they reported associations between eating behavior and weight and met all other eligibility criteria. When two papers reported the same data from the same study sample, the study with the most comprehensive outcome data was included. We did not limit the search to a certain year of publication.

Search strategy

Literature searches were conducted in April 2019 and updated in March 2020 using MEDLINE (via PubMed), EMBASE, and Web of Science databases. Search terms (Appendix 1) were developed with assistance of an experienced librarian. Synonyms and spelling variants to the concepts of ‘pregnancy’, ‘postpartum’, ‘eating behavior’ and ‘weight’ were used as search terms. The concept ‘eating behavior’ also included the names of eating behavior questionnaires as search terms (e.g. Three Factor Eating Questionnaire) as well as specific types of eating behaviors (e.g. restrained eating). No restriction on year of publication was applied. MeSH terms and Boolean operators were used and the search string was subsequently adapted to EMBASE and Web of Science formats.

Study selection

Duplicates were removed. Two reviewers (MB and HVU) independently conducted a first screening round of titles and abstracts, and a second screening round of full text articles. Their selections of articles were compared after each screening round and consensus was achieved by discussion.

Data extraction and synthesis

Two reviewers (MB and HVU) independently extracted data from the selected studies. A data extraction form was used to enter data on study design, specifications of participants, sample size, eating behavior measures, weight measures, and relevant outcomes. Consensus between the two researchers was achieved by discussion. The data were qualitatively synthesized by weight (GWG or PPWR) and type of eating behavior.

Quality appraisal

The quality of the final selection of studies was assessed using the NIH Study Quality Assessment Tools.[29] Since studies with different designs were included in this review, different variants of the tool were applied: for observational cohort an cross-sectional studies, for controlled intervention studies and for before-after studies without control group. Up to 14 questions were answered with yes, no, cannot determine, not reported, or not applicable. These comprise questions on study population, eligibility criteria, timeframe, objectivity of measurements, blinding, and statistical analyses, amongst others. The quality assessment was conducted independently by two reviewers (MB and HVU) after which they compared their findings and came to consensus by discussion. Table 3 shows the quality assessment and Appendix 2 provides the full list of quality assessment items.

Results

The literature search resulted in 802 articles, of which 361 duplicates were removed. Based on title and abstract screening, 364 articles were found ineligible: 174 did not assess eating behavior, 109 reported outcomes in children, 33 were animal studies, 29 were not conducted during pregnancy or first year postpartum, 8 were qualitative studies, 7 specifically studied adolescent mothers, 3 were study protocols, and one was a systematic review. An additional 57 articles were found ineligible during full-text screening: 19 did not report weight outcomes, 16 did not investigate eating behavior, 12 were conference abstracts, 3 studied eating behavior and weight, but did not report associations between them, 2 were not conducted during pregnancy or first year postpartum, 2 were study protocols, one was not full-text available in English. Furthermore, two studies were excluded because their results were already presented in other articles; the study that presented the most comprehensive outcome data was included in this review (Laraia et al.[30] was excluded, data presented by Mumford et al.[31]; Orloff et al.[32] was excluded, data presented by Blau et al.[33]). One study allowed women ≥16 to participate in their study, however they did not primarily focus on adolescent women and only a small minority of participants were underage (5% was <20 years)[31]. Therefore, this study was not excluded from this review. Twenty studies were eligible for further analysis (Figure 1).

Various questionnaires to determine eating behavior were used across studies. Some studies only used subscales of questionnaires or combined questionnaires. The used tools per study along with other study characteristics are listed in Table 1 (for studies on GWG) and Table 2 (for studies on PPWR). The original Three Factor Eating Questionnaire (TFEQ) has subscales on dietary restraint, disinhibition and hunger[34] and was used either fully or partially by eight studies.[35-42] The revised, 18-

item TFEQ (TFEQ-R18) consists of subscales on cognitive restraint, uncontrolled eating and emotional eating[11] and was used by one study.[43] The Dutch Eating Behavior Questionnaire (DEBQ) comprises restrained eating, emotional eating and external eating subscales[44] and was fully or partially used by three studies.[33,36,45] The Revised Restraint Scale (RRS) was used by three studies that adapted the wordings of the questionnaire in order to inquire retrospectively about restrained eating prior to pregnancy.[31,46,47] The Food Craving Inventory[48] was used by two studies.[33,40] Two studies used the Intuitive Eating Scale-2,[49-51] and two used the Intuitive Eating Scale for Pregnancy.[52-54] The Weight and Lifestyle Inventory with questions on food cravings,[55] the Mindful Eating Questionnaire[26] and the Eating Stimulus Index with a dietary restraint subscale[56] were used by one study each.[35,40,57] Two studies administered questions on food cravings that did not belong to an existing questionnaire.[36,58] Appendix 3 shows an overview of baseline BMI, data collection time points and method of weight recording for each study.

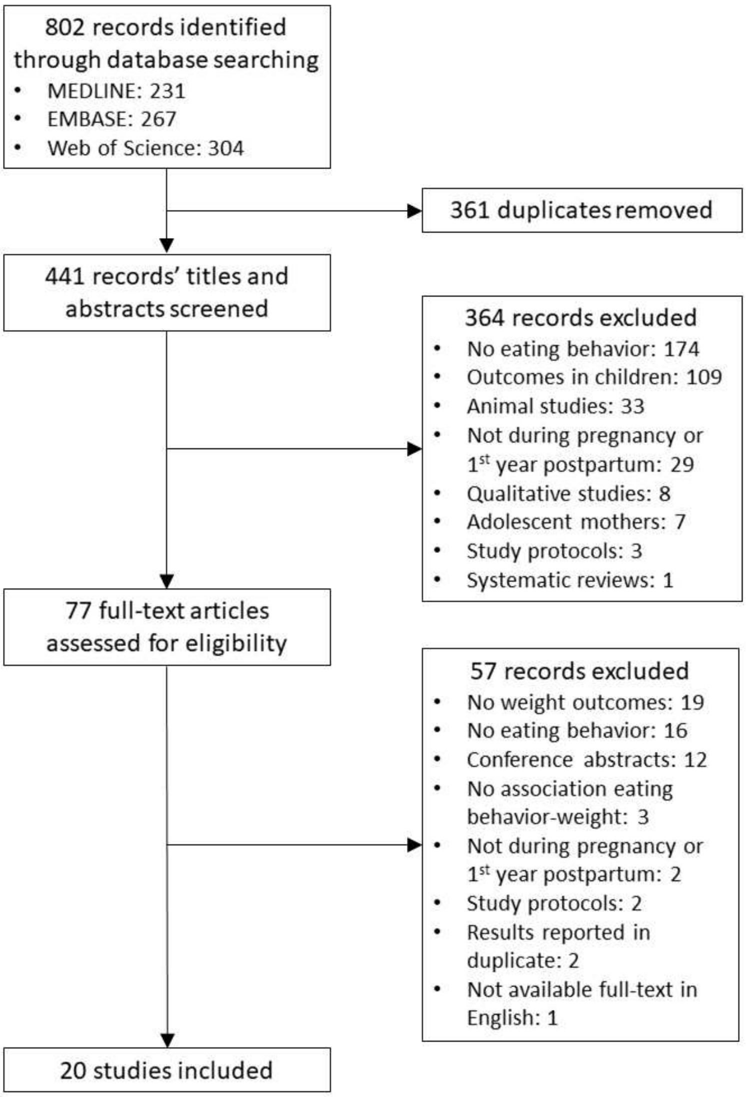

Figure 1. Flow diagram of study selection

Quality

Five out of 20 studies had a good quality (>75% of quality criteria met), 10 had a fair quality (50-75% of quality criteria met) and 5 studies had a poor quality (<50% of quality criteria met) (Table 3). A major issue was the use of self-reported weight. Fourteen out of 20 studies used self-reported pre-pregnancy weight, and some also used self-reported pregnancy weight.[33,36,46] Using self-reported pre-pregnancy weight might introduce considerable bias in the study findings, since pre-pregnancy weight is used to calculate both the pre-pregnancy BMI, on which IOM guidelines for recommended GWG are based, as well as GWG. Only three studies measured baseline weight[40,42,53] and three studies retrieved weight from the medical record,[43,50,58] although two of the latter used self-reported weight in case no measured weight was available in the medical record.[43,50] A disadvantage of using the weight from the medical record is that measurement took place during the antenatal booking visit, which usually takes place between 6 to 12 weeks of gestational age. Measured baseline weight is usually also taken in the first weeks of pregnancy rather than pre-pregnancy. Weight gain of the first weeks of pregnancy is in that case not taken into account. Appendix 3 provides an overview of the method of weight recording for each study. Another quality concern among the cross-sectional and cohort studies was that the exposure (eating behavior) was measured only once. Only six studies repeated measurement of eating behavior during the study period.[40,41,45,49,50,53] Neither of the RCT's had blinded participants and providers to treatment group assignment, but this was not possible due to the nature of a lifestyle intervention.[37,38] Six studies did not use validated questionnaires, or changed the wordings of questionnaires, which could therefore no longer be regarded as validated.[31,35,36,46,47,58] In one study, participants were not representative of the target population, since all participants had overweight or obesity, whereas this was not specifically the target population of the study.[57]

Eating behavior and gestational weight gain

Table 1 presents the study outcomes regarding the associations between eating behaviors and GWG.

Restrained eating

GWG and restrained eating were studied by 11 of the included papers. Four of these showed associations between higher restrained eating and increased GWG[31,39,46,47]; the remaining seven studies did not find associations.[33,35,36,41-43,45] Mumford et al. used the Revised Restraint Scale (RRS) and divided their sample in restrained and non-restrained eating based on the median of RRS scores. They found that women high in restrained eating with normal weight, overweight and obesity had on average a 2.2 kg higher GWG compared to women low in restrained eating of the same BMI-groups (significant for normal weight, P<.001, and obesity, P=.03).[31] Heery et al. likewise used the RRS, and similarly found that women high in restrained eating had a higher GWG (+0.8 kg) than those low in restrained eating. After adjustment for several covariates including pre-pregnancy BMI, restrained eating remained associated with GWG (B=1.49, 95% CI 0.70-2.29, P<.001). Furthermore, it was found that women high in restrained eating in comparison with women low in restrained eating were more likely to have an excessive GWG (67.6% vs 57.5%, P<.05), although the associations were not significant after adjustment for parity, nationality, BMI category, height and depressive symptoms.[47]

Conway et al. similarly used the RRS, but did not find an association between restrained eating and total GWG (based on self-reported weights). They did, however, find that women high in restrained eating were significantly less likely to achieve an adequate GWG based on 1990 IOM guidelines compared to women low in restrained eating (*P*=.026); their weight gain was more often either above or below the recommendations.[46] The study of Slane et al. among pregnant women who quit smoking, showed that higher restrained eating was associated with greater total GWG regardless of pre-pregnancy BMI and other covariates (*B*=1.4, SE 0.58, *P*=.02).[39] Seven studies did not find associations between restrained eating and GWG. Detailed information on study design, sample size, questionnaires used and outcomes can be found in Table 1.

External eating

Both Blau et al.[33] and Van der Wijden et al.[45] used the DEBQ to assess external eating and correlations with GWG. Blau et al. found that higher values of external eating resulted more often in excessive GWG based on self-reported weights (*r*=0.21, *P*<.05). Pre-pregnancy BMI was not accounted for.[33] Van der Wijden et al. found associations between higher external eating scores at 15 weeks and 35 weeks of pregnancy and higher GWG (at 15 weeks: beta=1.39, 95% CI 0.08-2.71, *P*=.04; at 35 weeks: beta=1.39, 95% CI 0.04-2.74, *P*=.04) adjusted for BMI, age and time between measurements, without correction for restrained and emotional eating. However, when all three eating styles concurrently were tested, no significant evidence for an association with GWG was found. [45]

Emotional eating

Four studies examined emotional eating[33,35,43,45] of which three found associations between greater emotional eating and increased GWG. Garduño-Alanis et al. found in their study of women with type 2 or gestational diabetes that more emotional eating was associated with higher GWG among women with a normal pre-pregnancy BMI (adjusted for age, beta=2.8, 95% CI 1.2-4.4, *P*=.003), but not among women with overweight and obesity.[43] Blau et al. found that higher emotional eating scores were associated with more frequent excessive GWG based on self-reported weights (*r*=0.31, *P*<.01), which was, however, mediated by frequency of cravings for high fat foods and not adjusted for pre-pregnancy BMI and other potential covariates.[33] Van der Wijden et al. showed a higher GWG among women with emotional eating behavior compared to women with restrained eating behavior (13.8 kg ± 4.1 and 10.8 kg ± 2.8, respectively, *P*<.05). Furthermore, higher emotional eating scores were associated with higher GWG at 35 weeks of pregnancy (beta=0.97, 95% CI 0.06-1.89, *P*=.04), adjusted for BMI, age, and time between measurements, without correction for restrained and external eating.[45] Allison et al. studied different emotional eating behaviors separately: eating when anxious, bored, stressed, angry, depressed, or alone. None of these emotional eating behaviors were significantly associated with GWG.[35]

Food cravings

Three studies reported results regarding the relationship between food cravings and GWG and all found that more food cravings were associated with higher GWG.[33,35,58] The study of Blau et al. was the only one to distinguish between cravings for different food groups. They reported associations between more frequent excessive GWG based on self-reported weights and higher scores of cravings for high fat foods (r=0.4, P≤0.001) as well as cravings for fast foods (r=0.23, P<0.05). Food cravings did not differ by pre-pregnancy BMI. As mentioned earlier, this study showed that cravings for high fat foods mediated the association between emotional eating and excessive GWG.[33] Allison et al. showed that among pregnant African American women with overweight, attributing GWG to food cravings was correlated with increased actual GWG (r = 0.21, p < 0.05). In a regression model with maternal age, gestational age, pre-pregnancy BMI and education, eating due to cravings was predictive of GWG: every unit increase of eating due to cravings (range 1-5) led to adjusted beta 5.1 kg higher GWG (95% CI 1.2-8.9, *P*=.01). Parity and smoking status only slightly changed the prediction (adjusted beta=4.7 kg, 95% CI 0.6-8.7, *P*=.026).[35] Hill et al. reported that a higher GWG was observed among women who had food cravings compared to women who did not have cravings during pregnancy (*P*=.043). Pre-pregnancy BMI was not accounted for.[58]

Disinhibition

Three studies investigated disinhibition and GWG,[39,41,42] of which one found that higher disinhibition scores were associated with higher odds of excessive GWG (based exclusively on measured weights) among women in their second pregnancy (unadjusted OR=1.17, 95% CI 1.05-1.29). This was, however, no longer significant after adjustment for baseline BMI category and sociodemographic factors (OR=1.09, 95% CI 0.97-1.23).[42] The two other studies did not find statistical evidence for an association between disinhibition and GWG. [39,41]

Uncontrolled eating

One study examined uncontrolled eating but did not find an association with GWG.[43]

Intuitive eating

Three studies investigated intuitive eating and all found significant associations with GWG. Paterson et al. showed that higher intuitive eating scores were associated with decreased total GWG (mean difference -1.3 kg per point intuitive eating score, 95% CI -2.5, -0.1, adjusted for ethnicity, parity, smoking, education, GA, and baseline BMI).[53] Plante et al. (2019) showed that in the first trimester of pregnancy specifically, women with an adequate GWG for gestational age scored significantly higher on intuitive eating compared to those with an excessive GWG for gestational age (respectively mean 3.9, SD 0.5 and mean 3.6, SD 0.6, *P*=0.4, adjusted for pre-pregnancy BMI).[49] In the study of Ledoux et al., the three intuitive eating subscales together explained 5% of the variance in GWG in the total sample, but 25% of the variance in GWG among women with obesity (*P*<.05). Intuitive eating could not predict excessive GWG.[52]

The subscale 'eating for physical rather than emotional reasons' of the intuitive eating scale was shown to be associated with GWG in the studies of Ledoux et al. and Plante et al. (2019). Higher scores on this subscale were associated with lower GWG among women with obesity (unstandardized beta=-5.92, standardized beta=-0.47, *P*<.05, adjusted for BMI).[52] In both the 1st and the 3rd trimester, women with adequate GWG scored higher on this subscale compared to women with excessive GWG (adjusted for pre-pregnancy BMI).[49] A higher score on the subscale ‘unconditional permission to eat’ was associated with lower GWG in one study (unstandardized beta=-2.31, standardized beta=-0.16, *P*<.05, adjusted for BMI).[52] None of the three studies found significant associations between the subscale ‘reliance on internal hunger and satiety cues’ and GWG. Plante et al. employed an expanded version of the intuitive eating scale with an additional subscale ‘body-food choice congruence’, but did not find an association between this subscale and GWG.[49]

Eating behaviors not identified in literature

No studies were identified on the association between mindful eating and GWG.

Eating behavior and postpartum weight retention

Table 2 presents the study outcomes regarding the associations between eating behaviors and PPWR.

Restrained eating

Two of four studies on postpartum weight and restrained eating showed evidence for associations. Cahill et al. conducted an eight-week non-randomized weight loss intervention in early postpartum among low-income women with overweight or obesity. Women with a higher postpartum weight loss (PPWL) (>2.27 kg cutoff) had a greater increase in restrained eating scores (+2.2 ± 0.4, range of restrained eating scale 3-15) compared to women with a less PPWL (<2.27 kg) (+0.6 ± 0.4, *P*<.01). Controlling for GWG and BMI, change of restrained eating scores over this period significantly predicted PPWL (standardized Beta=0.343, adjusted R2=0.199, *P*<0.05). These findings might be effects of the intervention, however, this could not be ascertained due to the absence of a control group. [57] Phelan et al. (2019) conducted a postpartum follow-up of a RCT that took place in pregnancy, which primarily aimed to limit GWG among women with pre-pregnancy BMI ≥ 25. The study showed that a decrease in restrained eating led to a lower odds of returning to pre-pregnancy weight (OR=0.92, 95% CI 0.85-0.98, *P*=.02). This was not a long-term effect of the intervention, as there was no difference between intervention and control group. Pre-pregnancy BMI and GWG were not adjusted for.[37] Phelan et al. (2014) likewise conducted a postpartum follow-up of a pregnancy RCT that aimed to limit GWG. However, in this study no relationship between PPWR and restrained eating was found.[38]

A cohort study among women with obesity by Most et al. did not find an association between PPWR and restrained eating either.[40]

Food cravings

No significant association between food cravings and PPWR was found in a cohort of women with obesity.[40]

Disinhibition

No significant associations between disinhibition and PPWR were reported.[37,38,40]

Intuitive eating

In one study, higher intuitive eating scores were shown to be associated with decreased PPWR (entirely based on measured weights) at one year postpartum among women who had had gestational diabetes mellitus. When stratified for BMI category, this association was found among those with overweight and obesity, but not among women with normal weight (total sample: adjusted for age and GA at first GDM visit 'eating for physical rather than emotional reasons' subscale: *B*=-0.230, 95% CI -2.976, -0.370, *P*=.012; 'reliance on hunger and satiety cues' subscale: *B*=-0.193, 95% CI -2.847, -0.083, *P*=.037. Among overweight and obese subsample: 'eating for physical rather than emotional reasons' subscale: *B*=-0.347, 95% CI -5.152, -0.562, *P*=.009; 'reliance on hunger and satiety cues' subscale: *B*=-0.405, 95% CI -6.529, -1.494, *P*=.002). Previous GWG was not adjusted for in these analyses.[50]

Mindful eating

No association was found between mindful eating and PPWR among women with obesity.[40]

Eating behaviors not identified in literature

No studies were identified on associations between PPWR and external eating, emotional eating, and uncontrolled eating.

Table 1. Characteristics and outcomes of included studies on eating behavior and gestational weight gain

Author (year)	Design	Participants	Sample size	Eating behavior measure	Outcomes
RESTRAINED EATING (RE)					
Plante et al. (2020)	Prospective	Pregnant women	53	TFEQ	No significant association between RE and adequacy of GWG.
Tang et al. (2020)	Prospective	Women in their 2nd pregnancy	190	TFEQ	No significant association between RE and likelihood of EGWG (unadjusted: OR=1.05, 95% CI 0.99-1.11; adjusted for BMI category: OR=1.02, 95% CI 0.96-1.09; adjusted for BMI category and sociodemographics: OR=1.02, 95% CI 0.96-1.09).
Garduño-Alanis et al. (2019)	Cross-sectional	Primigravid women with T2DM or GDM	57	TFEQ-R18	No significant association between RE and GWG (*P*=.6).
Blau et al. (2018)	Cross-sectional	Pregnant women	113	DEBQ	No significant association between RE and EGWG (*r*=0.16).
Heery et al. (2016)	Prospective and retrospective	Pregnant women	799	RRS	Higher GWG among RE compared to non-RE (mean GWG 16.3 kg and 15.5 kg, respectively, *P*<.05). Higher GWG among RE compared to non-RE after adjustment for parity, nationality, pre-pregnancy BMI, height, depressive symptoms, health insurance, GA, and time since last measurement until delivery (*B*=1.49, 95% CI 0.70-2.29, *P*<.001). More frequent EGWG among RE compared to non-RE (67.6% and 57.5%, respectively, *P*<.05). No significant association between RE and EGWG after adjustment for parity, nationality, BMI, height and depressive symptoms (*B*=1.28, 95% CI 0.92-1.78, *P*=.147).
Slane & Levine (2015)	Cross-sectional	Pregnant women who quit smoking as a result of pregnancy, GA ≥28 weeks	248	TFEQ	Higher RE scores associated with higher GWG, also after controlling for pre-pregnancy BMI, weeks to delivery, age, race, and nicotine dependence (*B*=1.4, SE 0.58, *P*=.02). No significant association between RE and adequacy of GWG.
Van der Wijden et al. (2014)	Prospective	Pregnant women, GA 15 and 35 weeks	161	DEBQ	No significant association between RE and GWG.
Allison et al. (2012)	Cross-sectional	Pregnant African American women; GA 14-24 weeks; pregravid BMI ≥ 25	120	TFEQ-RE	No significant association between RE and GWG (*r*=-0.023).
Mumford et al. (2008)	Prospective and retrospective	Pregnant women, mean GA 14 weeks	1223	RRS	Higher GWG among RE compared to non-RE with normal weight (+2.5 kg, *P*<.001), overweight (+1.59 kg, *P*=.168), and obesity (+1.93 kg, *P*=.03).
Clark & Ogden (1999)	Cross-sectional and retrospective	Primigravid women, GA 24-28 weeks	50	DEBQ-RE	No significant association between RE and GWG (mean GWG RE: 8.69 kg ± 4.91; non-RE: 8.16 kg ± 3.95).
Conway et al. (1999)	Prospective and retrospective	Pregnant Caucasian women, from GA ~12 weeks	62	RRS	Less frequent adequate GWG among RE compared to non-RE (data not shown, *P*=.026). No significant difference in GWG between RE-groups (mean GWG RE: 15.2 kg ± 4.87; non-RE: 16.2 kg ± 4.01, *P*=.42).
EXTERNAL EATING (EX)					
Blau et al. (2018)	Cross-sectional	Pregnant women	113	DEBQ	Higher EX scores associated with more frequent EGWG (*r*=0.21, *P*<.05).

Van der Wijden et al. (2014)	Prospective	Pregnant women, GA 15 and 35 weeks	161	DEBQ	Higher GWG associated with higher EX scores at 15 weeks of gestation (beta=1.39, 95% CI 0.08-2.71, *P*=.04) and 35 weeks of gestation (beta=1.39, 95% CI 0.04-2.74, *P*=.04) adjusted for BMI, age, and time between measurements. No significant association between EX and GWG with EE and RE in the model (at 15 weeks GA: beta=1.41, 95% CI -0.12 to 2.94; at 35 weeks GA: beta=0.96, 95% CI -0.53 to 2.45). No significant difference in GWG between women with EX (11.4 kg ± 4.0), RE (10.8 kg ± 2.8), and EM (13.8 kg ± 4.1).
EMOTIONAL EATING (EM)					
Garduño-Alanis et al. (2019)	Cross-sectional	Primigravid women with T2DM or GDM	57	TFEQ-R18	Higher EM scores (range 3-12) associated with higher GWG among women with normal pre-pregnancy BMI (adjusted for age, beta=2.8, 95% CI: 1.2-4.4, *P*=.003). No significant association between GWG and EM among women with overweight (*P*=.3) and obesity (*P*=.6).
Blau et al. (2018)	Cross-sectional	Pregnant women	113	DEBQ	Higher EM scores associated with more frequent EGWG (*r*=0.31, *P*<.01).
Van der Wijden et al. (2014)	Prospective	Pregnant women, GA 15 and 35 weeks	161	DEBQ	Higher GWG among EM compared to RE (13.8 kg ± 4.1 and 10.8 kg ± 2.8, respectively, *P*<.05). Higher GWG associated with higher EM scores at 35 weeks of pregnancy and GWG (beta=0.97, 95% CI 0.06-1.89, *P*=.04) adjusted for BMI, age, and time between measurements, without RE and EX in the model. No significant association between GWG and EM together with RE and EX in the model.
Allison et al. (2012)	Cross-sectional	Pregnant African American women; GA 14-24 weeks; pregravid BMI ≥ 25	120	Weight and Lifestyle Inventory	No significant associations between perceived contribution of eating when anxious, tired, bored, stressed, angry, depressed, or alone on GWG, and actual GWG.
FOOD CRAVINGS (FC)					
Blau et al. (2018)	Cross-sectional	Pregnant women	113	FCI	More frequent EGWG associated with FC for high fat foods (r=0.4, *P*≤.001) and FC for fast foods (r=0.23, *P*<.05). No significant associations between EGWG and FC for sweets (*r*=0.15), or cravings for carbohydrates/starches (*r*=0.08).
Hill et al. (2016)	Prospective	Pregnant women, GA ~29 weeks	1639	Self-designed questions	Higher GWG associated with FC (*P*=.043) (author contacted, no further data available). No significant difference in weekly rate of GWG between having FC and not having FC.
Allison et al. (2012)	Cross-sectional	Pregnant African American women; GA 14-24 weeks; pregravid BMI ≥ 25	120	Weight and Lifestyle Inventory	Perceived contribution of FC to GWG was significantly associated with actual GWG (*r*=0.21, *P*<0.05). Controlling for maternal age, gestational age, pre-pregnancy BMI and education, eating due to cravings was predictive of GWG (adjusted beta=5.1 kg, 95% CI 1.2-8.9, *P*=.01). Same prediction after adding parity to the model. Adding smoking status: adjusted beta=4.7 kg, 95% CI 0.6-8.7, P=.026.
DISINHIBITION (DI)					
Plante et al. (2020)	Prospective	Pregnant women	53	TFEQ	No significant association between DI and adequacy of GWG.
Tang et al. (2020)	Prospective	Women in their 2nd pregnancy	190	TFEQ	Higher DI score associated with higher odds of EGWG (unadjusted OR=1.17, 95% CI 1.05-1.29). Not significant when adjusted for baseline BMI category (OR=1.09, 95% CI 0.97-1.21) or baseline BMI category and sociodemographics (OR=1.09, 95% CI 0.97-1.23).
Slane & Levine (2015)	Cross-sectional	Pregnant women who quit smoking as a result of pregnancy, GA ≥28 weeks	248	TFEQ	No significant association between DI and GWG. No significant association between DI and adequacy of GWG.
UNCONTROLLED EATING (UE)					
Garduño-Alanis et al. (2019)	Cross-sectional	Primigravid women with T2DM or GDM	57	TFEQ-R18	No significant association between UE and GWG.
INTUITIVE EATING (IE)					

Ledoux et al. (2020)	Prospective and retrospective	Pregnant women	253	IES-P	Higher values intuitive eating subscale 'unconditional permission to eat' score associated with lower GWG in the total sample, adjusted for BMI (unstandardized beta=-2.31, standardized beta=-0.16, $P<.05$). Higher values intuitive eating subscale 'eating for physical rather than emotional reasons' score associated with lower GWG among subsample with obesity, adjusted for BMI (unstandardized beta=-5.92, standardized beta=-0.47, $P<.05$). No significant association between subscale 'reliance on internal hunger and satiety cues' and GWG. Overall intuitive eating explained 5% of the variance of GWG in the total sample, adjusted for BMI (adjusted R^2=0.05, $P<.01$) and 25% in participants with obesity (adjusted R^2=0.25, $P<.05$). IE no significant predictor of EGWG in the total sample (P=.61) or in BMI subsamples (under-/normal weight: P=.94; overweight: P=.28; obesity: P=.31).
Plante et al. (2019)	Prospective	Pregnant women	74	IES-2	1st trimester: Higher IE score among women with adequate GWG (mean 3.9, SD 0.5) compared to EGWG (mean 3.6, SD 0.6, P=.04) adjusted for pre-pregnancy BMI. Higher subscale score 'eating for physical rather than emotional reasons' among women with adequate GWG (mean 4.2, SD 0.7) compared to EGWG (mean 3.6, SD 0.9, P=.03) adjusted for pre-pregnancy BMI. 2nd trimester: No significant association between IE and adequacy of GWG adjusted for pre-pregnancy BMI. 3rd trimester: Higher subscale score 'eating for physical rather than emotional reasons' among women with adequate GWG (mean 4.2, SD 0.7) compared to EGWG (mean 3.5, SD 0.7, P=.02) adjusted for pre-pregnancy BMI.
Paterson et al. (2019)	Prospective	Pregnant women	218	IES-P	Higher IE scores associated with decreased GWG (mean difference -1.3 kg, 95% CI -2.5, -0.1 per point IE score), adjusted for ethnicity, parity, smoking, education, GA, and baseline BMI. No significant associations between GWG and IE subscales (unconditional permission to eat, eating for physical rather than emotional reasons, reliance on internal hunger and satiety cues).

Abbreviations: BMI = body mass index; DEBQ = Dutch Eating Behavior Questionnaire; DI= disinhibition; EGWG = excessive gestational weight gain; EM = emotional eating; EX = external eating; FC = food cravings; FCI = Food Craving Inventory; GA = gestational age; GDM = gestational diabetes mellitus; GA = gestational age; GWG = gestational weight gain; IE = intuitive eating; IES-2 = intuitive eating scale-2; IES-P = intuitive eating scale for pregnant women; IOM = Institute of Medicine; RCT = randomized controlled trial; RE = restrained eating; RRS = Revised Restraint Scale; T2DM = type 2 diabetes mellitus; TFEQ(-R18) = Three Factor Eating Questionnaire (revised 18-item version); UE = uncontrolled eating

Table 2. Characteristics and outcomes of included studies on eating behavior and postpartum weight

Author (year)	Design	Participants	Sample size	Eating behavior measures	Outcomes
RESTRAINED EATING (RE)					
Most et al. (2020)	Prospective	Women with 1st trimester BMI ≥30	37	TFEQ	No significant association between RE and PPWL.
Phelan et al. (2019)	Follow-up of RCT in pregnancy (no postpartum intervention)	Women 6 and 12 months postpartum with pre-pregnancy BMI >25	257 (128 enhanced usual care; 129 intervention)	TFEQ	Decreased RE from 35-36 weeks of pregnancy until 12 months postpartum associated with lower odds of returning to pre-pregnancy weight, equal for intervention and control group (OR=0.92, 95% CI 0.85-0.98, *P*=.02).
Phelan et al. (2014)	Follow-up of RCT in pregnancy (no postpartum intervention)	Women 6 and 12 months postpartum	331 (167 standard care; 164 intervention)	TFEQ	No significant association between RE and PPWL.
Cahill et al. (2012)	Non-randomized weight loss intervention	Low-income women with BMI ≥ 25; 0-4 months postpartum	58	Eating Stimulus Index	Greater increases of RE scores among women with higher PPWL (≥2.27 kg) compared to lower PPWL (<2.27 kg) (+2.2 ± 0.4 and +0.6 ± 0.4, respectively, range 3-15; P<.01). Controlled for GWG and BMI, regression of change in restrained eating scores from prestudy to poststudy in predicting postpartum weight loss were significant (standardized beta=0.34, adjusted R^2=0.20). GWG, infant feeding method and BMI explained 11.7% of the variance of PPWL. Addition of RE and total energy intake significantly improved the prediction model (*P*<.01): explained variance of 24.6% of PPWL.
FOOD CRAVINGS (FC)					
Most et al. (2020)	Prospective	Women with 1st trimester BMI ≥30	37	FCI	No significant association between FC and PPWL.
DISINHIBITION (DI)					
Most et al. (2020)	Prospective	Women with 1st trimester BMI ≥30	37	TFEQ	No significant association between DI and PPWL.
Phelan et al. (2019)	Follow-up of RCT in pregnancy (no postpartum intervention)	Women 6 and 12 months postpartum with pre-pregnancy BMI >25	257 (128 enhanced usual care; 129 intervention)	TFEQ	No significant association between DI and PPWL.
Phelan et al. (2014)	Follow-up of RCT in pregnancy (no postpartum intervention)	Women 6 and 12 months postpartum	331 (167 standard care; 164 intervention)	TFEQ	No significant association between DI and PPWL.
INTUITIVE EATING (IE)					

Quansah et al. (2019)	Prospective	Pregnant women with GDM	117	IES-2	Higher postpartum IE scores associated with decreased PPWR, adjusted for age and GA at first GDM visit (‘eating for physical rather than emotional reasons’ subscale: *B*=-0.230, 95% CI -2.976, -0.370, *P*=.012; ‘reliance on hunger and satiety cues’ subscale: *B*=-0.193, 95% CI -2.847, -0.083, *P*=.037). Among overweight and obese subgroup: higher postpartum IE scores associated with decreased PPWR, adjusted for age and GA at first GDM visit (‘eating for physical rather than emotional reasons’ subscale: *B*=-0.347, 95% CI -5.152, -0.562, *P*=.009; ‘reliance on hunger and satiety cues’ subscale: *B*=-0.405, 95% CI -6.529, -1.494, *P*=.002). No significant association between postpartum IE and PPWR among normal weight women. No significant association between IE measured during pregnancy and PPWR.
MINDFUL EATING (ME)					
Most et al. (2020)	Prospective	Women with 1st trimester BMI ≥30	37	MEQ	No significant association between ME and PPWL.

Abbreviations: BMI = body mass index; DI= disinhibition; FC = food cravings; FCI = food craving inventory; GA = gestational age; GDM = gestational diabetes mellitus; GWG = gestational weight gain; IE = intuitive eating; IES-2 = intuitive eating scale-2; ME = mindful eating; MEQ = mindful eating questionnaire; PPWL = postpartum weight loss; PPWR = postpartum weight retention; RCT = randomized controlled trial; RE = restrained eating; TFEQ = Three Factor Eating Questionnaire

Table 3. Quality assessment

Quality assessment of observational cohort and cross-sectional studies [a]														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Ledoux et al. (2020)	✓	✓	NR	✓	✓	✓	✓	✓	✓	✗	✗	✓	✓	✓
Most et al. (2020)	✓	✗	NR	NR	✗	✓	✓	✓	✓	✓	✓	NR	NR	✓
Plante et al. (2020)	✓	✓	NR	✓	✗	✗	✓	✓	✓	✓	✗	NR	✗	✗
Garduño-Alanis et al. (2019)	✓	✓	✓	✓	✗	✗	✓	✓	✓	✗	✓	✓	✓	✓
Paterson et al. (2019)	✓	✓	✗	✓	✗	✗	✓	✓	✓	✓	✓	✗	✓	✓
Plante et al. (2019)	✓	✓	NR	✓	✗	✗	✓	✓	✓	✓	✗	NR	✓	✗
Quansah et al. (2019)	✓	✓	NR	✓	✗	✓	✓	✓	✓	✓	✗	NR	✗	✓
Blau et al. (2018)	✓	✗	NR	✗	✓	✗	✓	✓	✓	✗	✗	NA	NR	✗
Heery et al. (2016)	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗	NR	✓	✓
Hill et al. (2016)	✓	✓	NR	✓	✗	✗	✓	✗	✗	✗	✓	NR	NR	✓
Slane et al. (2015)	✓	✗	CD	✗	✗	✗	✓	✓	✓	✗	✗	NR	NR	✓
Van der Wijden et al. (2014)	✓	✓	NR	✓	✗	✓	✓	✓	✓	✓	✗	✗	✓	✓
Allison et al. (2012)	✓	✗	✓	✓	✗	✓	✓	✓	✗	✗	✗	NR	✓	✓
Mumford et al. (2008)	✓	✓	✓	✓	✗	✓	✓	✗	✗	✗	✗	NR	✓	✓
Clark et al. (1999)	✓	✗	✓	✓	✗	✓	✓	✗	✗	✗	✗	NA	✓	✗
Conway et al. (1999)	✓	✓	✓	✓	✗	✓	✓	✗	✗	✗	✗	NR	✓	✗
Quality assessment of controlled intervention studies [b]														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Phelan et al. (2019)	✓	✓	✓	✗	✓	✓	✗	✓	CD	✓	✓	✓	✓	✓
Phelan et al. (2014)	✓	✓	✓	✗	✓	✓	✗	✓	CD	✓	✓	✓	✓	✓
Quality assessment of before-after studies with no control group [c]														
	1	2	3	4	5	6	7	8	9	10	11	12		
Tang et al. (2020)	✓	✓	✗	✓	✓	✓	✓	NR	✓	✓	✓	NA		
Cahill et al. (2012)	✓	✓	✗	✓	✗	✓	✓	NR	✓	✓	✗	NA		

NA = Not Applicable, NR = Not Reported, CD = Cannot Determine

[a] Items of the NIH quality tool for observational cohort and cross-sectional studies: 1=research question; 2=study population; 3=participation rate; 4=recruitment; 5=sample size; 6=exposure prior to outcome measurement; 7=timeframe; 8=levels of exposure 9=reliability of exposure measures; 10=repeated exposure assessment; 11=reliability of outcome measures; 12=blinding; 13=follow-up rate; 14=statistical analyses.

[b] Items of the NIH quality tool for controlled intervention studies: 1=described as randomized; 2=method of randomization; 3=concealment of randomization; 4=blinding of participants and providers; 5=blinding of assessors; 6=similarity of groups at baseline; 7=drop-out; 8=differential drop-out between groups; 9=adherence; 10=other interventions avoided; 11=reliability of outcome measures; 12=sample size; 13=prespecified outcomes; 14=intention-to-treat analysis.

[c] Items of the NIH quality tool for before-after studies with no control group: 1=study question; 2=eligibility criteria; 3=representativeness of study population; 4=all eligible participants enrolled; 5=sample size; 6=clear intervention

description; 7=reliability of outcome measures; 8=blinding of assessors; 9=follow-up rate; 10=statistical analysis; 11=multiple outcome measures; 12=group-level interventions and individual-level outcome efforts. (Full description in Appendix 2)

Discussion

The current systematic review is novel in its approach of investigating associations between a range of eating behaviors and both GWG and PPWR.

Restrained eating was the most often studied type of eating behavior in relation to GWG. Seven out of 11 identified studies did not find associations between restrained eating and GWG, of which two were of good quality, three of fair quality and two of poor quality. The four studies that did find associations (3 of fair quality, 1 of poor quality), demonstrated associations between higher scores of restrained eating and a higher GWG. This is in line with findings from non-pregnant populations, where the majority of studies point towards associations between higher restrained eating scores and higher BMI.[12,59,60]

Although the findings provide limited evidence for an association between higher restrained eating and higher GWG, several explanations for a potential relationship can be suggested. Schaumberg et al. (2016) indicated in their review focusing on non-pregnant populations that even though restrained eating entails a cognitive attempt to limit food intake, it might actually result in an increased intake, as periods of restrained eating are often alternated with periods of uncontrolled eating.[61] In such case associations between GWG and uncontrolled eating or disinhibition, which are greatly overlapping concepts, would be expected. Only one study in this review, however, found an association between disinhibition and the likelihood of having excessive GWG, yet this study was of good quality. Contrastingly, three studies (of good, fair and poor quality) could not establish any associations between disinhibited or uncontrolled eating and GWG. A second potential explanation is that restrained eating might be a reaction to weight gain rather than a risk factor for weight gain.[61] In the current review, however, such causal pathways could not be confirmed for pregnant populations. Thirdly, pregnancy might generate a shift from highly restrained eating prior to pregnancy towards unrestrained eating during pregnancy, as some women see pregnancy as an excuse to gain weight.[62,63] This perception might diminish the attempt to limit food intake for weight control typical for restrained eating. Some of the studies in the current review retrospectively determine restrained eating based on pre-pregnancy eating behaviors. This could result in biased conclusions if the presumed shift from restrained to non-restrained eating indeed occurs. This might therefore explain the association between high restrained eating (prior to pregnancy) and increased GWG as found in seven of 11 studies in the current review. Remarkably, three out of four studies that found associations between restrained eating and GWG indeed used the Revised Restraint Scale, which retrospectively examines restrained eating prior to pregnancy.

Restrained eating and PPWR were investigated in four studies of good quality (two) and fair quality (two). Two of these studies (one of good, one of fair quality) indicated that higher restrained eating is associated with higher PPWL, which is an opposite trend compared to the findings of four studies in pregnancy, in which higher restrained eating tended to be associated with more weight gain. Since restrained eating is a more cognitive eating behavior (in some studies even called cognitive restraint) compared to the other eating behaviors that are more related to emotions and other circumstances, these findings might possibly indicate that the postpartum is a more suitable timeframe for encouraging cognitive attempts to change eating behavior compared to pregnancy. The two other studies on restrained eating and PPWR (one of good, one of fair quality) did however not endorse these associations.

Higher external eating was found to be weakly associated with increased GWG by both of the identified studies that both had a small sample size (N=113 and N=161) and that were of fair and poor quality, respectively. A study among non-pregnant individuals showed similar findings (r=0.14, *P*<.001),[64] although in another study, external eating was not significantly associated with weight (r=0.05, *P*>.01),[59] so evidence among general populations is contradictory. One of the studies on external eating and GWG noted that there is high correlation between eating behaviors, and therefore also tested the association between GWG and external, restrained and emotional eating together. There was no longer statistically significant evidence for an association.[45] In all eating behavior questionnaires, the different types of eating behaviors are shown to be correlated to some extent.[11,34,51,54,65] However, of the studies identified in the current review, only the study by Van der Wijden et al.[45] took that correlation into account in their analyses.

More emotional eating was in this review found to be associated with increased GWG by three out of four studies of different quality (good, fair, and poor), although one of the studies pointed out that the association was mediated by frequency of food cravings. This might also have been the case for the other studies in this review, however, they did not investigate such mediation. In a qualitative study among Latina pregnant women, emotional eating emerged as a perceived difficulty for controlling GWG especially among women with obesity.[66] Contrastingly, a study in the current review only found a significant association between more emotional eating and higher GWG among women with a normal pre-pregnancy BMI.[43] The other studies on emotional eating did not stratify for BMI, and could therefore not confirm these findings. The potential association between emotional eating and increased GWG as found in this review is in line with studies among non-pregnant populations, which showed that more emotional eating was associated with more weight gain and less weight loss.[23] The study that did not find an association between emotional eating and GWG was of fair quality, however, no validated questionnaire was used to inquire emotional eating. Instead, participants were asked for several types of emotions separately (anxiety, tiredness, boredom, stress, anger, depression, and loneliness) whether they believed this had contributed to GWG. Then, associations with actual GWG were investigated. Thus, potentially the method of examining emotional eating might have hindered finding associations rather than associations being non-existing.

Food cravings during pregnancy are a well-known phenomenon and are perceived as a major challenge for controlling GWG by many women.[66] Among general populations it is shown that food cravings are associated with higher BMI.[48,67] Three studies on food cravings in this review (one of fair, two of poor quality) reconfirmed that experiencing more food cravings potentially plays a role in increased GWG. Only one study on food cravings in the postpartum was identified. This study of fair quality did not find an association with PPWR. This might imply that food cravings especially play a role during pregnancy and not during postpartum, although this remains uncertain due to the limited number of available studies. Future longitudinal studies on food cravings starting in pregnancy and continuing in the postpartum could shed light on this presumption.

Intuitive eating was studied by four recent studies of good quality (one) and fair quality (three) and several associations were found between intuitive eating (sub)scales and both GWG as well as PPWR. All three studies in pregnancy indicated that higher intuitive eating scores were associated with lower GWG, and the study in postpartum indicated that higher intuitive eating scores were associated with less PPWR. This might potentially signify that intuitive eating is protective of increased GWG and PPWR, although causal pathways could not be established. Studies among non-pregnant populations similarly show that intuitive eating is associated with lower weight and BMI.[68] To a certain extent, intuitive eating overlaps with mindful eating, since both eating behaviors rely on awareness of hunger and satiety cues.[69] However, in the current review only one study on mindful eating was identified, and this study of fair quality did not find evidence for an association with PPWR.

A limitation to this review is the scarcity of studies investigating the associations between eating behaviors and GWG and PPWR. Twenty studies were identified in this review, but not all studies covered all different types of eating behaviors. The majority of eating behaviors were only investigated in few studies. For example, there were only two studies to investigate external eating and GWG. Furthermore, there is no consensus on which questionnaire is the most appropriate to measure eating behavior. As a result, different questionnaires were used to assess the same eating behavior, compromising comparability of studies. For example, restrained eating was an outcome of the RRS, TFEQ, TFEQ-R18, DEBQ, and Eating Stimulus Index, yet these questionnaires all use different questions and wordings to determine restrained eating. Adams et al. (2019) recently conducted a study to compare the Restraint Scale (RS) and the restrained eating scale of the DEBQ and came to the conclusion that the two questionnaires measure to a large extent the same subject. Yet, an important difference between the two scales is that the RS has stronger associations with external and disinhibited eating, food cravings and BMI than the DEBQ. It is suggested that the RS is associated with unsuccessful restraint, whereas the restrained eating scale of the DEBQ measures successful restraint.[70] Additionally, eating behaviors are analyzed differently across studies. Whereas some studies formed two groups based on median scores (e.g. restrained vs. non-restrained eating), others approached eating behaviors as continuous variables. Also, the weight variables were approached differently: variations for GWG included total GWG, weekly GWG, and number of women with adequate and excessive GWG based on IOM guidelines; variations for PPWR included weight retention at a certain time point in the postpartum period, and the number of women reaching pre-pregnancy weight. As a result of to the abovementioned heterogeneity of studies on different aspects, no meta-analysis could be performed. Besides, 16 out of 20 studies partly or entirely relied on self-reported weights, which might have introduced response bias. Only published scientific research is included in this review and no grey literature search is conducted, which might have enhanced publication bias.

Conclusion

The available evidence for relationships between eating behaviors and peripartum weight change is too scarce, ambiguous and of varying quality to draw robust conclusions. However, the findings of this review indicate that intuitive eating might potentially be related to a decreased GWG as well as a decreased PPWR. Restrained eating might potentially be related to an increased GWG and a greater PPWL, which would imply that the postpartum might be a more suitable phase for the initiation of cognitive behavioral lifestyle interventions than pregnancy. External, emotional and disinhibited eating, as well as eating in response to cravings might potentially be related to an increased GWG. No evidence was found for associations between GWG and uncontrolled and mindful eating, and for PPWR and food cravings, external, emotional, disinhibited, uncontrolled and mindful eating.

Overall, insufficient studies investigated relationships between eating behaviors and peripartum weight change, and part of the findings are contradictory. There is especially a lack of research on eating behavior in relation to weight in the postpartum period. Yet, it is vital to gain more insight in this topic, as influencing eating behavior in this phase might lead to less PPWR, and as a result, lead to less long-term obesity and less complications in subsequent pregnancies. It is therefore highly recommended that future studies are undertaken to shed light on this. Prospective cohort studies commencing prior to pregnancy and continuing in pregnancy and postpartum are needed to gain insight in how eating behaviors evolve throughout the peripartum period and to better understand how they influence GWG and PPWR. The analyses should account for maternal pre-pregnancy BMI. The underlying mechanisms driving eating behavior, food intake and peripartum weight change should also be taken into account. Subsequently, intervention studies targeting changes in eating behaviors should be developed and evaluated to determine whether this could contribute to preventing excessive GWG and PPWR.

Conflicts of interest

No conflict of interest was declared.

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